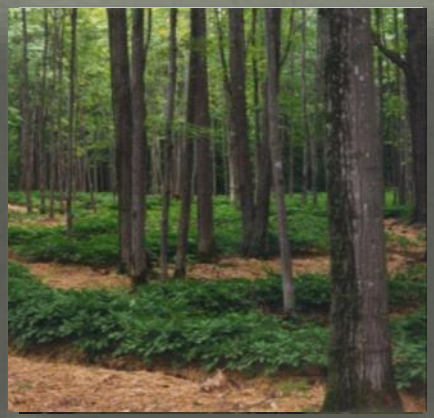
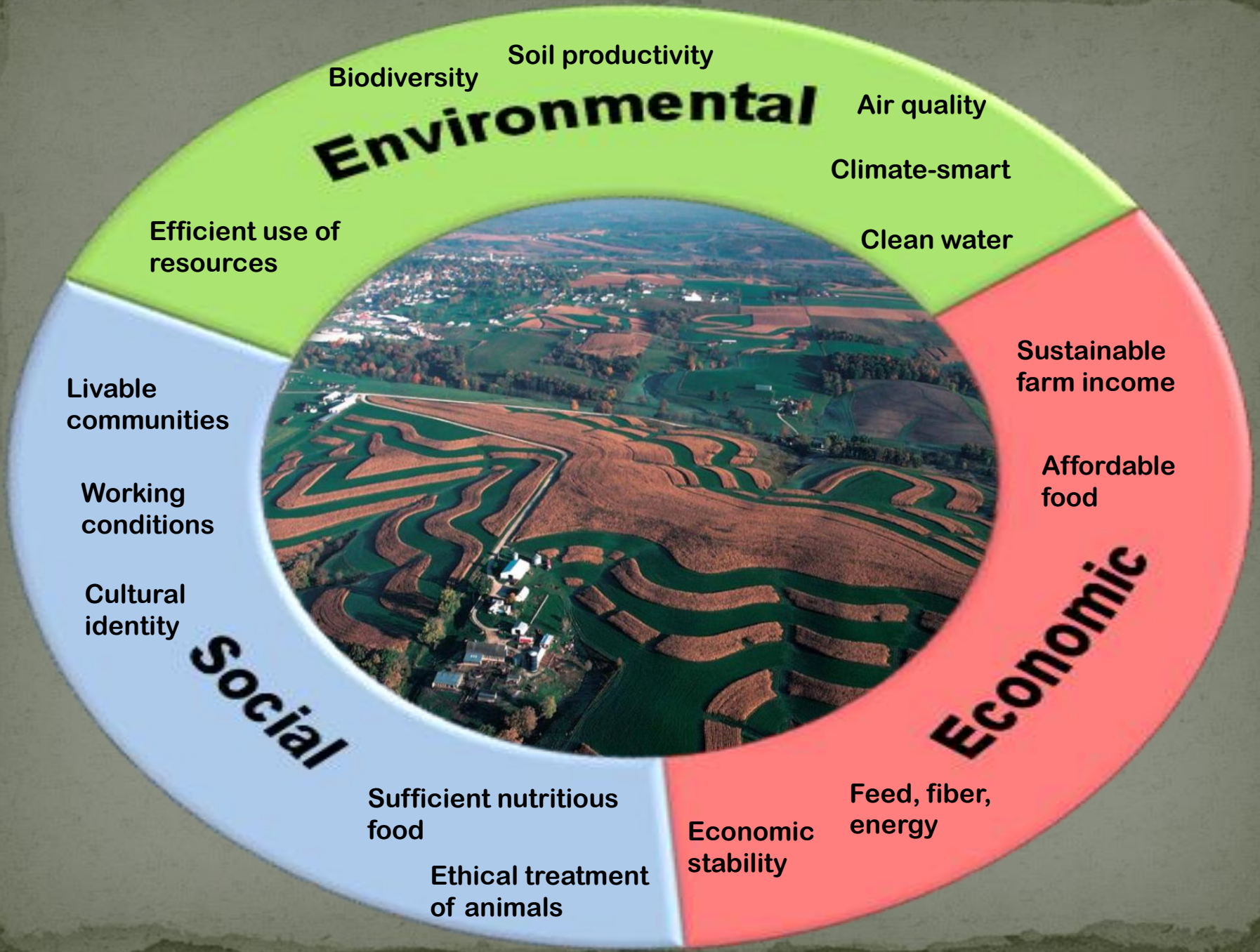
Designer Landscapes:

Enhancing Ecosystem Services on Agricultural Lands



ACES: Linking Science,
Practice, and Decision Making
Washington, DC
December 9, 2014

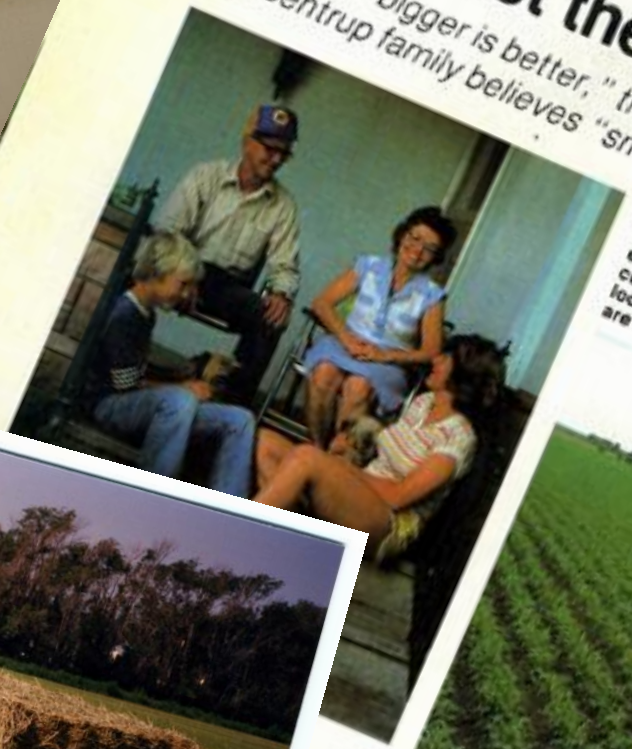

Environmental
Biodiversity
Soil productivity
Air quality
Climate-smart
Clean water
Efficient use of resources
Economic
Sustainable farm income
Affordable food
Feed, fiber, energy
Economic stability
Social
Livable communities
Working conditions
Cultural identity
Sufficient nutritious food
Ethical treatment of animals

Yes, you can—

Go against the wind

Rejecting "bigger is better," the Bentrup family believes "small is sufficient."

By GEORGE BRANDSBERG



CONVERSATION ON THE FRONT steps is one of the simple ways the Bentrups enjoy each other. Here Gary and Diane cuddle the family dogs as their parents look on. Absent from the family portrait are Beth, 25, and husband, Ron Perez.

WITH GOOD CARE, his 1971 model tractor will probably last him until he is ready to retire, Bentrup figures. He logs 300 hours a year.

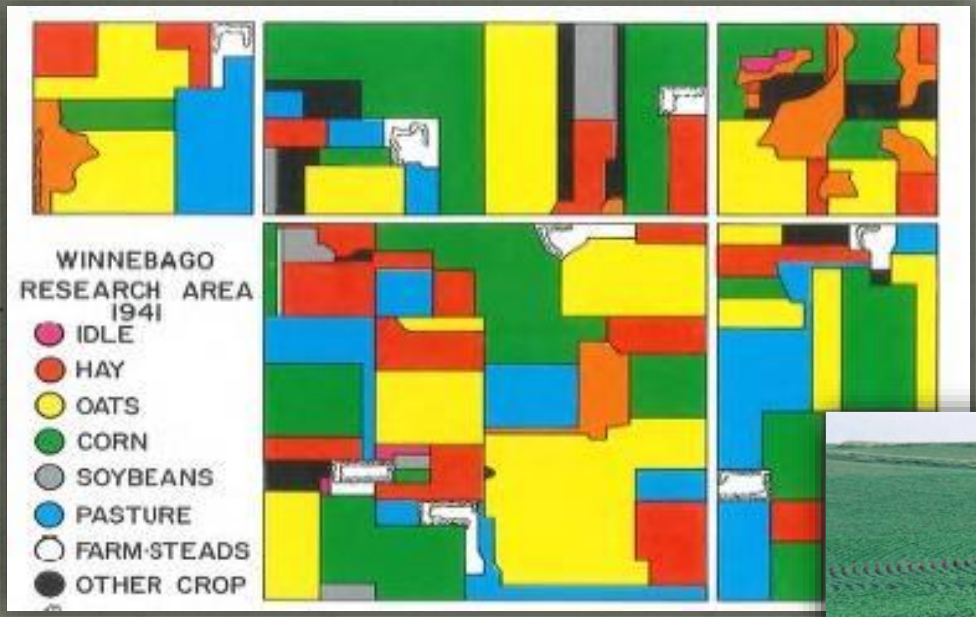
noticed that many of the coupl... knew and liked were plann... ing things after retiri... they were sl... them, we recalls. "We also

"We felt that if we had more and more things to do, it would mean longer hours and more pressure," Mary Ann recalls. "We decided we would rather sacrifice some added income for a better family life."

Was it an irresponsible decision? Common sense suggests there is no way you can make a decent living on a small farm and still have the time and money to afford other interests. Most farmers today figure that about $1 million in ... an annual gross ... and $150,000 ...

heard of the Bentrups' farming lifestyle. On the contrary, the family farm is their main source of income. Their only other income is interest farm profits earn in certificates of deposit at the bank. Here's ... Bentrups net $50 ... gross farm income ... • They ...

Landscape Simplification



Winnebago County, IA

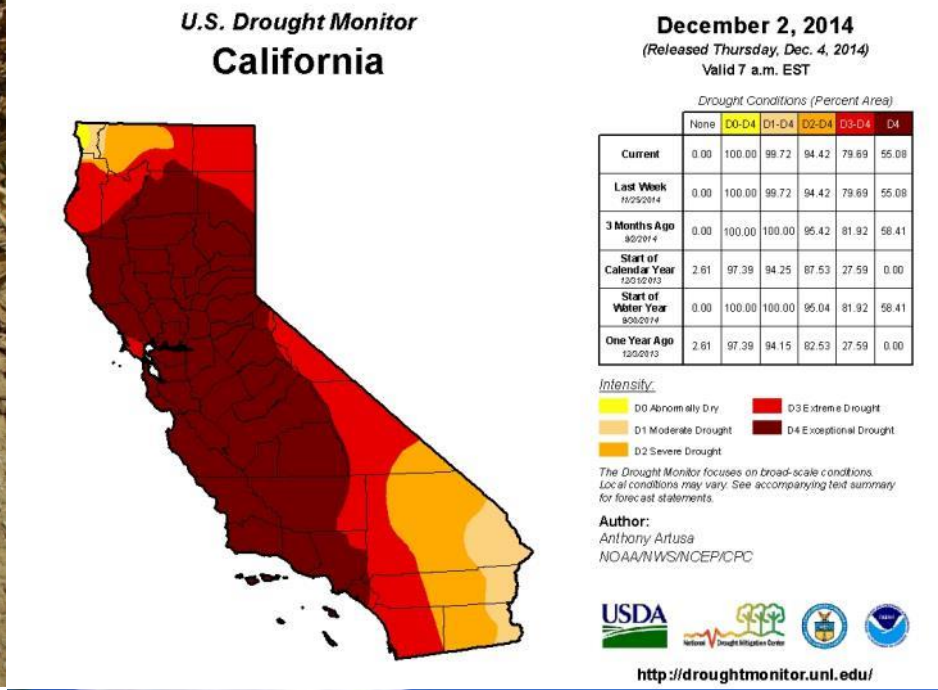
Farris et al. 1977

Tree Cover Loss

2009 aerial image and tree cover classification output

2012 aerial image – yellow circles show where tree cover has been removed

Marginal Lands


U.S. Drought Monitor
California
December 2, 2014
(Released Thursday, Dec. 4, 2014)
Valid 7 a.m. EST
Drought Conditions (Percent Area)
None D0-D4 D1-D4 D2-D4 D3-D4 D4
Current 0.00 100.00 99.72 94.42 79.69 55.08
Last Week 11/25/2014 0.00 100.00 99.72 94.42 79.69 55.08
3 Months Ago 9/2/2014 0.00 100.00 100.00 95.42 81.92 58.41
Start of Calendar Year 12/31/2013 2.61 97.39 94.25 87.53 27.59 0.00
Start of Water Year 9/30/2014 0.00 100.00 100.00 95.04 81.92 58.41
One Year Ago 12/3/2013 2.61 97.39 94.15 82.53 27.59 0.00
Intensity:
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
Author:
Anthony Artusa
NOAA/NWS/NCEP/CPC
USDA
http://droughtmonitor.unl.edu/

