An Overview of Agroforestry Practices

Ecological agriculture for America

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Has anything REALLY changed?
This map shows estimates of sediment delivered to rivers and streams for the approximately 2,150 watersheds comprising the contiguous United States. The Universal Soil Loss Equation was used to estimate sheet and rill erosion rates for the agricultural land in each watershed (other erosion processes are not included in this estimate). Erosion rates were converted to tons of sediment delivered to streams from agricultural land using a delivery ratio formula based on an empirical relationship between soil erosion rates and sediment loads in several U.S. river basins.

Sediment Delivered

### LEGEND
- **High**
- **Medium**
- **Low**
- **None/No Data**

**Source:** USDA/NRCS based on data from R. Stouwason and C. Walker, Texas Agricultural Experiment Station, 1996
Past discovery based on ExxonMobil (2002). Revisions backdated.
• Why does everyone seem to be working so hard to create and maintain something that doesn’t seem to be working very well?
What is agroforestry?

- Agroforestry is the intentional combining of trees and livestock, crops or forest-grown products to achieve economic, conservation, and ecological goals.
Permaculture

Wrote the book:

A Designers Manual

Bill Mollison
“Permaculture is about relationships that we can create between minerals, plants, animals and humans by the way we place them in the landscape. The aim is to create systems that are ecologically sound and economically viable, which provide for their own needs, do not exploit or pollute and are therefore sustainable in the long term.” (Bill Mollison)

Permanent Agriculture = Permanent Culture

(Permanent- Latin: per- throughout + manere- to remain; Culture- Middle English: cultivation, tillage; from Old French; from Latin: cultura, from cultus- cultivation, from Germanic: skel- to cut)
The piece of planet where I live has been photosynthetically productive and has supported a rich variety of life for a bajillion years; all without the use of fossil fuels, commercial fertilizers, pesticides, herbicides, fungicides or even tillage!

- How do I design my farming system to operate this way?

- Can such a form of agriculture provide the staple foods (carbohydrates, proteins and oils) currently provided by annual crops?

- Can such a farm be economically viable according to the current economic system?
Fagaceae:
Oak, Chestnut, Beech

Apples

Hazelnut

Prunus:
plum, cherry,
peach, almond,
apricot

Raspberry, grape, currant
2.3 Restoration Plan Evaluation

Environmental Framework

Illustration of Restoration Concept
Agroforestry Practices

- Forest Farming
- Alley Cropping
- Windbreaks
- Silvopasture
- Riparian Buffers
Windbreak / Shelterbelt / Timberbelt

Definition

Plantings of single or multiple rows of trees or shrubs that are established for one or more purposes.

Planted and managed as part of a crop or livestock operation to enhance crop production, protect livestock, manage snow distribution, control soil erosion and create wildlife habitat.
How do Windbreaks provide these Benefits?

Windbreak function depends upon six key windbreak components:

- Height
- Density
- Orientation
- Length
- Width
- Continuity
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Why Is Windbreak Height Important?

**Element: Height**

Match height to achieve desired protected area

The height determines the distance of the sheltered zone. For example, select the tallest trees suited to the site for large fields and fewest windbreaks.

H = Height of windbreak

10H to 15H
Windbreak Density

Dense = Maximum wind reduction but short wind shadow

Moderately Dense = Less wind reduction but longer wind shadow
Windbreak Orientation

- Orient windbreaks perpendicular to troublesome winds
- Plan multiple windbreaks for whole field protection
Field Windbreak - Benefits

Weighted Average Crop Yield Increase:

- Corn - 12%
- Soybeans - 13%
- Barley - 25%
- Winter Wheat - 23%
- Hay - 20%
- Spring Wheat - 8%

(Kort, 1988)
Windbreaks help prevent weight loss in cold weather and provide shelter for cattle.
Riparian Forest Buffers

A combination of trees and other vegetative materials established on stream and river banks to regulate microenvironments and buffer these waterways from non-point source pollution from adjacent land use.
Because of watershed modifications, *Riparian Forest Buffers* are needed. Often, *no perennial riparian vegetation* is left, and riparian buffers/filters have to start from scratch.
Riparian Forest Buffers

First year, just planted

Year 5
Riparian Forest Buffers

1990

1994

1994
Riparian Forest Buffers
Only one Conservation Practice For Improving Stream Ecology
Planned combinations of trees, shrubs, grasses, forbs & bioengineered structures designed to mitigate the impact of land-use on a stream or lake.
Benefits of Forested Riparian Buffers

• Filter sediment, nutrients and pesticides
• Helps prevent stream bank erosion
• Provides income potential
• Develop and improve wildlife habitat
• Protects aquatic habitat
• Protects against flood damage
Woody florals
Shrubs with market value
$0.35 – $0.45 per stem wholesale

Red osier dogwood
*Cornus stolonifera*
• **Alley Cropping**

Alley cropping is the growing of an annual or perennial crop between rows of high-value trees.

