USDA National Agroforestry Center

AGROFORESTRY NOTES

AF Note —38 May 2008

Landscape planning for environmental benefits

Purpose

Producing some environmental benefits of agroforestry, such as cleaner stream water, healthier aquatic ecosystems and greater wildlife diversity, requires a larger planning area than individual farms and ranches. In this Agroforestry Note, we:

- Explain why larger landscape areas should be considered when planning agroforestry practices.
- Describe a technique that facilitates such landscape planning.
- Discuss landscape assessments and plans, and how they are used.

A landscape perspective

Agroforestry practices are typically planned and implemented for sites on individual farms and ranches. Understanding how individual sites function in the larger landscape will help to identify where to locate and how to design agroforestry practices to efficiently produce landscape-scale environmental benefits. A landscape perspective involves looking beyond the fence line to determine how a planning site is affected by off-site conditions and how the site affects the surrounding landscape.

How far you look beyond the fence line is determined by the problem you want to address. For example, if improving water quality is the goal, then each site needs to be evaluated for its relevance to water quality problems in the larger watershed. If enhancing wildlife populations is the goal, then each site needs to be evaluated for its relationship to existing habitat and migration routes.

Examples of natural resource problems that can be addressed by planning at a landscape scale:

- Excess sediment and nutrients in water
- Limited and fragmented wildlife habitat
- Degraded aquatic habitat
- Stream bank erosion
- Blowing dust and snow
- Monotonous and undesirable scenery

Looking beyond the fence line allows agroforestry practices to be located and designed to address landscape problems like water quality and wildlife habitat. In this example, riparian forest buffers were located to connect habitat patches and to help downstream water quality problems. USDA NRCS file photo.

A technique for landscape planning

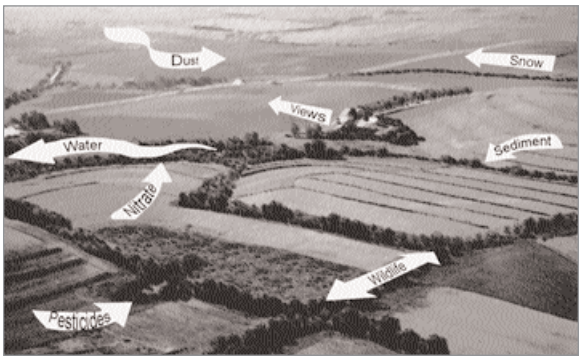
Most landscape-scale problems involve the movement of things; the movement of organisms, air, water, and materials that are carried with them. Understanding the sources and pathways of movement is critical to addressing these problems with agroforestry.

A useful technique is to visualize the flow of things through the landscape: how water pollutants flow off of agricultural land into streams; how fish travel along streams to suitable habitat; how wildlife move to and from large habitat areas through corridors; and how soil blows from cultivated fields in prevailing winds, for example.

How things flow is influenced by how the landscape is structured. Landscape structure is determined by the various land cover elements and the pattern that they create. Most landscapes are dominated by a particular land cover type – forest, grassland, row-crop agriculture, urban, etc. This dominant land cover is called the matrix. Other types of land cover are usually present that break up the matrix. These smaller land cover elements are called patches if they are in block shapes, or corridors if they are linear. The pattern that is created by the arrangement of these patches and corridors in the matrix, along with the land form characteristics (hills, valleys, etc.), determine how things move through the landscape.

Agroforestry practices alter the structure of the landscape by creating new patch- and corridor-shaped forest elements. When designed properly, these new vegetative elements can perform important functions, such as:

- Increasing water infiltration and slowing runoff flow
- Stabilizing and protecting stream banks from erosion
- Filtering pollutants from runoff water
- Shading streams for controlling temperature
- Providing woody debris that promotes good stream habitat
- Providing habitat for wildlife
- Providing conduits for wildlife movement
- Slowing erosive winds and promoting dust and snow deposition
- Providing visual diversity that improves scenic quality
- Screening undesirable views



Landscape structure determines where the major sources of water pollutants, wildlife, and soil erosion are located, where those resources flow, and how easily they do so. Original photo, USDA NRCS.

For more information on how to design agroforestry practices to address landscape scale problems, see AF Note – 40.

The role of landscape assessments

Agroforestry installations will function better and generate greater landscape benefits if the appropriate designs are put in the right places. Such places might include locations where runoff water is known to converge before entering a stream, where large gaps between habitat patches prevent movement of wildlife, and where soil erosion is occurring. Landscape assessments are needed to determine the right places. Geographical information systems (GIS) are helpful in this process for collecting and organizing spatial information about various types of resource problems and where they occur, where sources of the problems likely occur, where and how resources flow across the landscape, and for providing an understanding of landscape structure that determines spatial patterns of resources and their movement. More information about conducting landscape assessments is provided in AF Note – 39.

Creating a landscape plan

Typically, agroforestry practices are planned for sites on individual farms and ranches. A single site may have little impact on landscape problems such as overall water or air quality of an area, but when combined with other sites in a systematic way significant impact can be achieved.