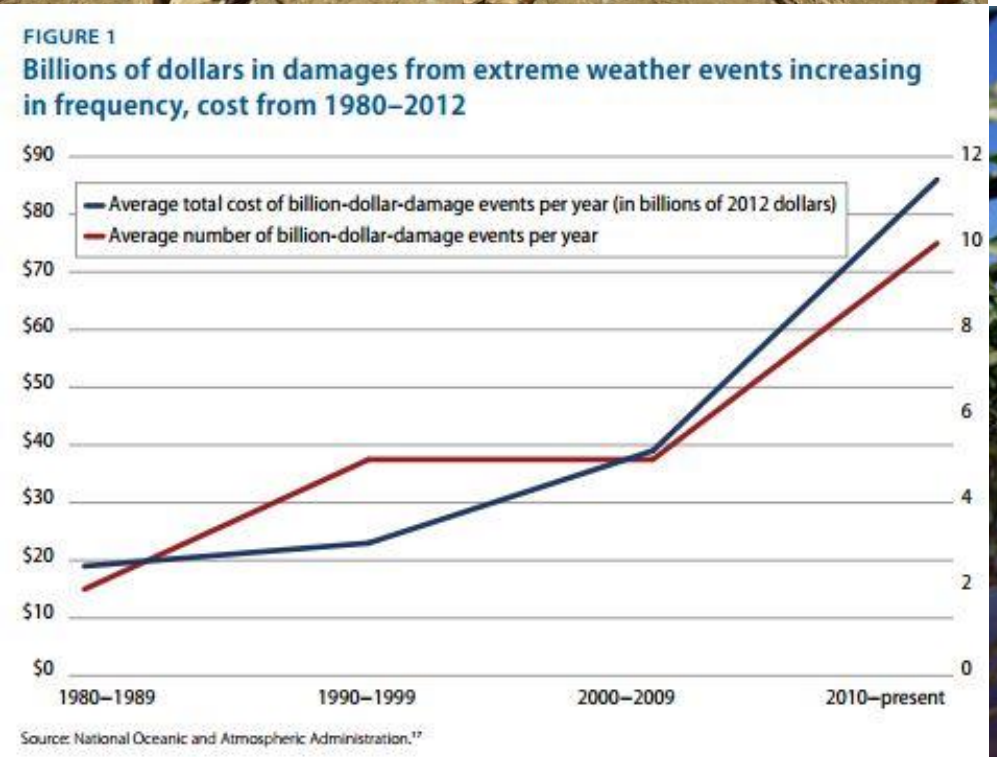
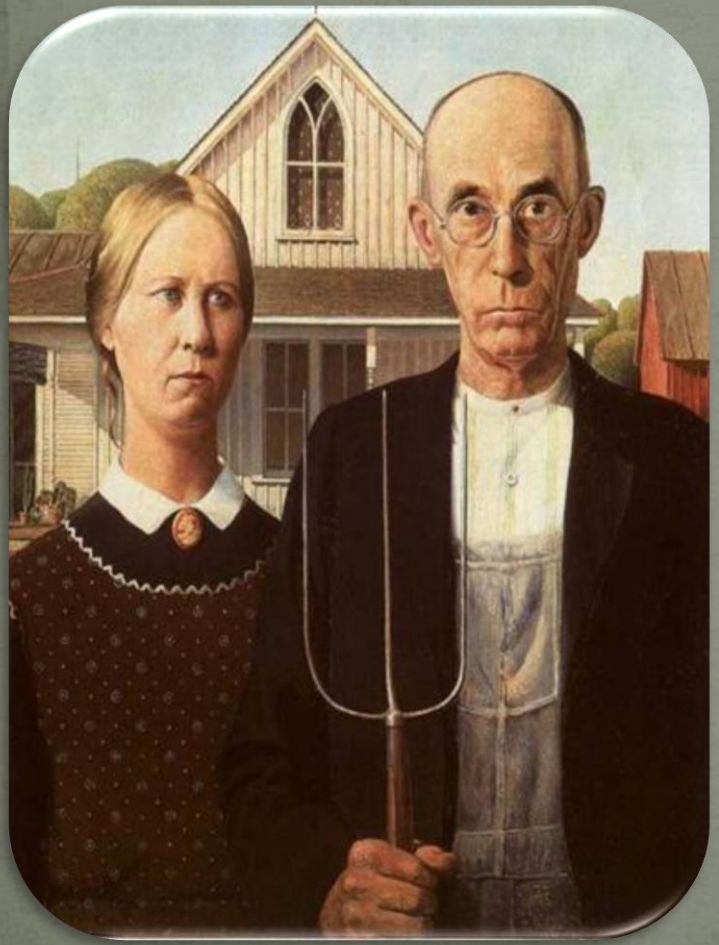


FIGURE 1
Billions of dollars in damages from extreme weather events increasing in frequency, cost from 1980–2012
$90
$80
$70
$60
$50
$40
$30
$20
$10
$0
12
10
8
6
4
2
0
Average total cost of billion-dollar-damage events per year (in billions of 2012 dollars)
Average number of billion-dollar-damage events per year
1980–1989
1990–1999
2000–2009
2010–present
Source: National Oceanic and Atmospheric Administration.[17]

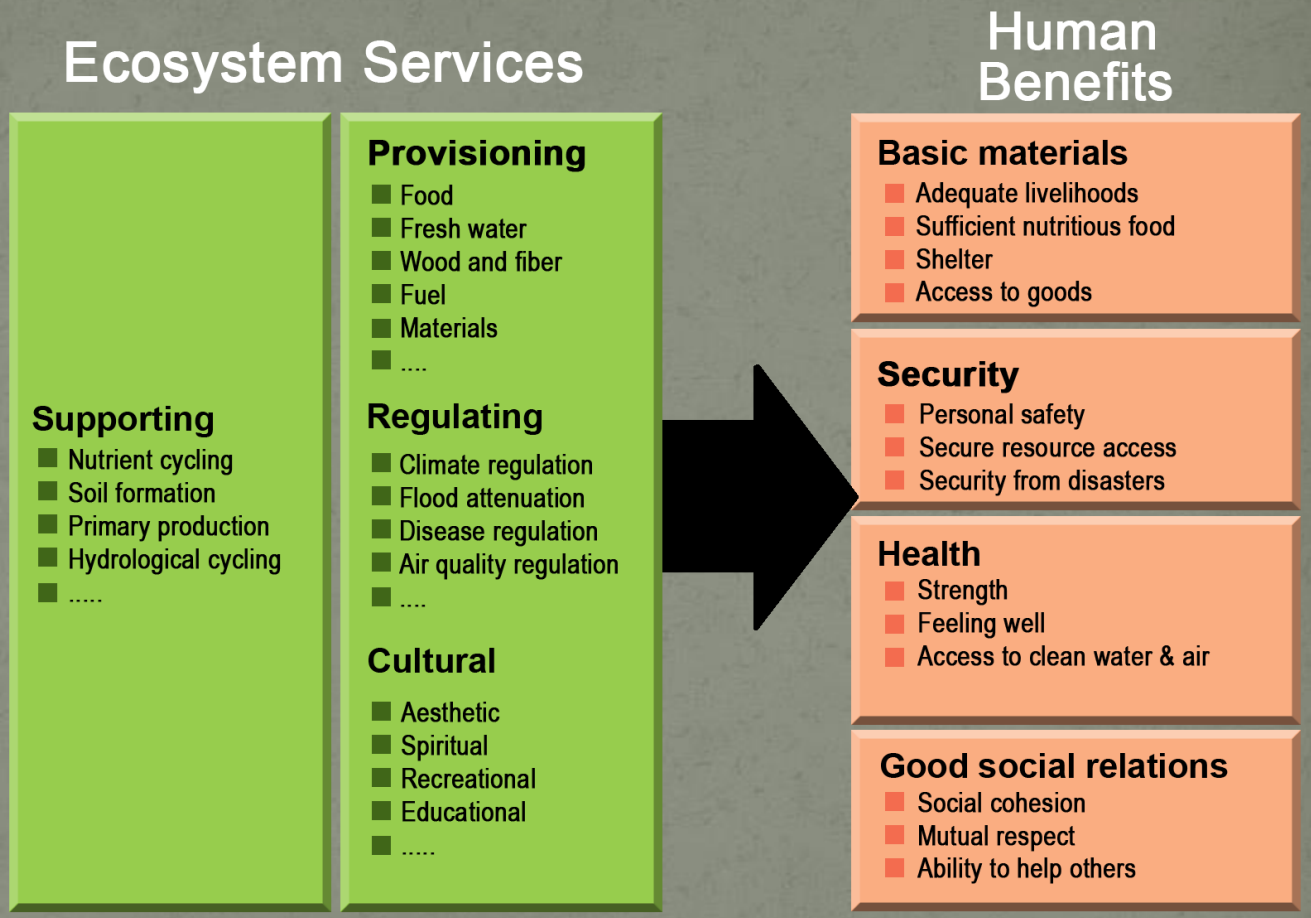
Playing with Loaded Dice

It is now possible to roll a 13 (i.e. the maximum possible temperature is higher than before) and would be more likely (because the dice are loaded) than rolling a 12 with two normal dice.

