
Section 20 of 22 (20f – Sustainable Farming Systems Planning)
Agronomy Tech Note 76
(http://www.nm.nrcs.usda.gov/technical/handbooks/iwm/nmiwm.html
Sustainable Farming Systems Planning, Evaluation, and Outreach
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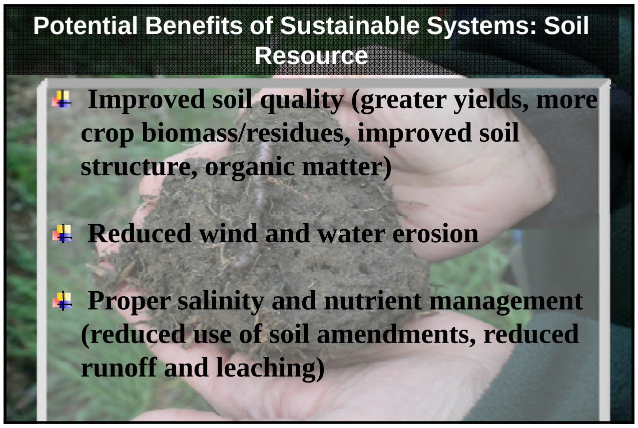
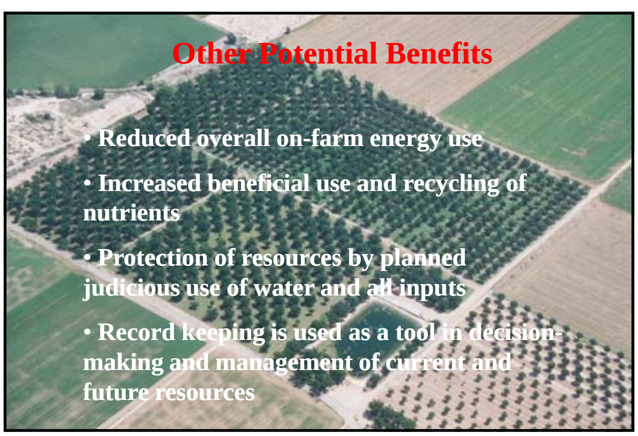
We've achieved a lot, but we must all do a better job
This is our chance, maybe only chance, to really achieve sustainability


Sustainable Farming Systems must integrate:
Soil Quality
Water Quality
Nutrient and Salinity Management
Cropping Systems, incl. Cover Crops
Irrigation Water Management and Systems
Integrated Pest Management
Livestock and Wildlife
Energy and Air Quality
Economics
Whole Farm Planning
Watershed, Marketing Opportunities


Potential Benefits of Sustainable Systems: Water Resource
Conserved surface and ground water quantity and quality
Increased efficiency, higher yields
Reduced pumping costs
Water losses minimized (evaporation, runoff and deep percolation)


Potential Benefits of Sustainable Systems: Soil Resource
Improved soil quality (greater yields, more crop biomass/residues, improved soil structure, organic matter)
Reduced wind and water erosion
Proper salinity and nutrient management (reduced use of soil amendments, reduced runoff and leaching)


Potential Benefits: Plant Resource
• Crop production costs reduced
• Increased crop yield and quality
• Reduced pest incidences (e.g. weeds, insects, diseases)
• Available water quantity and quality meet specific requirements of crop (consumptive use, leaching)


Other Potential Benefits
• Reduced overall on-farm energy use
• Increased beneficial use and recycling of nutrients
• Protection of resources by planned judicious use of water and all inputs
• Record keeping is used as a tool in decision-making and management of current and future resources

Achieving Sustainable Farming

- Whole System (Ecosystem, Field, Farm, Watershed)
- Resource Opportunities
- Think Critically
- Use Problem-Posing/Solving Approach

Achieving Sustainable Farming

- Producers need to demand quality service. NRCS, in addition to NMSU, CES, and other agencies, must help develop sustainable farming systems.

- Form interdisciplinary, interagency team, producer networks to identify/resolve resource problems/ opportunities
- Producers are the drivers of sustainable farming as we develop/exchange technologies, case studies, field trials, on-farm demonstrations, farmer-to-farmer networks.