The agricultural crop generates an annual income while the longer-term tree crop matures.
Spacing Considerations

Within the Row

Between the Row
6 row corn planter, tree rows on 22.5 foot centers, 5 feet between trees within the row.

Age 3

Age 9, 35 ft. tall and time to thin.
Plant Materials - Trees

Species Selection

1. Trees matched to site conditions
2. Produce a light shade
3. Produce desired products
   -- Nuts, Timber, Honey …
4. High value
   -- grafted vs. nursery seedlings
   -- Black Walnut vs. White Oak
5. Deep rooted or minimal surface roots
6. Provides additional wildlife habitat to the site
Competitive interactions

- Spatially
- Temporally
- Above and below ground
Establishing Alley-Crops

**Establishment phase**
- Shade-intolerant species (annuals and/or perennials)
- Crop rotation according to light requirements as trees develop

**Mature plantation**
- Choose species according to light requirements
- Take advantage of micro-environments created in the system
Salad Greens alleycropped between tart cherries.
Alley Cropping

Raspberries (U-Pick) planted between rows of pecans
Corn, beans & alfalfa are all compatible with Walnut sp.
Asparagus between Chestnuts & Raspberries
Orchard Grass & Red Clover between Black Walnuts
Silvopasture
The Intentional combining of trees and/or shrubs, forage and livestock.
Allowing livestock to graze in a natural woodland area without any type of tree or forage management is not considered agroforestry.
Is this Silvopasture?
INTEGRATING TREES, FORAGES, AND ANIMALS

• The four variables in a silvopastoral practice that can be subjected to management are:

  • Tree Species.
  • Tree Density. (affects light vs shade and more!)
  • Forage Species.
  • Animal Maintenance.
Desirable Tree Species

- Loblolly Pine
- Slash Pine
- Black Walnut
- Pecan
- Bur Oak
- Red Oaks
- White Oaks
- Chestnut
- Hazelnut
- Hickories
The Effect of Light / Shade

(40 - 60% shade is ideal)

1. Yields can be maintained --
Select the appropriate forage combination(s).

2. Improved quality
   a) Reduced lignin &
      improved digestibility
   b) Increased or no change in crude protein
   c) Improved N content
ANIMAL MAINTENANCE

• Maintain the proper stocking density (i.e., do not exceed carrying capacity of site).

• Use rotational grazing instead of continuous grazing.

• Remove livestock during excessively wet periods to minimize tree root damage and soil compaction.
TWO APPROACHES

Establish trees in pastures

Establish pastures in trees
Electric fence protects young trees, 40x10’ spacing, 108 trees/acre, trees planted into tall fescue pasture
Loblolly pine
Tree tubes protect young trees
Silvopasture

Cattle rotationally-grazed in a mature pecan stand
Forest Farming

• ...the intentional manipulation of the forest canopy to improve the forest stand and produce understory crops
FOOD - Edible Forest Mushrooms

- Shiitake
- Maitake
- Reishi
- Oyster
- Morels
- Chanterelles
- King Stropharia
- Honey Mushrooms
- Chicken-of-the-Woods
- Coral Mushrooms
A Landowner points out ginseng plants in a forest setting
Edible Fruits

- Brambles
- Elderberry
- Grapes
- Gooseberry
- Currants
- Serviceberry
- Mayhaw
- Mulberry
- Paw Paw
- Persimmon
- Wild Blueberry

(Can you say winery?)
Some multi-story polycultures...
The Apple “Orchard”:
Grapes on Chestnut over Hazelnut
next to Rose behind Apple over
Daffodil, Iris and Comfrey and
more...
A highly productive, pest and disease-free home garden. Can you find 10 different types of garden produce?
Food, juice, vinegar, alcohol
Hazelnuts!
Protein & Oil

Oil + alcohol = Diesel Fuel!
OK... Do the math:

7 times the energy capture per acre
Improving resource base
Perennial: reproduces itself
No plowing, cultivating, pest or disease control
Year-round harvest. Multiple yields/products
No erosion, non-toxic and BEAUTIFUL!

Working WITH nature
Degrading resource base: Soil erosion, chemical contamination
Plowing, herbicide, pesticide, fungicide, fertilizers
7 times less energy capture than a Savanna!
YEAR after YEAR after YEAR!
One Crop, one market, total risk exposure
Degraded landscape, small towns, culture,
Where does this lead?
OR…
Thank you for Farming in Nature's Image!