Design Multifunctional & Resilient Ag Landscapes

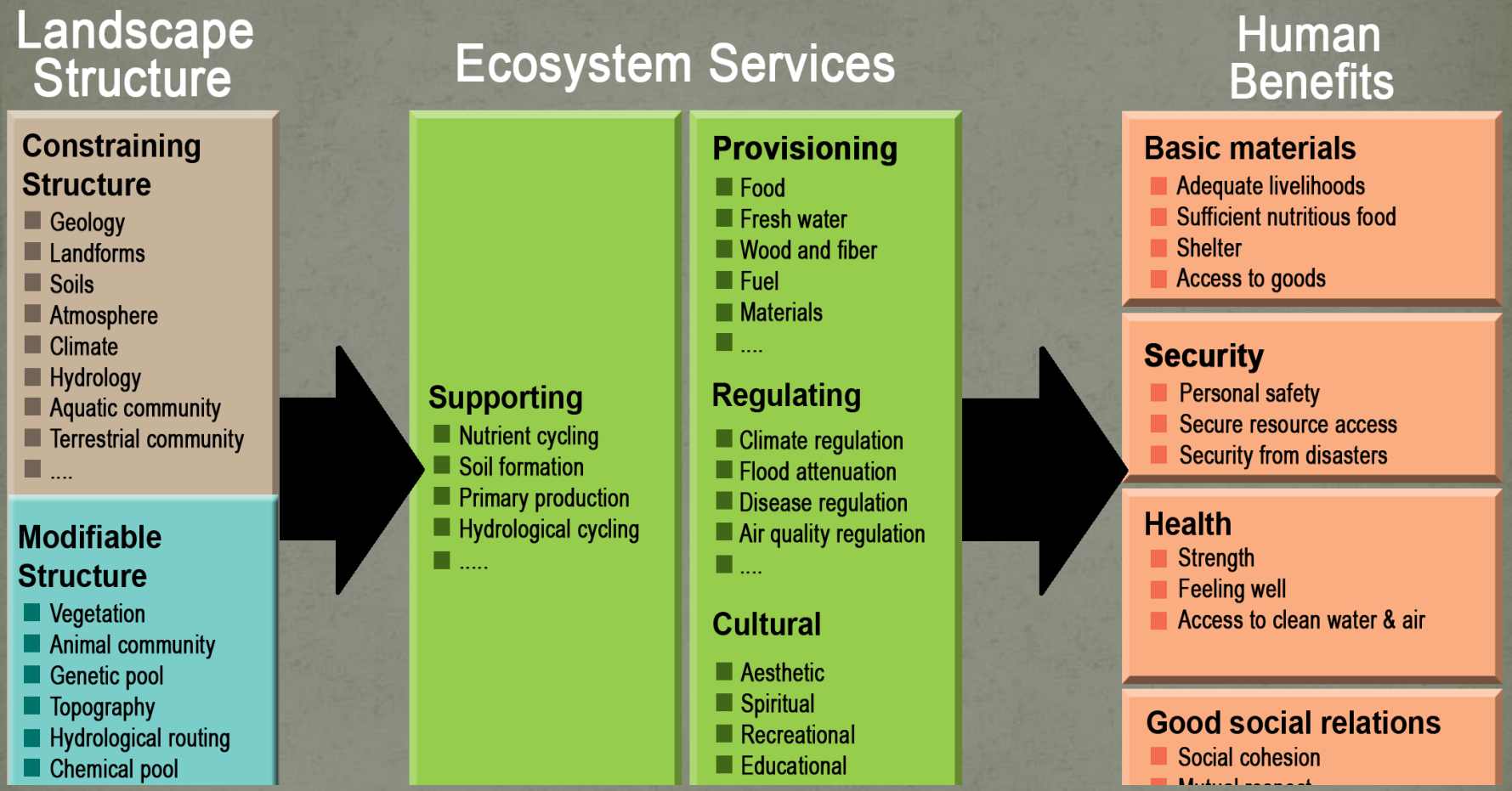


Ecosystem Service Framework



(Millennium Ecosystem Assessment 2003)

Landscape Planning & Design

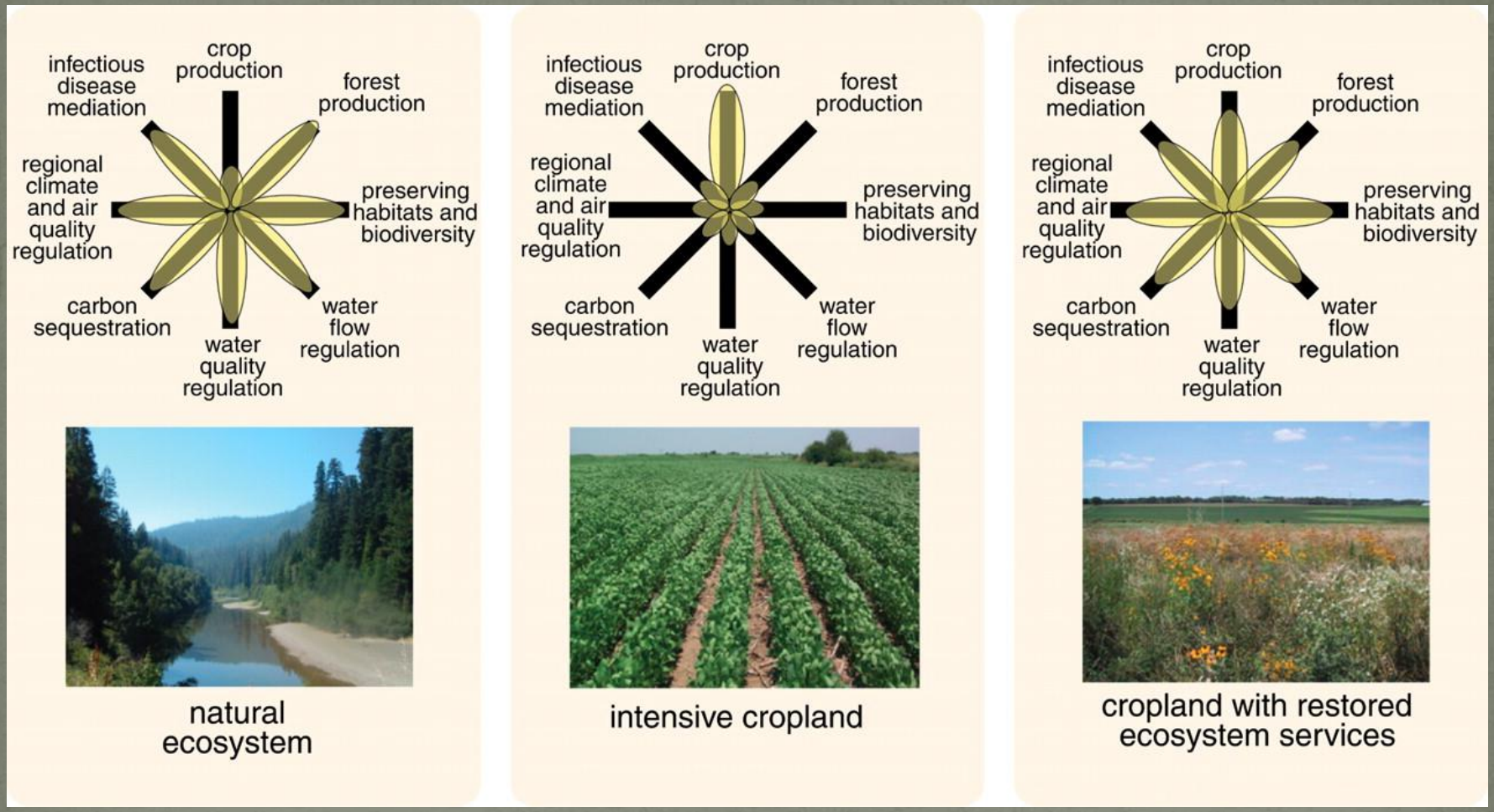


Dosskey, M., Wells, G., Bentrup, G., & Wallace, D. (2012). Enhancing ecosystem services: designing for multifunctionality. *Journal of Soil and Water Conservation, 67*(2), 37A-41A.

Landscape Planning & Design

1. Design for optimization
2. Target locations
3. Minimize negative effects
4. Tailor the design

1. Design for Optimization

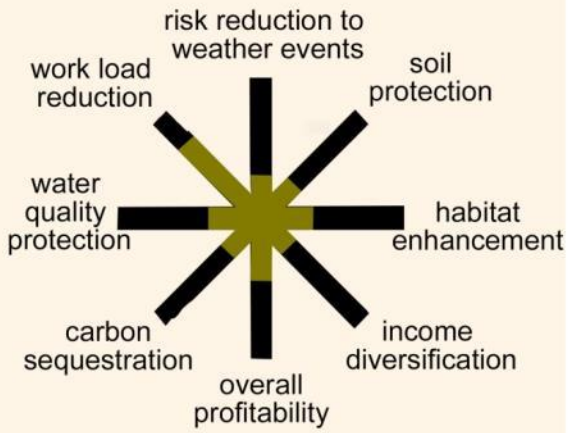


Adapted from Foley et al. 2005

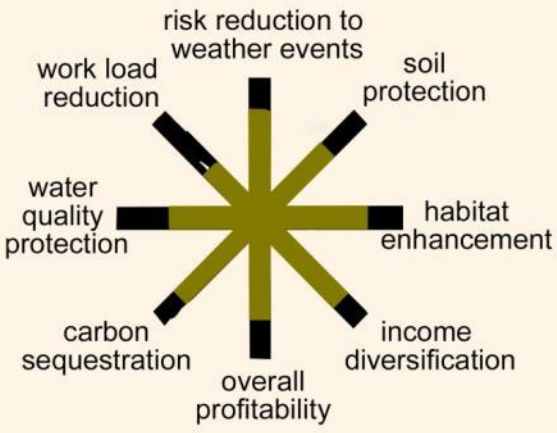
Many options in the toolbox

Not *area efficient* or *cost effective* to implement BMPs for a single ecosystem service.