Achieving Sustainable Farming: Perspective and Attitude is Everything

- **We are part of interconnected system comprised of soil, water, air, plant, animal, and human components/ resources, constantly changing, interacting, through which energy is flowing**

- **Team members must come to the table/field in active listening/learning mode and with open mind, keen observational skills, and be ready to adapt to change.**
- **Arrogance will not work**
- **Proactively become involved in every step; only hands-on experience changes paradigms**

Achieving Sustainable Farming

- **. Keep energy flow through the integrated system.**
- **Integrate chemical, biological, and physical.**
- **Improving soil quality is basis for improving soil, water, air, plant, and animal resources.**

Sustainable Farming – Diversify Enterprise

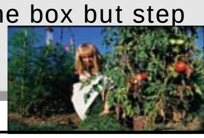
- Market outside commodity supply
- Emphasize direct marketing and specialty markets
- Form cooperative
- Add value through on-farm processing

Sustainable Farming – Build Soil Quality

- Minimize or eliminate tillage
- Apply nutrients according to soil, plant, tissue tests and nutrient budget
- Increase on-farm nutrient cycling, plant species diversity
- Maintain ground cover year round by using cover crops and mulches and by leaving crop residues in field
- Manage/protect soil organisms to preserve biodiversity
- Rotational grazing, prescribed grazing

Sustainable Farming – Develop Conservation Plan

- Use integrated approach to inventory resources and develop conservation plan for whole farm
- Choose and apply conservation practices, technologies, approaches to address identified resource concerns and take advantage of opportunities
- Not only think outside the box but step outside the box



Sustainable Farming – Manage Pests Ecologically

- Prevent pest problems by building healthy, biologically active soil, creating habitat for beneficial organisms, and choosing appropriate plant cultivars/rotations
- *Tolerate, don't eradicate*
- *There is no silver bullet*
- *Treat the causes of pest outbreaks, not the symptoms*
- *If you kill the natural enemies, you inherit their job*
- *Pesticides are not a substitute for good farming*

Sustainable Farming – Maximize Biodiversity

- Integrate crop and livestock production
- Use hedgerows, insectary plants, cover crops, etc. to attract beneficial insects, bats, and birds
- Plant trees and perennial crops
- Abandon monocropping in favor of crop rotations, intercropping and polycultures
- Manage pastures to support diverse selection of forage plants
- Plant cover crops

Sustainable Farming – Other Considerations

- **Take an inventory; think about every field, pasture, stream, well, etc.**
- **What are the natural resources on my farm? How can these be used more efficiently?**
- **What resource opportunities exist throughout the watershed?**
- **What crops can I grow? Marketing niche / opportunities, climatic considerations, agroecological needs, etc.**

Sustainable Farming – Other Considerations

- **How is water quality on farm for all purposes? Have I minimized runoff and leaching?**
- **How can I protect air quality, including reducing dust, odor?**
- **Am I using crop rotations for nutrient cycling and to reduce disease/pest problems?**
- **What type of livestock/wildlife exists or could be raised?**

Sustainable Farming – Other Considerations

- Have I taken a soil test?
- Have I taken an irrigation water test?
- Have I taken plant tissue tests?
- How is my soil quality? Soil fertility, Aggregate stability, active organic matter; visual indicators, including erosion, weeds, blowing soil, sediment deposition, crop or plant quality and production, earthworms

Sustainable Farming – Other Considerations

- Besides using crop residues and cover crops, what other practices can I apply to build soil quality? To recycle nutrients? To use water efficiently?
- Which practices would contribute to an environmentally and economically sound farm?
- Am I making the best use of compost, animal manure, legumes as nutrients for plants?
- How can I conserve/produce energy or reduce energy use?

Sustainable Farming – Evaluations

- Evaluation of need, design, implementation and impact are all essential
- Without proper evaluation at all phases, a plan/project may not properly function and address the needs/concerns/issues identified
- Criteria, tools, and ongoing mechanisms should be established for each type of evaluation
- Recordkeeping is an excellent management and evaluation tool so that changes can be made

Achieving Sustainable Farming: Evaluations

- Evaluation of need – many methods, including producer surveys, observation, scoping meetings
- Evaluation of design - ensure objectives are clearly defined and will be met and that the plan/project will have positive impacts.
- Implementation evaluation - phase which is most clearly understood and most conducted. It ensures that a practice/system is constructed/ applied according to design, but does not address how effective or how well designed it is.

