Inside Agroforestry
USDA Forest Service, Lincoln, Nebraska
Spring, 1994

Windbreak Evaluation Software Available

Researcher Jim Brandle at the University of Nebraska and John Kort at the PFRA Shelterbelt Centre released the second generation of their windbreak evaluation software, WBECON, in January, 1994. The new program offers several major advantages over the first generation model that was presented at the International Windbreak and Agroforestry Symposium in Ridgetown, Ontario in 1991.

The program evaluates field windbreak plantings for any rectangular shape field with dimensions greater than 500 feet by 500 feet. It allows the user to select from a number of windbreak tree species and designs and allows additional tree species to be added for local growing conditions. The program considers 27 common crops and allows additional crops to be added. It considers all input costs such as establishment and maintenance costs, crop production costs, land costs, and interest. Crop production benefits are assumed to begin in the fifth year after planting and are phased in as the trees mature. Results of the analysis include the annual economic return, the total return on investment, and a net present value based on the life of the windbreak investment. Results can be viewed on the screen or printed.

The program is designed primarily for use by consultants, extension agents, or other professionals and can be used by producers too. The initialization portion of the program allows the user to customize the analysis program to fit their conditions making it usable almost anywhere in both the United States and Canada.

Copies of the program are available by sending one 5 1/2 or 3 1/2 inch formatted disk, double-sided and high-density, and a computer disk mailing envelope to: Jim Brandle, Department of Forestry, Fisheries, and Wildlife, University of Nebraska-East Campus, Lincoln, Nebraska 68583-0814 or to John Kort, Shelterbelt Centre, PFRA, Indian Head, Saskatchewan, Canada S0G 2K0.

The Increasing Role of Nurseries in Biodiversity and Ecosystem Management

With increasing emphasis on biodiversity and ecosystem management, the demand for a wide variety of plant species is on the rise. Nurseries all across the nation have responded to this demand. In addition to the traditional commercial timber species, nurseries are now propagating a wide variety of diverse plants, from sedges and grasses to woody shrubs and trees. In an effort to increase biodiversity levels, natural resource specialists are using nursery stock for innovative planting projects like gene conservation, resource protection, ecosystem restoration, wildlife habitat enhancement, rehabilitation of recreation sites, and forest health.

For example, seedlings of turkey oak, which had previously been considered a weed tree, are being grown for wildlife habitat. And, little bluestem seedlings are being produced for a grassland restoration project in Michigan.

To further examine this trend, planting projects that promote biodiversity and ecosystem management are listed. Keep in mind that the following list of projects is by no means comprehensive.

(See Nurseries on page 2)

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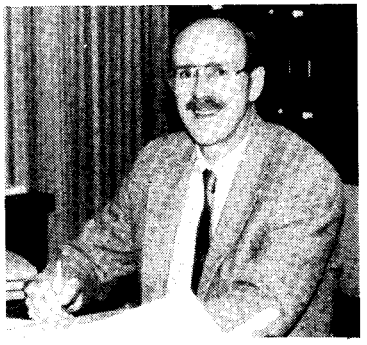
Inside This Issue



Message From the Manager

A column of important events and programs as reported by CSA Program Manager Bill Rietveld

Coming Together

Agroforestry is coming of age. Concepts and definitions of agroforestry are becoming more unified, and agroforestry science and practice is becoming more broadly recognized.

The notion of *conservation agroforestry* is gaining widespread acceptance. This encompasses the numerous benefits from ecological interactions (physical and biological) when trees and shrubs are integrated into cropping and livestock systems. Sure, we still need to justify agroforestry based on simple economics (a payoff from tree products), but today the less tangible benefits from agroforestry are perceived to have equal value. Land stewardship has many stakeholders, whose interests need to be defined and recognized. As agroforestry science and practice evolve, and a unified understanding and vision advance, so too will its credibility and acceptance.

I recently traveled to Nairobi, Kenya to coordinate on agroforestry with ICRAF (International Centre for Research in Agroforestry), a well-respected and effective private organization with a worldwide mission to advance agroforestry as a sustainable land-use system. My visits and tours with ICRAF leaders and scientists made me realize that various institutions are developing agroforestry science and practices worldwide for exactly the same reasons: to overcome environmental degradation, land depletion, water impairment, loss of biodiversity, and to establish a sustainable land-use system that will provide for people's economic and social needs. These needs hold true whether you are an agroforestry scientist in the humid tropics or the semiarid Great Plains. Our strategic research to develop methods, principles, technologies, tools, and models can be shared globally. But adaptive research by local networks is essential to locally adapt and integrate appropriate technologies and evaluate the cost and benefits. Agroforestry science is global; agroforestry practice is local.