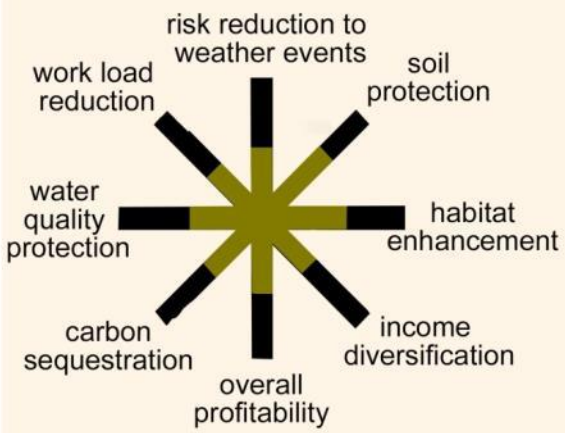
Comparison of options



Monoculture Alternative

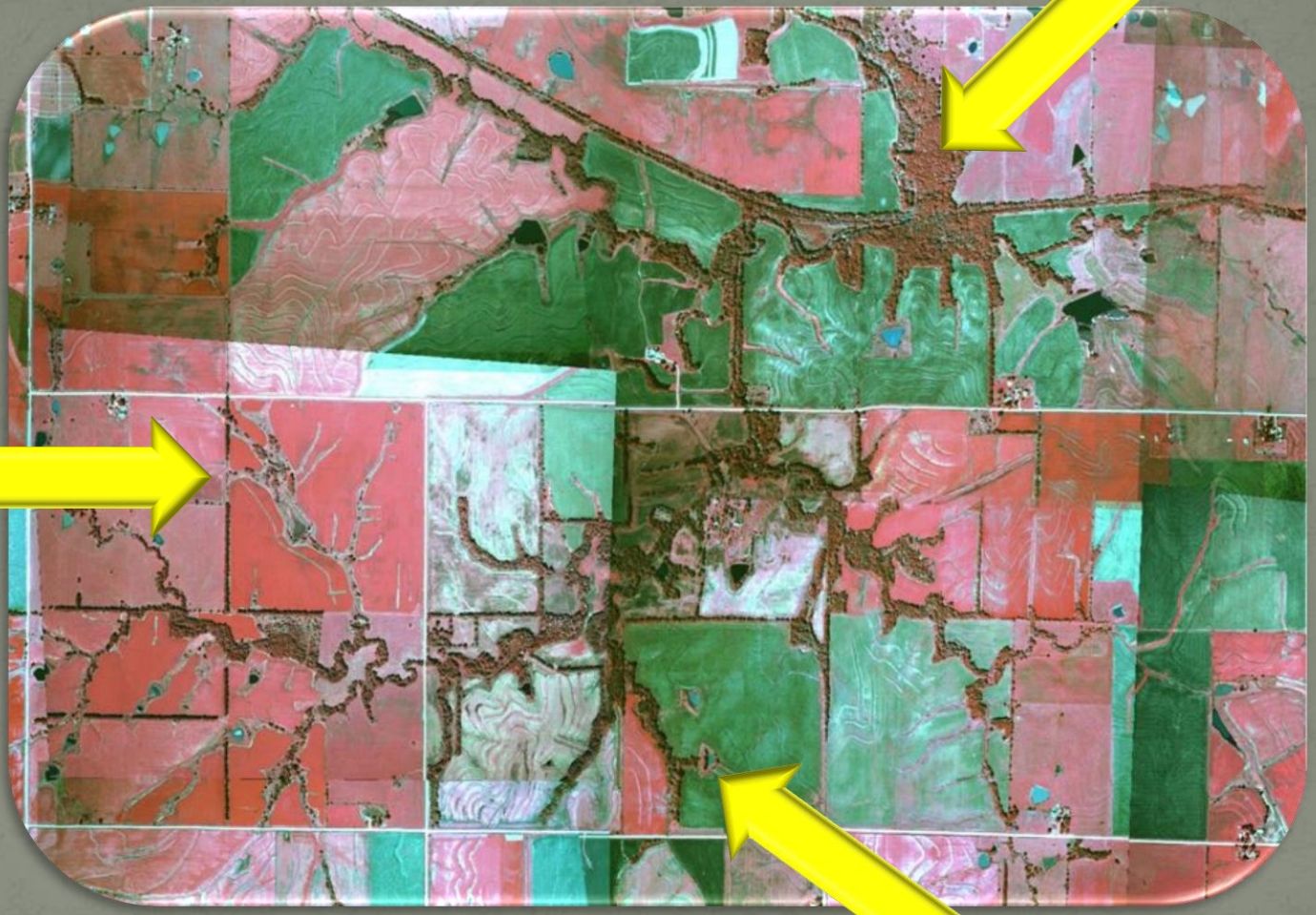


Agroforestry Alternative

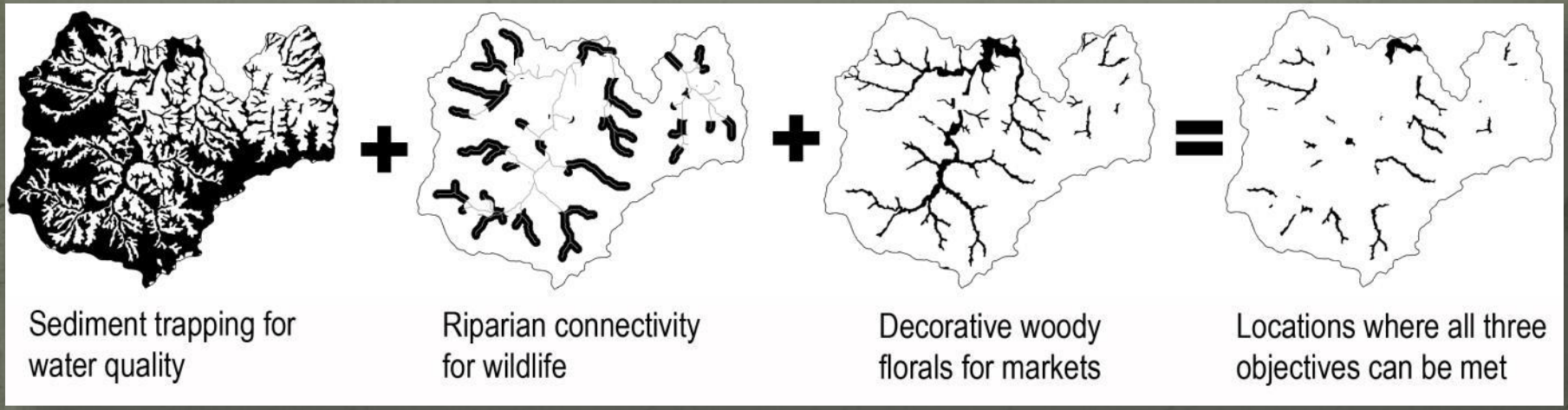


Strip Cropping Alternative

2. Target locations



2. Target locations



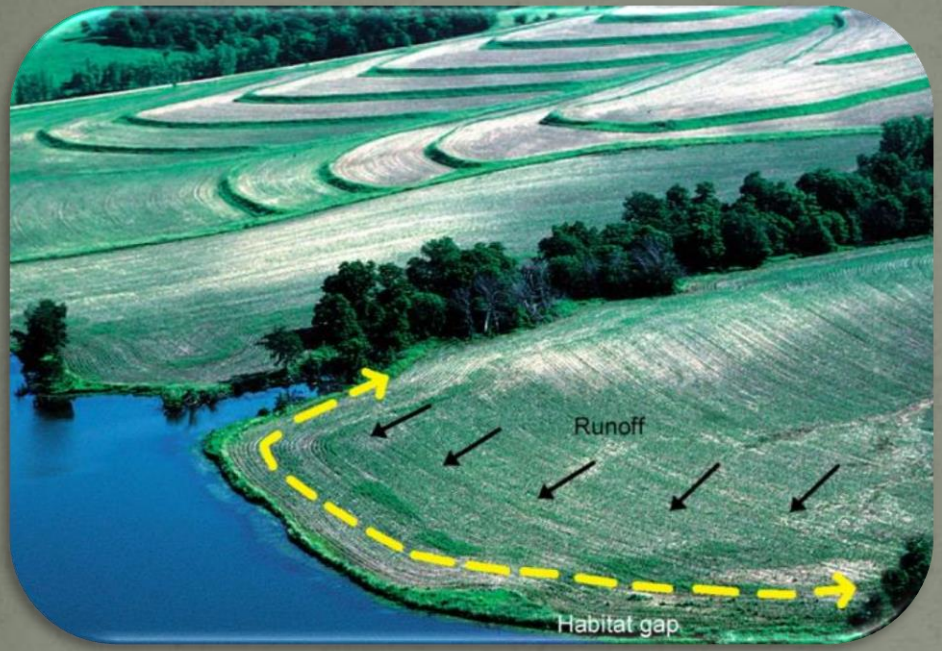
Bentrup, G., Dosskey, M., Wells, G., & Schoeneberger, M. (2012). Connecting landscape fragments through riparian zones. In *Forest Landscape Restoration*(pp. 93-109). Springer Netherlands.

3. Minimize negative impacts

- Increase transport of water borne contaminants

- Cotton boll weevil overwintering habitat

4. Tailor the design



- Site capabilities

- Landowner considerations

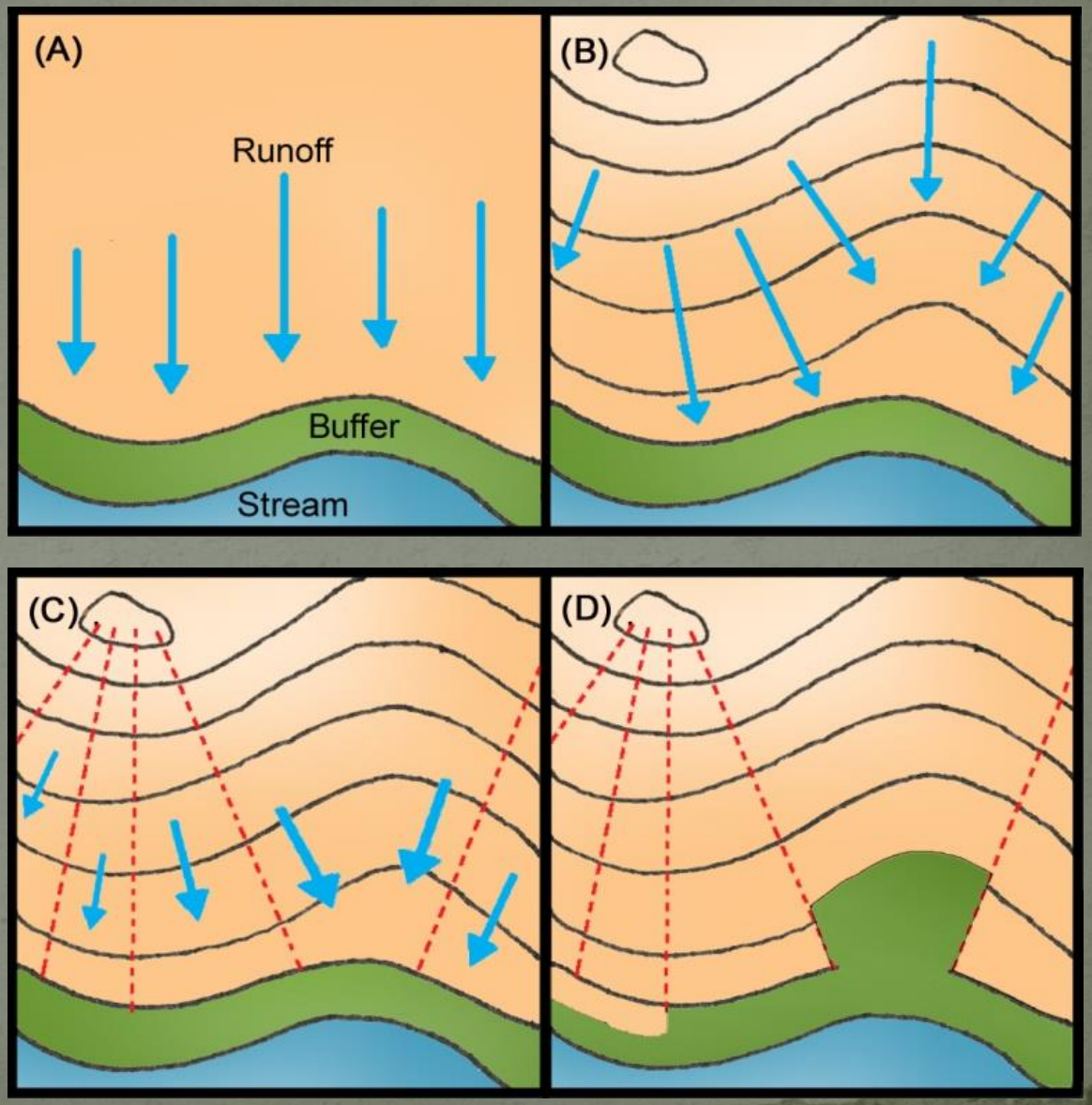
Pollutant reduction in runoff passing through vegetated buffers

Component	Pollution Reduction (%)
Sediment	40 to 100
Total P	27 to 93
Dissolved P	(-47) to 90
Total N	(-6) to 91
Nitrate N	7 to 100
E. coli	43 to 91
Atrazine	11 to 100

Dosskey, M. G. (2001). Toward quantifying water pollution abatement in response to installing buffers on crop land. *Environmental Management*, *28*(5), 577-598.