Achieving Sustainable Farming: Evaluations

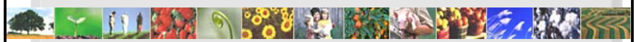
- Evaluation of impact or evaluation of the success and effectiveness of the sustainable system is based partially on achieving a loop effect or a balanced ecosystem.
- Potential and actual negative and positive impacts should be evaluated. It is often the most forgotten of the evaluations, yet one of the most important, since this can lead to a multiplier effect of negative results.

Achieving Sustainable Farming: Outreach

- Case studies, field trials, on-farm research/ demonstrations, field days, farmer-to-farmer networks, tours, exchanges are some of many important components of successful technology exchange and outreach. These can also serve in assisting in several of the evaluation types.
- Case studies, including comparing a benchmark condition to a planned condition and showcasing integrated approaches/practices/systems/ technologies.
- Criteria, target audience, method should be established prior to developing case studies to ensure achieving targeted objectives.

Achieving Sustainable Farming: Outreach

- Field trials and on-farm research/demonstrations serve to ground-truth on-station research and provide an effective method for planners, consultants, universities to exchange/test technology with producers.



- Workshops, field days, farmer-to-farmer networks, tours, international exchanges are also very effective outreach methods.

Sustainable Farming Workshops

- **Share resources, including Integrated Water Management Handbook on NRCS website: http://www.nm.nrcs.usda.gov, click on Irrigation**
- **Evaluate site-specific conditions, including chemical, biological and physical**
- **Build soil health and improve overall farming system**

Sustainable Farming Workshops

- **Promote user friendly integrated management and technology exchange**
- **Reduce overall on-farm energy use, inputs, production costs, pest incidences, pumping costs, water loss, soil loss.**
- **More economical, sustainable farming enterprise**
- **Healthier watershed and community**

On Farm Demos/ Case Studies: Adelino

Farming Goal

- To produce high quality crops through implementation of agro-ecological principles.

Larry Sanchez Farm

Located in Adelino

<u>South Field</u>:

- **3.1 Acres**
- **Dovey Fescue**

<u>North Field:</u>

- **5.3 Acre**
- **Dovey/Alfalfa Mix**

<u>Field 2</u>

- **Vegetable Garden**

Irrigation Water Management

- **Flood Irrigation: Concrete Lined Ditch- 8 CFS**
- **Land Leveling to correct slope on soils**
- **Irrigation Timing**
- **Farming Practices**

ORGANIC MATTER

What Have We Done with Chicken Manure?

Organic Matter

- **Chicken Manure**
- **Cover Crop**
- **Stubble**
- **Soil Sampling**
- **Minimum Till**

REDUCED TILLAGE FIELD

SOILS

GE=Gila Loam, Slightly Saline

GK=Gila Clay Loam

PRODUCING PLANTS WITH HIGH NUTRIENTS

PRODUCING PLANTS WITH HIGH NUTRIENTS

- Amendments in soils to improve physical properties
- Trials that Plant Materials Center assisted with finding highest producing grass
- Working the soil

Before and After


CUTTING HAY

Bailing Hay


Harvest

Before

After

Measuring


Case Studies: Rio Grande Community Farm

- **Urban organic and community garden vegetable production.**
- **MLRA 42: 138-acre farm owned by Albuquerque's Open Space Division.**
- **City acquired land in 1995. Occupies site of Los Poblanos, one of earliest Spanish Colonial settlements in Rio Grande Valley.**
- **Living link that extends over 1700 years; one of oldest parcels of continually farmed land in U.S.**

Case Studies: Rio Grande Community Farm

Farm Objectives:

- **Use a working farm to demonstrate sustainable urban agric.**
- **Enhance urban wildlife habitat.**
- **Research and interpret relationships between people, food and public land**
- **Create education and training opportunities in agriculture**
- **Celebrate the traditions and culture of agriculture**

Case Studies: Rio Grande Community Farm

Current Operations:

- **Operate greenhouse for starting crops and plants for sale**
- **Coordinates annual Maize Maze open to public**
- **Organizes community garden with over 100 members and groups**
- **Grows field crops and flowers for sale**
- **Gives tours of farm to school and community groups**
- **Plants grain and seed crops for migrating flocks of birds**
- **Maintains soil enriching and erosion preventing cover crops on field acreage**
- **Maintains a Heritage Seed program**

Case Studies: Rio Grande Community Farm

- Provides organic vegetables for Albuquerque Public Schools food program

Case Studies: Rio Grande Community Farm

- Involves community in all stages of farming

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Case Studies: Rio Grande Community Farm

- Involves community in all stages of farming

- Developed Whole-Farm Conservation Plan
- Environmental Quality Incentives Program funding obtained for Subsurface drip, additional conservation practices
- Conservation Innovation Grant received for Subsurface Irrigation Project on Field 4

SOILS

Af=Agua loam

Ag=Agua silty clay loam

An=Anapra silt loam

Br=Brazito fine sandy loam

Bs=Brazito silty clay loam

Gb=Gila loam

Ge=Gila clay loam

Field 4: 16 acres

Subsurface Drip Irrigation Project

SOILS

Af=Agua loam

Ag=Agua silty clay loam

An=Anapra silt loam

Ge=Gila clay loam

Field 4: 16 acres

Subsurface Drip Irrigation Project

7 zones: 2010 season

1. & 2. Grain rye followed by sorghum/sudan (soil building)

3. 4. & 5. Grain rye followed by sunflowers for wildlife food

6. And 7. Spring oats followed by cash crop

2011 season: (organic vegetables)

Each zone divided into 3 subzones for varying organic vegetables and treatments.

RGCF Subsurface Drip Irrigation Project

- NRCS CIG grant
- Other agencies collaborating include: City of Albuquerque Open Space Division, New Mexico Organic Commodities Commission, New Mexico State University Extension Service, and New Mexico Department of Agriculture. Established a "brain trust".
- Cutting edge of irrigation on-farm research/ demonstration.
- System consists of subsurface drip irrigation (SDI) operated in a manner consistent with the USDA National Organic Program

RGCF Subsurface Drip Irrigation Project

- Purpose - to demonstrate that two well established agricultural systems – SDI and certified organic – can be combined to produce an optimum growing system that conserves water, results in high yields and enhances soil and environment.
- Already installed, and funded through EQIP, is the SDI system, consisting of permanently buried drip tape that is organized into 36 ft. wide beds separated by an 8 ft. drive path.
- There are 7 zones allowing growth of 7 (or more) different crop rotations.

RGCF Subsurface Drip Irrigation Project

- Project deliverables include: a monograph and other publications on organic SDI; detailed data on water usage by crop and zone; presentations at a New Mexico and national conference; highly detailed growing protocols that outline procedures for specific crops that articulate the organic and SDI processes followed; a roadmap of organic field solutions for traditional SDI problems.
- Document process of: maintaining traditional organic techniques of soil improvement while using SDI, preserving the integrity of buried drip tape using organic methods, maximizing the SDI system for fertilizing crops using drip tape (fertigation), and maintaining water quality.

Sustainable Agriculture Issues

- Environmental Quality and Ecological Function
  - Soil, Water and Climate Constraints
  - Nutrient Cycling
  - Pest Management
- Socioeconomic Viability
  - Volatile Markets; Uncertain Yields
  - Social Acceptance

Soil, Water, and Climate Constraints

- Using precision placement of drip lines in furrows with seed placement close to drip line vs. flood irrigation should provide a water conservation factor between 10 and 15, i.e. currently flood irrigation uses 4000 gpm ditch water per unit of field crops. The number is anticipated to drop to 200-400 gpm of water use with the drip system.
- Besides tremendous savings in water usage, a precision drip line system will allow crop diversification within the field. Drip lines controlled by valves give the operator wide latitude in which rows to water, when, and how much. Currently with flood irrigation, the only control is by creating berms that contain flood water – a gross control at best.

Soil, Water, and Climate Constraints

- A third benefit of subsurface drip is the ability to eliminate harmful weed seeds and other debris that currently arrives in the ditch water, creating crop pressure and competition for nutrients.
- A fourth benefit will be to add nutrients systematically through "precision application" and other injectible inputs through the distribution lines. Using specially designed low impact tillage equipment that will disturb the soil only within the first 2-3 inches of the grade level, earthworms and other soil organisms will be able to thrive.