If this is the case, planners working with individual landowners can still assess the larger landscape conditions to identify landscape problems and determine appropriate locations for agroforestry practices to help solve these problems. A larger landscape plan identifies off-site concerns and strategies for solving landscape-scale problems. Formal planning efforts may exist in some communities that address landscape-scale problems. Such efforts would include Watershed and Basin Area planning, Areawide planning, and Coordinated Resource Management Planning. These special types of planning bring multiple landowners and other stakeholders together to make landscape management decisions.

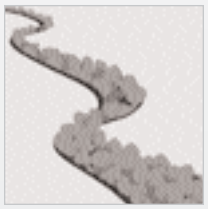
Landscape ecology

Landscape ecology is the study of the biological, physical, and human interactions of a geographical area. It looks at the spatial patterns of fixed landscape elements (landscape structure) and things that move in the landscape, (which include animals, water and nutrients); how the landscape functions (the flows of things between landscape elements); and changes in the landscape over time. These concepts are used in this note to help understand the larger landscape and how agroforestry practices can be used to effectively address larger landscape problems.

Illustrations from Stream Corridor Restoration: Principles, Processes, and Practices, 1998.

These concepts can be used at various scales: At the site scale to understand how nutrients and organisms move in a farm field; at a watershed scale to understand wildlife migration routes or water pollutant sources and movement, for example.

Agroforestry practices create new landscape elements that affect the biological, chemical, and physical processes that occur in the landscape. These new elements create either patches or corridors that are different than the dominate land cover of an area. These new elements affect how the larger landscape functions by creating:



Habitat – the spatial structure of the environment that allows species to live, reproduce, feed, and move.

Sink – a setting where input of materials, energy and organisms exceed output.

Conduit – the ability of the system to transport materials, energy and organisms.

Source – a setting where output of materials, energy and organisms exceed input.

Filter – the selective penetration of materials, energy and organisms.

Barrier – the stoppage of materials, energy and organisms.

The culmination of these efforts produces a plan that helps locate agroforestry practices and provide design guidance for achieving larger landscape goals.

Whether done by an individual resource planner for their area or part of a formal planning effort, a landscape assessment can be used to inform and educate landowners and communities about existing and potential resource problems in their area and about how agroforestry plantings might contribute to solving them. Armed with this knowledge, individual landowners and community residents can develop objectives for what they want to achieve and options for how and where to attain them. This planning process will create a general plan that identifies the best landscape locations for agroforestry. The plan can be used in several ways to guide more effective and efficient agroforestry installations.

One important use is to identify landscape-scale objectives to consider when developing agroforestry designs for individual sites. Information on how to conduct a planning process is provided in AF Note – 20.

A landscape plan has many uses:

- Indicates how effective agroforestry might be at addressing landscape problems
- Provides options to landowners that inquire about agroforestry
- Identifies how best to design sites to achieve landscape and landowner benefits
- Targets agroforestry to landowners and sites located in hot spots
- Evaluates tradeoffs and limitations associated with agroforestry options
- Addresses multiple issues simultaneously
- Creates more-efficient systems of practices that connect across land ownerships

Summary

Agroforestry can be an important component of plans to address environmental problems that reach beyond the farm or ranch. A landscape perspective is needed to properly locate and design agroforestry practices to address these problems. Landscape planning and design can help to ensure that individual agroforestry practices provide desired environmental benefits.

Additional information

Related Agroforestry Notes

AF Note – 20: Planning agroforestry practices. USDA National Agroforestry Center.

AF Note – 39: Conducting landscape assessments for agroforestry. USDA National Agroforestry Center.

AF Note – 40: Guidelines for fitting agroforestry into the landscape. USDA National Agroforestry Center.

Instructional books

Landscape Mosaics by R.T.T. Forman, 1995. Cambridge University Press, Cambridge, UK.

Ecology of Greenways by D.S. Smith and P.C. Helmund, 1993. University of Minnesota Press.

Green Infrastructure: Linking Landscapes and Communities, by Mark Benedict and Ed McMahon, 2006. Island Press, Washington D.C.

Related handbooks

Stream Corridor Restoration: Principles, Processes, and Practices by The Federal Interagency Stream Restoration Working Group, 1998. U.S. Department of Agriculture.

Conservation Corridor Planning at the Landscape Level: Managing for Wildlife Habitat by C.W. Johnson, G. Bentrup, and D. Rol, 1999. USDA NRCS National Biology Handbook.

Authors

Gary Wells (NRCS) and Mike Dosskey and Gary Bentrup (USFS), USDA National Agroforestry Center, Lincoln, NE.

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A partnership of

FOREST SERVICE USDA DEPARTMENT OF AGRICULTURE

NRCS Natural Resources Conservation Service

Contact: USDA National Agroforestry Center, 402.437.5178 ext. 4011, 1945 N. 38th St., Lincoln, Nebraska 68583-0822. www.unl.edu/nac

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