Site Capabilities

- Uniform flow
- Non-uniform flow



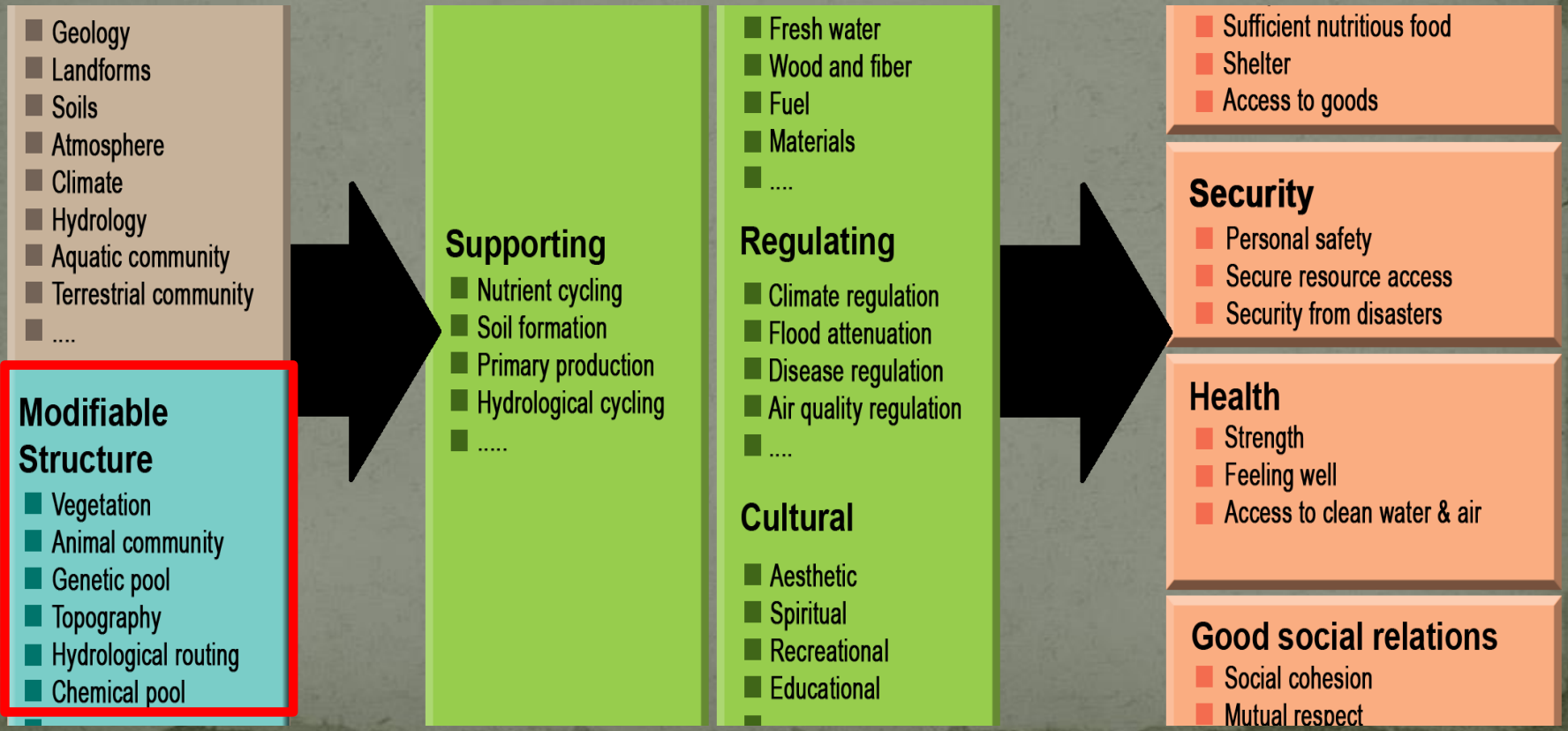
Landowner Considerations

- Positive economics
- Work load and timing
- Tolerable complexity
- Reduced risk to weather extremes
- Practices that look “tidy”
- Other considerations….

Atwell et al. 2009
Baumgart-Getz et al. 2012
Shandas 2007

BMP Design Criteria

- Location
- Dimensions
- Vegetation
- Management



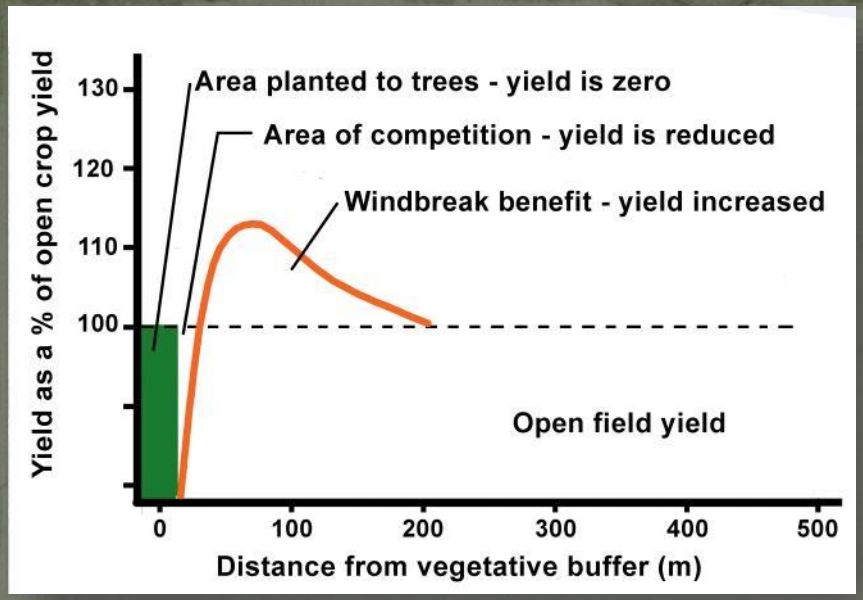
Increase crop yield

Reduce wind erosion

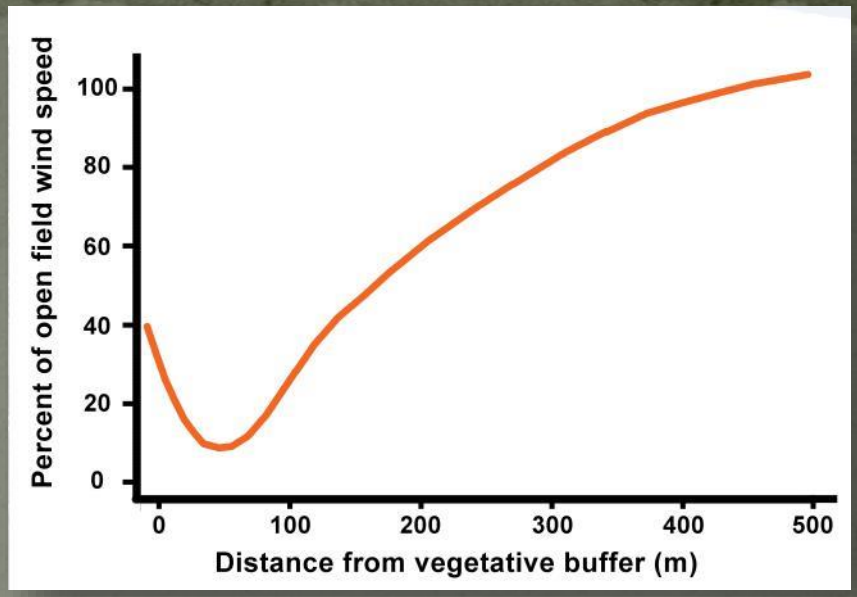
Provide pollination services

Provide biological pest control

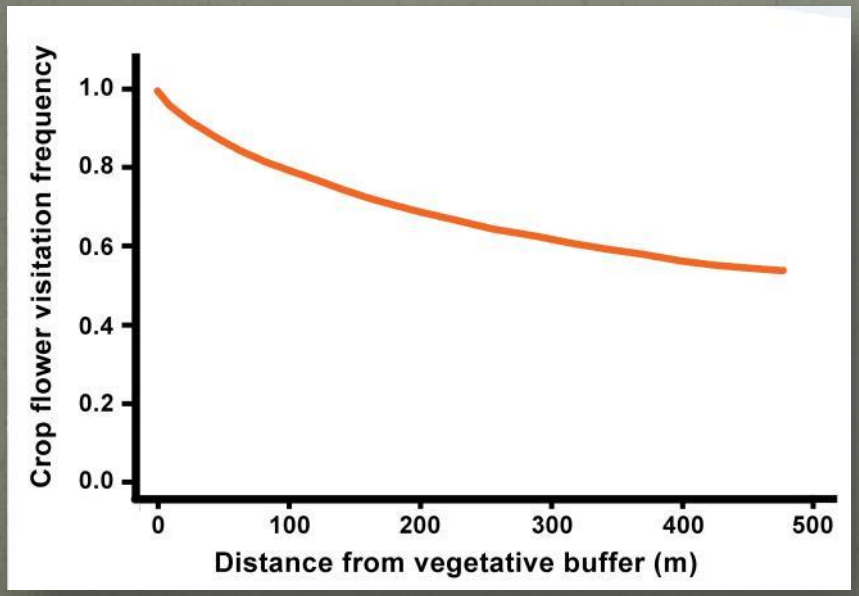
	Ecosystem Services				
Design Criteria	*Increase crop yield*	*Reduce wind erosion*	*Provide pollination services*	*Provide biological pest control*	**Σ**
Location	+	+	+	=	?
Dimensions					
Vegetation					
Management					