Soil, Water, and Climate Constraints

- Building ecological biodiversity above and below ground is a definite part of the strategic plan.
- RGCF maintains cover crop on all of the fields, protecting the soil from wind erosion and building soil quality.
- Side dressing of rows with organic compost, mulching with organic hay, and applications of compost teas will also be demonstrated on the subsurface drip project.

Soil, Water, and Climate Constraints

- The soils and low rainfall at RGCF require irrigation. Improper irrigation water management can promote diseases that can lead to significant yield reductions.
- Salinity is also a concern. RGCF subsurface drip irrigation system allows more accurate control of the water each bed receives. Thus RGCF can ensure enough water in the summer to prevent stress but not so much that it promotes fungal disease.
- By managing water use more carefully, RGCF also reduces the potential for nitrate leaching and the probability of salinity problems that can reduce yield and crop quality. RGCF plans to monitor salinity and to water by flood irrigation when needed to obtain the appropriate leaching fraction.

Soil, Water, and Climate Constraints

- RGCF has noted that soil fertility is improving over time. Active carbon tests have been taken. Organic matter in the soil has increased since a permanent cover crop has been maintained. There has been a dramatic change in surface soil color, and the soil structure has changed over time from massive to granular.
- Even the cover crops are looking healthier. Achieving better residue management with organic crops will be targeted in the near future.

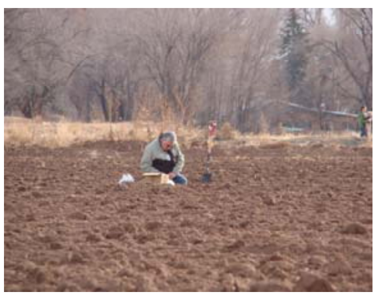
Active Carbon Sampling

Field 4, West Sample:

Active Carbon in mg/kg oven dry soil:

0-6” depth: 485

6-12”depth: 422



Active Carbon Sampling

Field 4, East Sample:

Active Carbon in mg/kg oven dry soil:

0-6” depth: 413

6-12”depth: 270

Nutrient Cycling

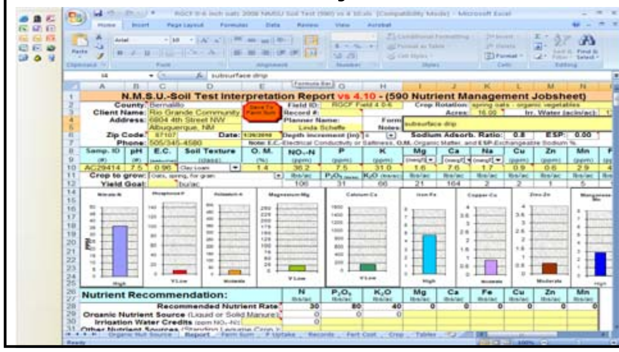
- Soil and irrigation water samples are taken and analyzed prior to application of nutrients. RGCF fields receive nutrients which are compatible with the National Organic Plan and with the nutrient budget.
- Irrigation water, legume cover crops, and other organic nutrient sources are all figured into the budget.
- Supplemental micronutrients are foliar applied according to foliar tissue tests and recommendations.

Nutrient Cycling

- RGCF maintains cover crops, consisting largely of annual grains (rye, oats, wheat) and legumes (vetches and clovers), on all of the fields. These serve a variety of functions, including erosion control, pest management, moisture retention, and nutrient cycling.
- The vetches and clovers also enhance the nitrogen status of the soil.
- RGCF estimates the water and nutrients provided to the cover crop this year will be returned to crops in the following year in the form of soil organic carbon and recycled nutrients

Soil Fertility Sampling: 0-6 and 6-12 inches

Soil Fertility Results



Integrated Pest Management

- RGCF grows a diverse set of crops, including rye, alfalfa, corn and oats. These crops harbor different kinds of insects, helping keep the insect population in balance, a key to RGCF's pest management strategy.
- RGCF believes that in addition to monitoring insect pest levels to determine when control measures will be needed, farmers should cultivate and monitor beneficial insect and animal habitat and they will keep insect pests in check.
- RGCF has a *Field of Dreams* philosophy: "build it and they will come." The multi-species cover crop is primarily insect habitat. They are also working with NRCS to strategically install insectary plants (plants that provide habitat for insects) around the farm.