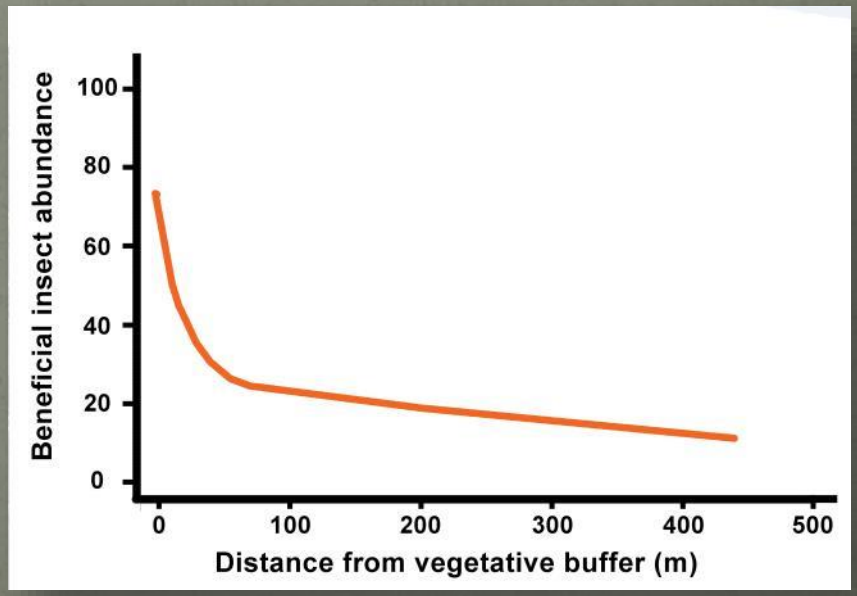
Increase crop yield



Reduce wind erosion

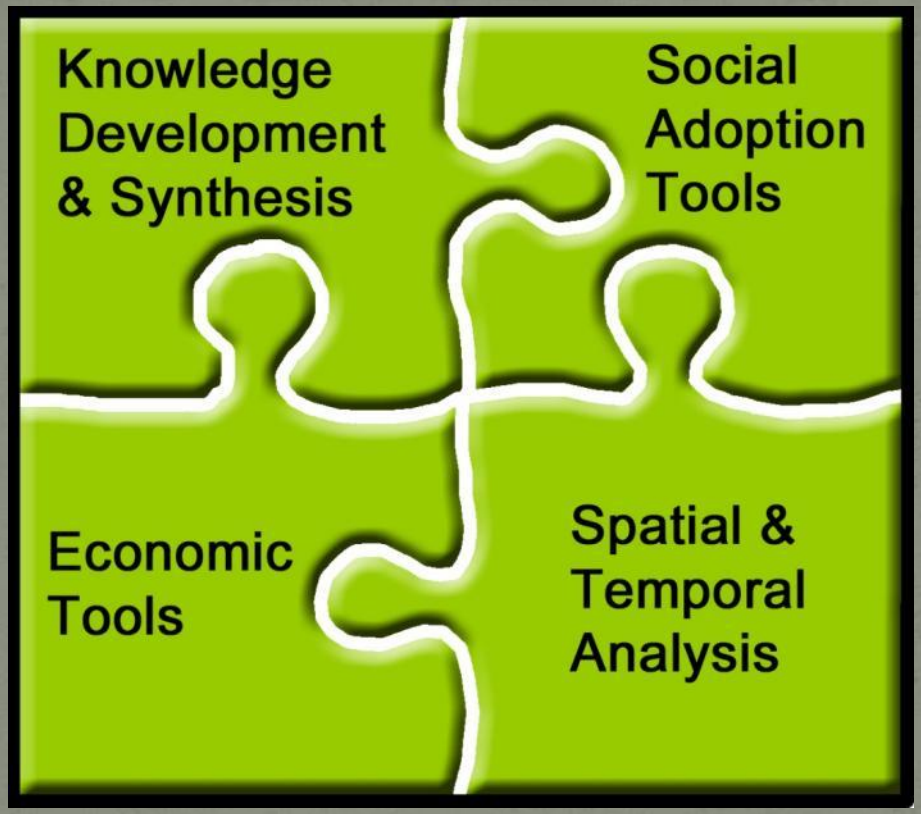


Provide pollination services



Provide biological pest control

Planning/Design Tool Portfolio

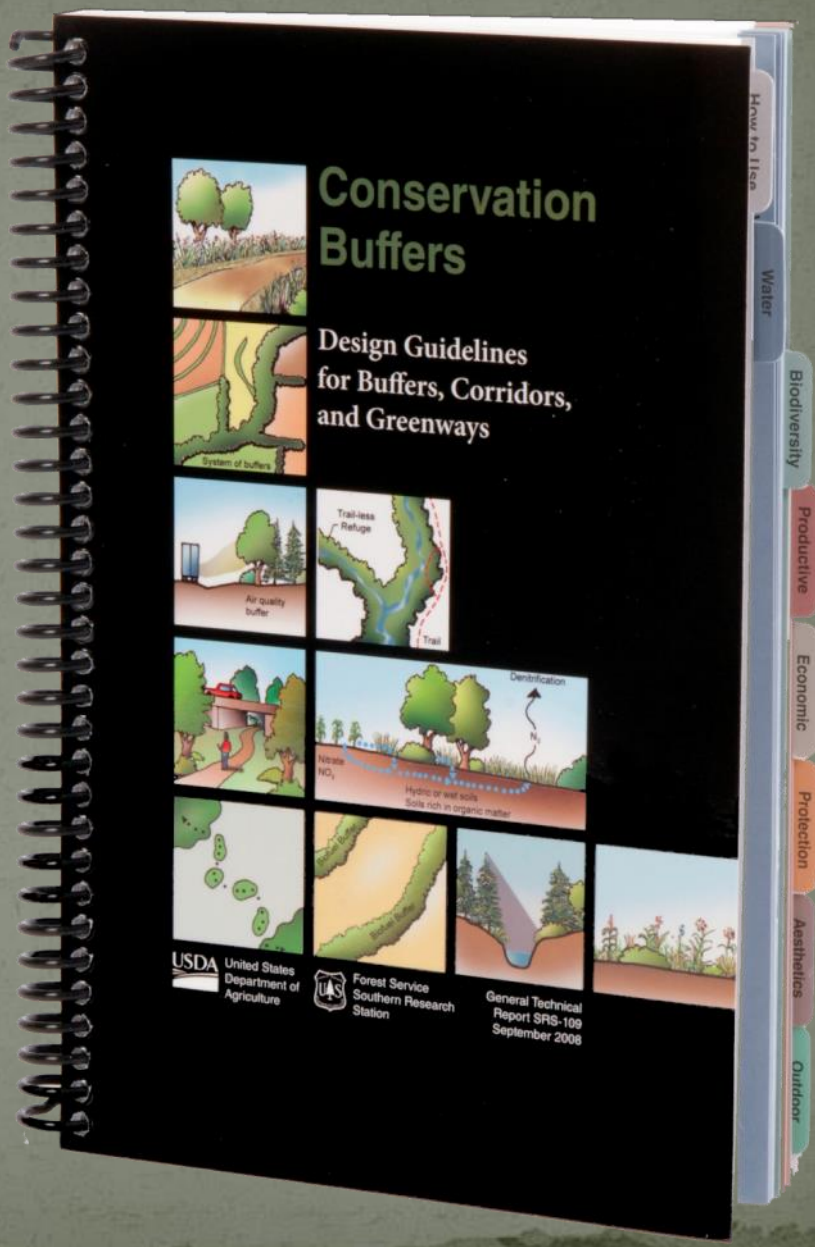


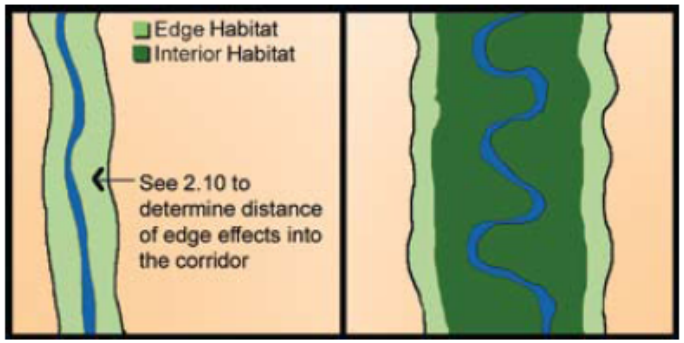
www.nac.unl.edu/

Conservation Buffers

Design Guidelines for Buffers, Corridors and Greenways

- Water quality
- Biodiversity
- Productive soils
- Economic opportunities
- Protection & safety
- Aesthetics & visual quality
- Outdoor recreation





2.9 Corridor width

Wide corridors, both upland and riparian, provide greater habitat area with reduced edge effects, while generally promoting more opportunities for species movement. Wider riparian corridors can facilitate stream meandering, providing overall higher habitat quality and diversity.

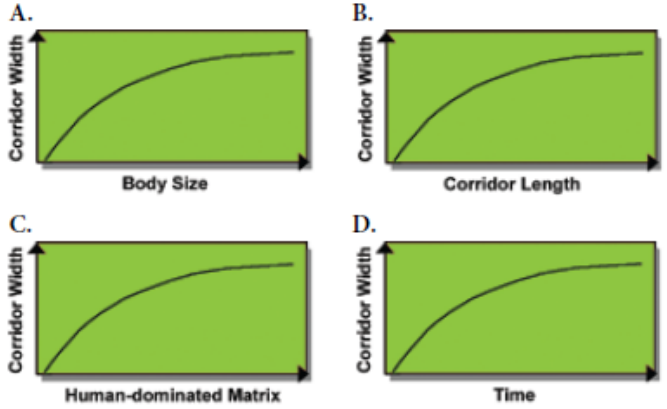
Many studies have examined the issue of corridor width for certain species. However, many of the studies have not tested a significant range of corridor widths to adequately determine optimal corridor widths. In addition, for a given width, corridor effectiveness will vary with corridor length, habitat continuity, habitat quality, and many other factors.

With those limitations in mind, the bar graph on the next page summarizes research on species movement through corridors. The black bar denotes the suggested minimum corridor width while the gray bar indicates the upper end of recommended widths. These ranges should be refined with a biologist.

Based on this research, some general relationships on corridor width can be inferred (see line graphs).

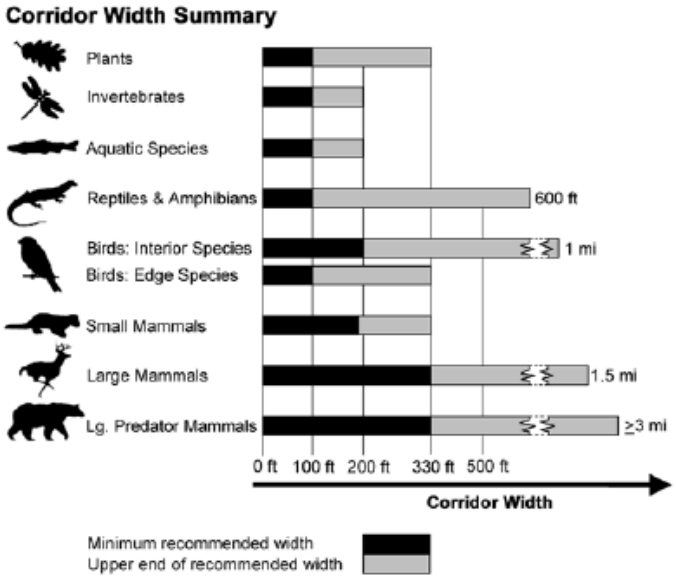
A. The larger the species, the wider the corridor will need to be to facilitate movement and provide potential habitat.

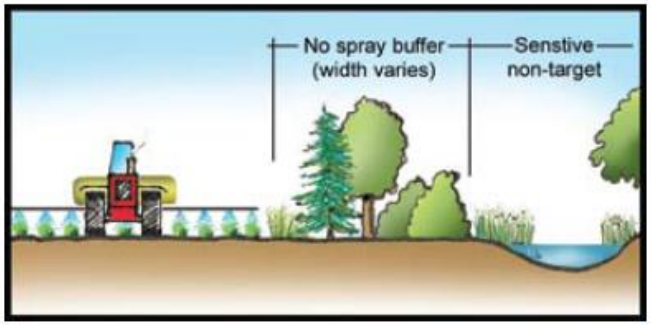
B. As the length of the corridor increases, so should the width. Shorter corridors are more likely to provide increased connectivity than long corridors.



C. A corridor will generally need to be wider in landscapes that provide limited habitat or that are dominated by human use.

D. Corridors that need to function for decades or centuries should be wider. Some functions that require significant time include dispersal for slow-moving organisms, gene flow, and changes to range distribution due to climate change.





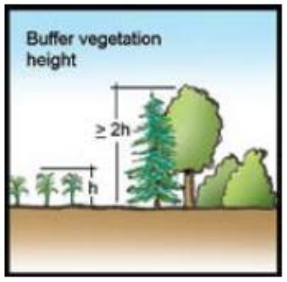
5.3 Buffers and spray drift

Buffers can help protect sensitive non-target areas from chemical spray drift. The buffer design is dependent on many variables including spray method, wind, chemical type, and the type of sensitive nontarget.

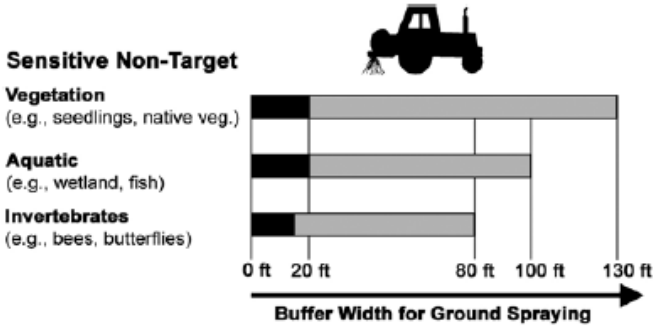
The adjacent graphs summarize recommendations for buffer widths based on spray method and the type of sensitive nontarget to be protected. Below are general design considerations.

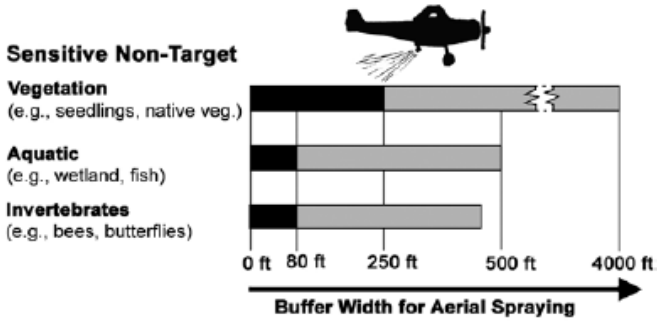
Key design considerations

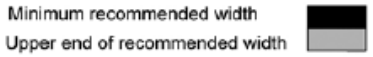
- Use vegetation with fine or needle-like leaves. Broadleaf plants capture less drift but are good for reducing wind.
- Use vegetation tolerant of the chemical being applied.
- Provide a permeable barrier (40 to 50 percent density) to allow air passage. Several rows of vegetation are better than one dense row.
- Buffer should be at least two times taller than the crop.
- Use a mixture of plant forms to ensure no gaps.
- Locate to intercept the prevailing winds and as close as possible to the spray zone.



The black bar denotes the suggested minimum recommended width while the gray bar indicates the upper end of the recommended widths based on current research. This summary should only serve as a starting point for design.