Integrated Pest Management

- To control rodents, RGCF has installed owl boxes. However, the farm is not pest-free. You have to live with *some* pests to make the system work. The beneficial predators would not stay around if all the pests were gone.
- According to RGCF, organic farmers have no weeds, they have native vegetation. Some kinds of vegetation are less desirable than others, but the cover crops control these fairly well. RGCF does not mind the extra water and nutrients needed to maintain the cover crop, since they are eventually recycled into the crop or the soil organic matter.

Uncertain Yields, Volatile Markets

- RGCF has cornered a niche market for organic vegetable, which helps stabilize cash flow.
- RGCF admits that the restrictions placed by organic certification can sometimes reduce yields, but in the long term, the price differential between organic and conventional more than compensates.

Social Acceptance

- Urban encroachment into farmlands is occurring throughout the United States but is also apparent in New Mexico. People living near agricultural land often fear the use of agricultural chemicals, are disturbed by odors and noises, and are irritated by slow-moving farm machinery on the roads.
- Urban populations need to understand the constraints under which farmers operate. Conversely, farmers need to understand the concerns of the urban population.
- Some farmers have found that selling their products directly to local consumers through farmers markets or other means can help them understand where food comes from. It can also increase net farm income by eliminating the “middle”.

Social Acceptance

- The RGCF is farming organically and hopes to reduce tillage as they become more sustainable. They have used innovative approaches of involving the community at all phases through community gardens, providing tours to public and school groups, educational events. RGCF serves as a model for obtaining social acceptability in urban environments.

Case Studies: Rio Grande Community Farm

- Involves community in all stages of farming

Santa Fe - Raised Beds, Drip, Diversity, Manure, Compost, Cover Crops,Transitioning to Organic

Las Cruces Dairy Cropland – High Flow Turnouts, Irrigation Water Management, Manure Management, Conservation Crop Rotation, Diversity

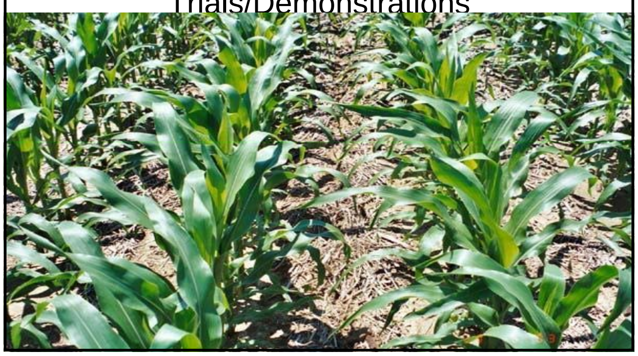
Carlsbad - Integrated Water Management/Nutrient Management Field Trial/Demonstration

Golden: Double Dug, Composting,Mulching

Las Cruces: Cover Crops, Residue Management, Salinity Management, Integrated Water/Nutrient Management

Deming: Wind Erosion/Herbaceous Wind Barriers Field Trials/Demonstrations

Residue Management/Soil Quality Field Trials/Demonstrations



Keys to Achieving Sustainable Farming

- use integrated systems approach (ecosystem, whole farm, watershed)
- problem-posing, problem-solving
- actively seek resource, watershed, marketing opportunities
- resource efficient and resource conserving
- technology “exchange” vs. “transfer”
- develop whole farm conservation plan creatively and flexibly, step outside the box
- consider on-site and off-site effects
- focus on keeping energy flow through the integrated system
- reemphasize biological factors, improve biodiversity
- improving soil quality is key to improving soil, water, air, plant, and animal resources
- case studies, field trials, on-farm research / demonstrations, farmer-to-farmer networks
- interdisciplinary teams including producers and partners
- farmers need to demand quality service
- recordkeeping is tool in decision-making and management of current and future resources
- need user friendly fact sheets, brochures on integrated systems