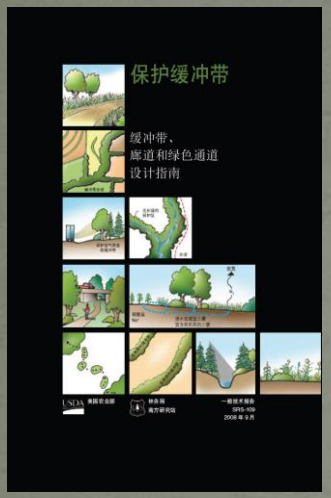




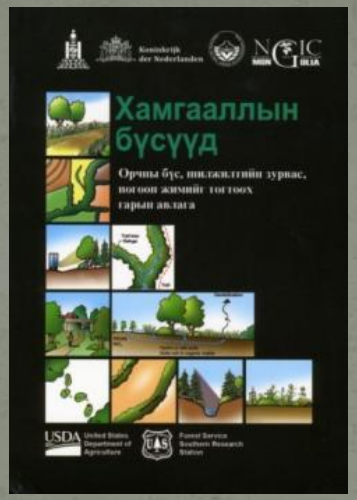
Due to the variability of chemical toxicity, these guidelines need to be used in conjunction with specific management recommendations for the particular chemical in use. Computer models are also available to help calculate spray drift potential and buffer zones.

Buffers should not be a substitute for other safety measures. Additional best management practices for chemical spraying need to be used in conjunction with buffers.

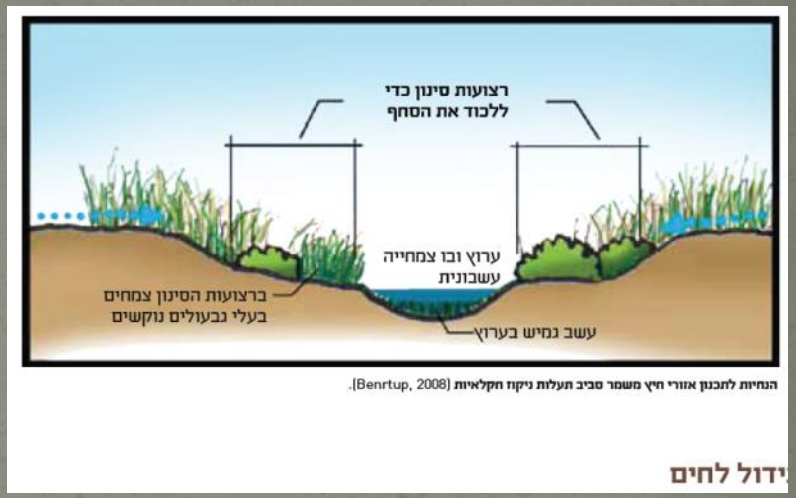
Foreign Language Versions



Chinese

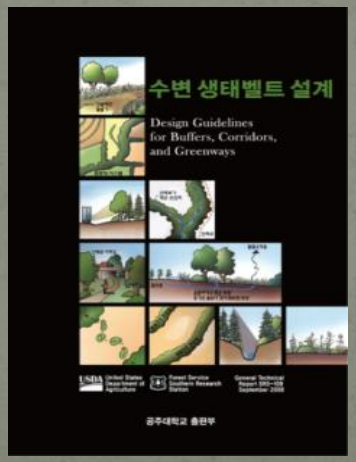


Mongolian



Hebrew

Spanish



Korean

French

Windbreaks – 4

AGROFORESTRY NOTES

AF Note — 41 April 2011

Windbreaks: A "fresh" tool to mitigate odors from livestock production facilities

Introduction

Windbreaks (shelterbelts, vegetative environmental buffers) placed around livestock production facilities as *Working Trees* can help mitigate the movement of odors and dust generated by these operations. Four primary factors are thought to contribute to these odor issues:

- Urban expansion has placed many more people into closer contact with agricultural operations.
- Large scale livestock confinement production has led to increased concentrations of manure.

General — 8

USDA National Agroforestry Center

AGROFORESTRY NOTES

AF Note — 34 February 2007

Enhancing Nest Sites For Native Bee Crop Pollinators

Introduction

The European honey bee receives most of the credit for crop pollination, but the number of managed honey bee hives is half of what it was in the 1950s; and this number continues to decline primarily because of honey bee pests and diseases. Native bees, however, contribute significantly to crop pollination and, on farms with sufficient natural habitat located nearby, may even provide all of the required pollination for some crops. In order to support the native bee community, it is essential to provide nesting sites in addition to floral resources. Unfortunately, intensively managed farm landscapes often lack

General — 5

USDA National Agroforestry Center

AGROFORESTRY NOTES

AF Note — 30 January 2006

Photo-realistic visual simulation: an agroforestry planning tool

Introduction

Planning an agroforestry project involves many steps, but perhaps the most difficult is trying to communicate planning alternatives to the decision-maker. Despite the use of plans and written descriptions, many clients still have difficulty conceptualizing what a proposed activity will look like on their landscape after it has matured. Clients often say that if they could just see a picture of the proposed action, then they could make a decision. Now, with the aid of image-editing software, you can create photo-realistic visual simulations of proposed projects to help convey practice or system alternatives.

Visual simulations graphically represent what a proposed activity would look like on the land from a particular viewpoint. Based on perspective principles, simulations range from drawings and edited photographs to complex 3-D models and computer animations. While some of these simulation methods are time consuming and difficult to learn, illustrating proposed landscape changes in digital photographs is a skill that can be acquired. The information in this Note focuses on this type of visual simulation.

What is visual simulation?

Photo-realistic simulations are created by using image-editing software. The base image of a project can be acquired from either a digital camera or a scanned slide or photograph. Proposed alternatives are created by adding or duplicating images of plants and other materials onto the base image. By using this technique, windbreaks, riparian buffers, and other conservation practices and systems can be illustrated at various stages of development, or with different species compositions or arrangements.

Existing landscape photograph

Visual simulation of proposed agroforestry system

1

General — 11

USDA National Agroforestry Center

AGROFORESTRY NOTES

AF Note — 39 May 2008

Conducting landscape assessments for agroforestry

Purpose

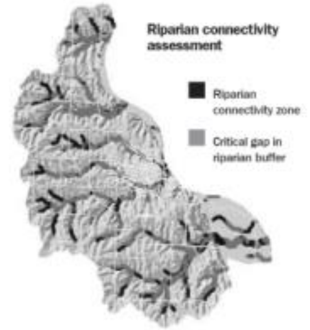
Landscape assessments describe existing resource conditions and trends within a larger planning area and identify opportunities to produce environmental benefits with strategically placed management activities, including agroforestry practices. In this Agroforestry Note, we:

- Explain why assessing the landscape is important for agroforestry
- Describe a basic landscape assessment process
- Discuss ways to use landscape assessments for agroforestry

Why assess the landscape?

Landscape assessments provide a way to understand the relationships between landscape structure, environmental problems, and agroforestry opportunities. Landscape structure influences the sources and movement of organisms, water, air, and materials across the landscape (see AF Note – 38). By understanding the sources and flows of these things, landscape structure can be modified with agroforestry practices to produce environmental benefits that can only be produced at the landscape scale such as improving water quality in a watershed or linking habitat patches with a wildlife corridor.

Tree-based systems like agroforestry take time before the benefits start to accrue. Consequently, it is critical to locate agroforestry in appropriate locations without trial and error. In some cases, agroforestry practices may also create negative impacts such as excessive woody debris in streams or



This landscape assessment identifies critical gaps in riparian vegetation that could be restored with riparian forest buffers to improve connectivity for wildlife movement and to minimize unfiltered runoff from reaching a stream.

A riparian connectivity zone is a continuous segment of riparian vegetation.

A critical wildlife gap is a break in riparian vegetation that exceeds the distance that a particular species can cross.

A gap in riparian vegetation that is adjacent to an agricultural field may pass unfiltered runoff directly to a stream.

For more information:
http://www.unl.edu/nac/research/2004riparianconnectivity.pdf

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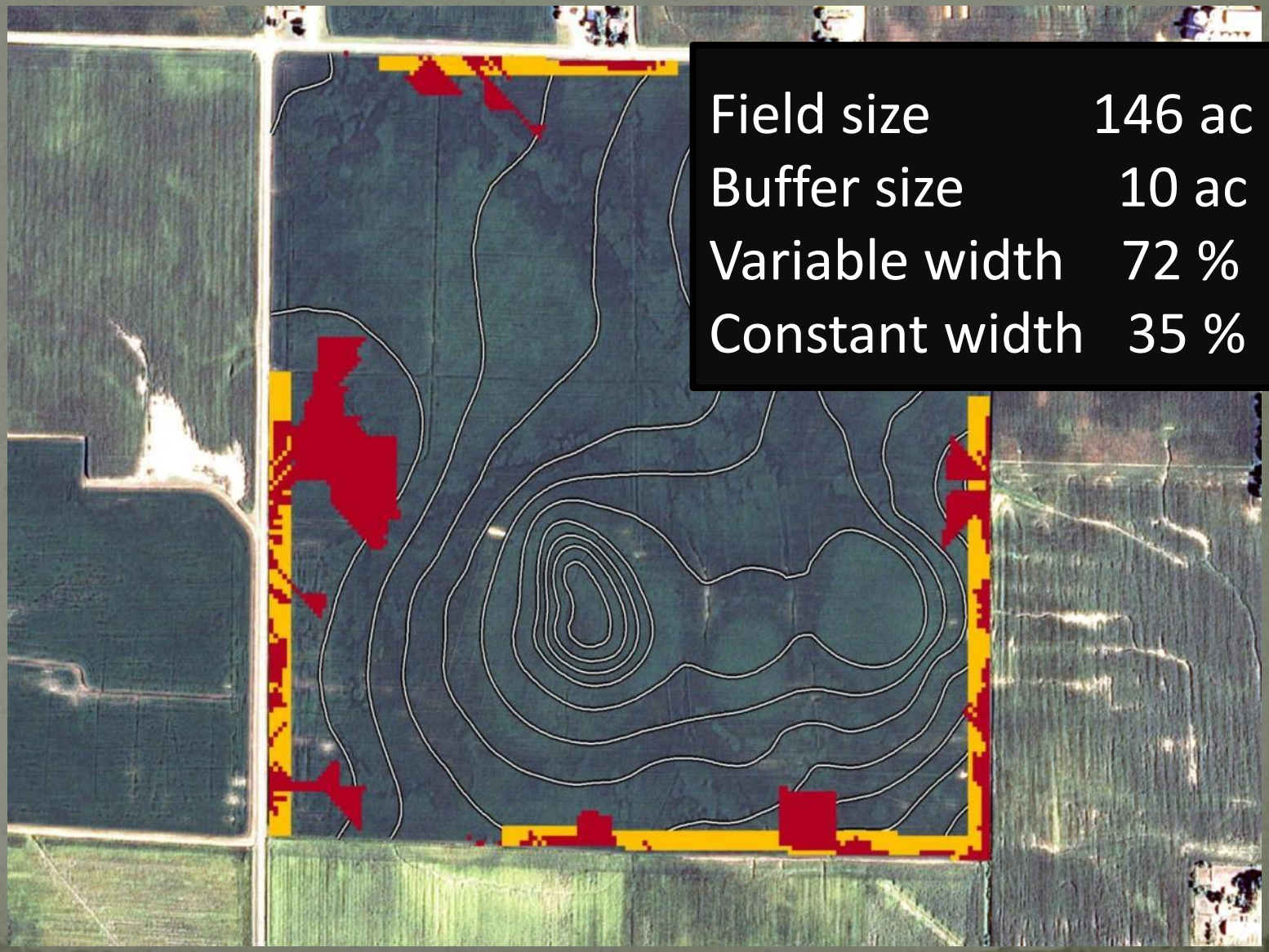
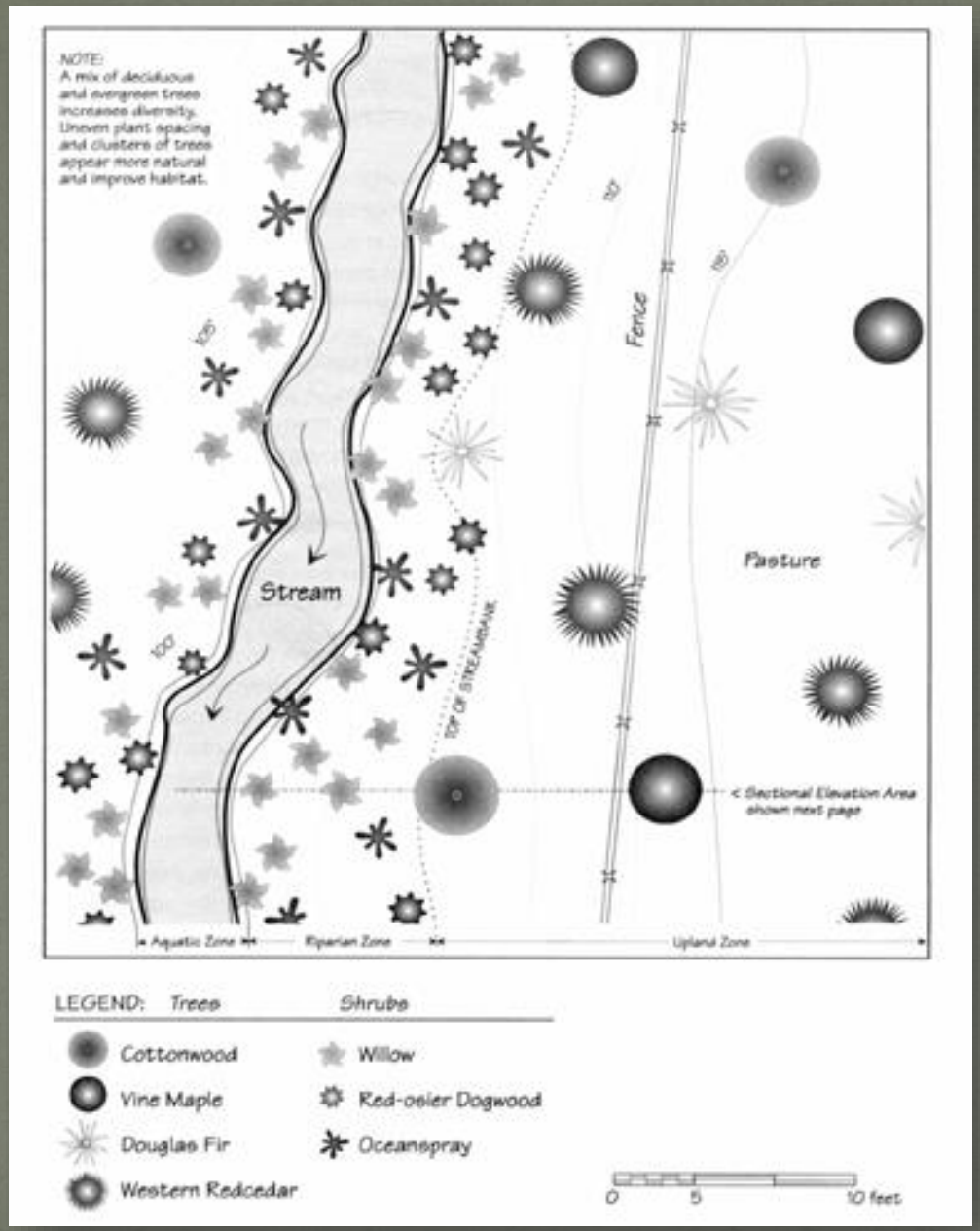
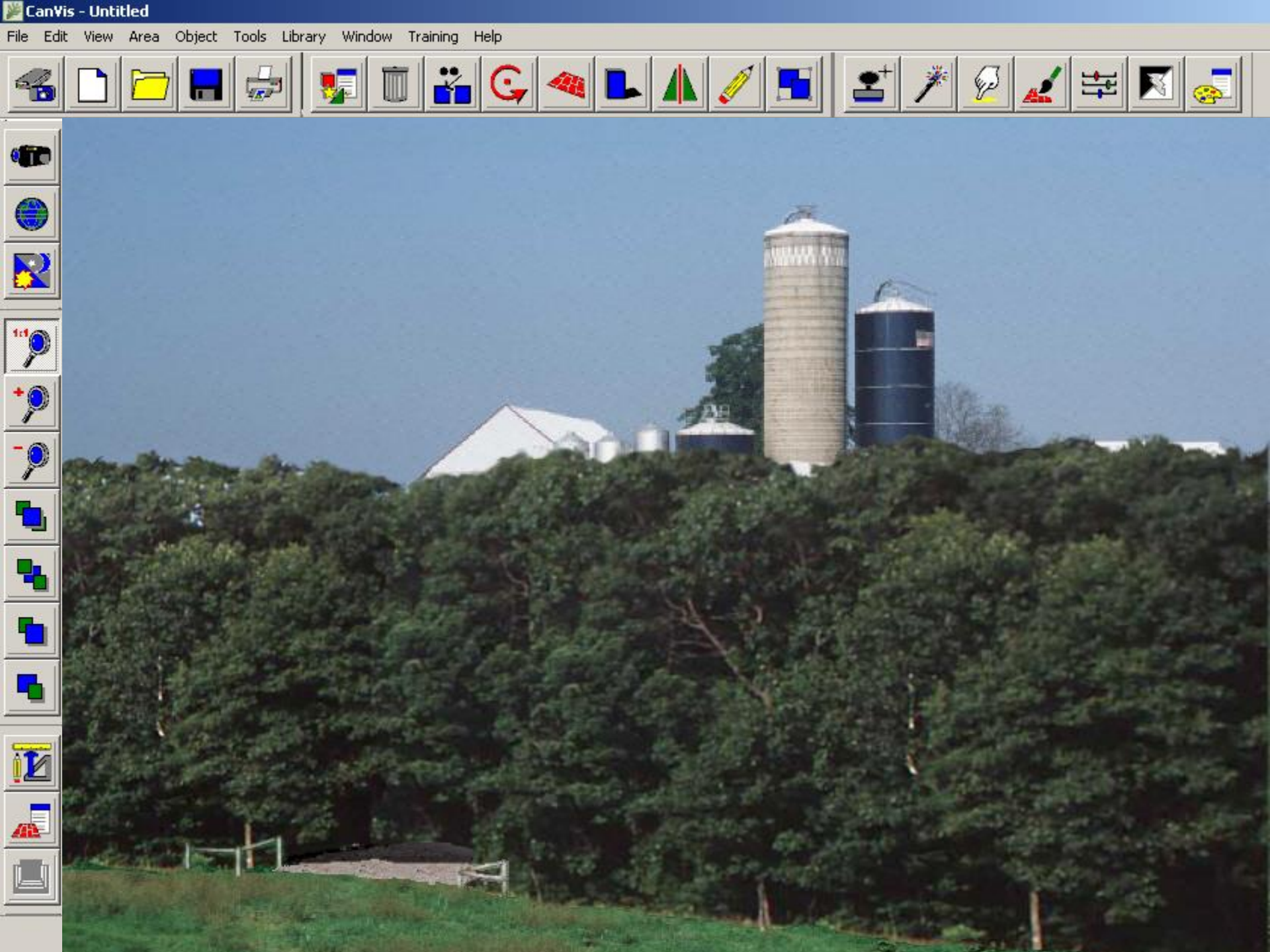
AgBufferBuilder



Visual Simulations

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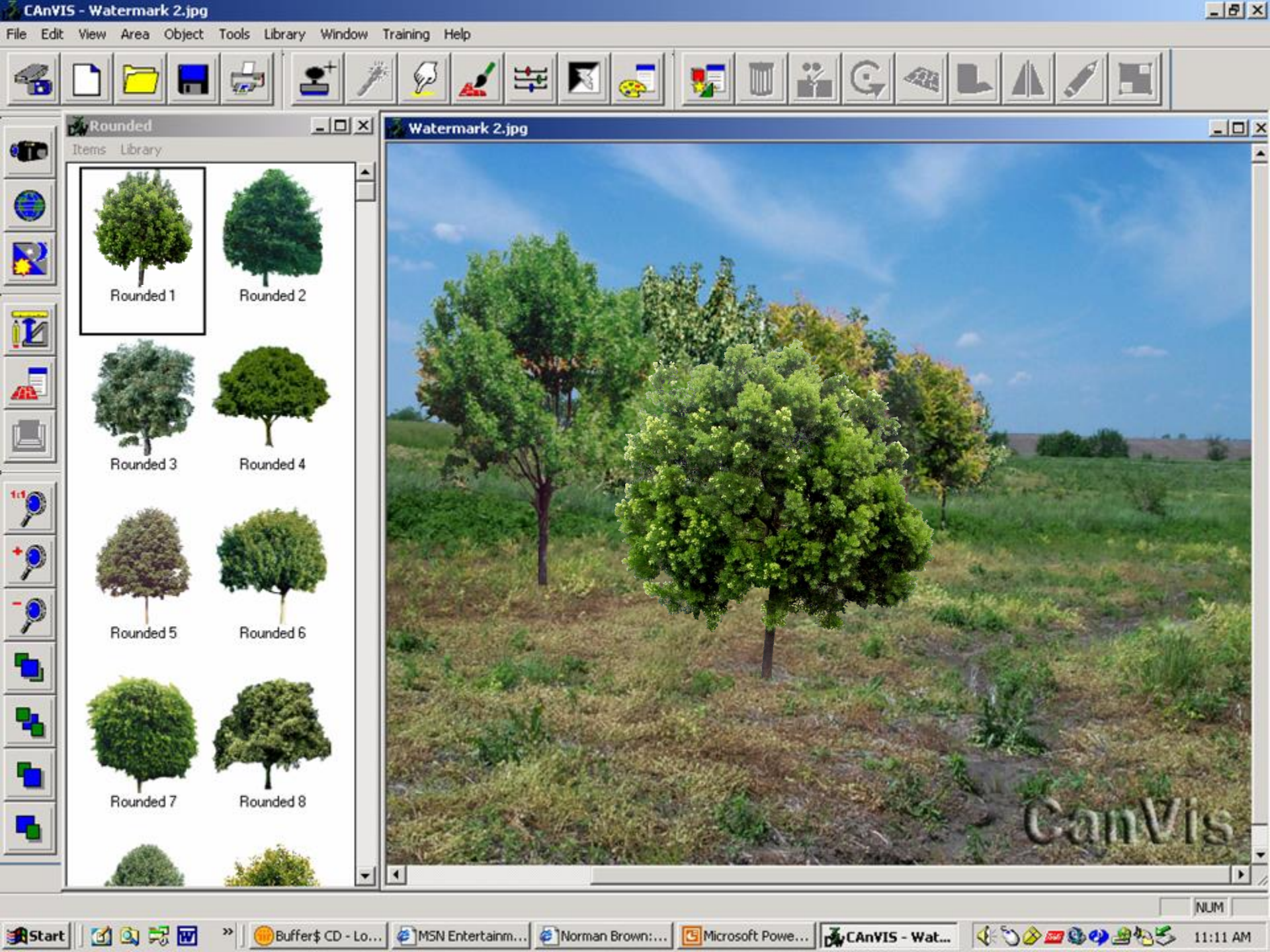
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Existing conditions


With new conservation practices


Before


Bioengineering - 1 year Growth

USDA National Agroforestry Center

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NRCS

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