Another key element that is becoming widely recognized and accepted is that agroforestry is a sustainable land-use system, or is an essential component of a sustainable land-use system. On a small farm or home garden, a multilayer integrated tree/crop/livestock design is a sustainable system to increase the productive capacity from a limited land base. As part of a larger scale land-use system, integrated agroforestry practices can substantially contribute to attainment of sustainment development. Agroforestry is one of the few management practices that can mitigate serious environmental problems (such as non-point source pollution), and simultaneously enhance the economic and human components within the same system.

Perhaps we haven't thought of it before in these terms, but agroforestry is part of an ecosystem-based approach to sustainable land use. Today a holistic, integrated, multi-resource, landscape scale approach to land management is popular, and many agencies are shifting to an ecosystem or watershed perspective. Now more than ever, people are realizing that all disciplines of agricultural, environmental, and natural resource science have something to offer to attain the common goal of developing sustainable land-use systems.

Ecosystem-based management is especially challenging on private lands, compared to public lands. On private lands, ecosystems transcend many boundaries: ownership, vegetation, use, political, and agency -- to name a few. Agency programs and responsibilities overlap, and the agencies are not the land stewards. Agencies only provide guidelines, incentives, and assistance. Stewardship is a shared responsibility, and the issue of private property rights needs to be respected and clarified.

Ecosystem-based research on private lands needs to develop an understanding of component interactions (especially interactions with the human component), identify options, and evaluate the costs and benefits of each option to various stakeholders. The outputs need to be scientifically based information that policy makers and managers can translate into appropriate guidelines, incentives, and assistance programs.

Never before has there been stronger and more compelling reasons to come together to blend and balance expertise to develop solutions to shared problems.

(Nurseries from page 1)

Gene conservation: Most forestry seedlings are sold by seed zone - a numerical code corresponding to a geographic area that is relatively similar in climate and soil. Some species that are widely distributed in geographically isolated populations, such as white fir, contain high levels of genetic variability. Besides obvious differences in physical characteristics, researchers found that local ecotypes of white fir differed significantly in traits that will affect seedling survival and growth such as cold tolerance and date of bud break. So, besides ensuring that only locally-adapted plant materials will be used in forest and conservation plantings, nurseries are ensuring the preservation of a wide variety of local genotypes by the use of "source-identified" seed.

Resource protection and conservation: Water quality is being threatened by many types of pollution. Growing plants for constructed wetland treatment systems is another way in which forest and conservation nurseries can help protect natural resources. A few years ago the Lone Peak Conservation Center Nursery, which is operated by the Utah Division of State Lands and Forestry, worked with the USDA Soil Conservation Service to design a constructed wetland to collect and treat runoff water from their greenhouse. At about

(See Nurseries on page 5)

Soil Bioengineering: Using Trees to Stabilize Slopes

By Gary W. Wells
Landscape Architect and Soil Bioengineering Team Leader
Midwest National Technical Center, USDA Soil Conservation Service

The value of vegetation to reduce soil erosion has long been recognized. Grasses and forbs are an integral part of many conservation practices. However, the value of woody vegetation to reinforce slopes and to provide barriers to earth movement has been overlooked until recently. Soil bioengineering is a term used to describe the use of live plant parts as a structural component for soil reinforcement and a barrier to earth movement.

"With increasing public concern to find more environmentally sensitive engineering solutions, soil bioengineering will continue to grow in popularity."

Soil bioengineering combines biological elements with engineering design principles to create environmentally sensitive solutions to both upland slope protection and streambank stabilization. It is an applied science that utilizes woody species that can root from cuttings to create a living structure. Initially the arrangement of the cuttings provides mechanical protection for the soil. As the plants grow, the roots reinforce the soil and other species invade to create a self-sustaining community.

With the renewed interest in sustainable land management systems, there has been a renaissance in the use of plants to solve slope stability problems. Even though soil bioengineering is a recent term, the concepts date back to the fourteenth century in Europe. In the 1930's and 40's, there were several professionals using and perfecting "living construction" techniques. The Soil Conservation Service was also evaluating soil bioengineering techniques during the 1930's. After World War II these techniques lost out to more conventional engineering solutions of concrete, rock, and steel.

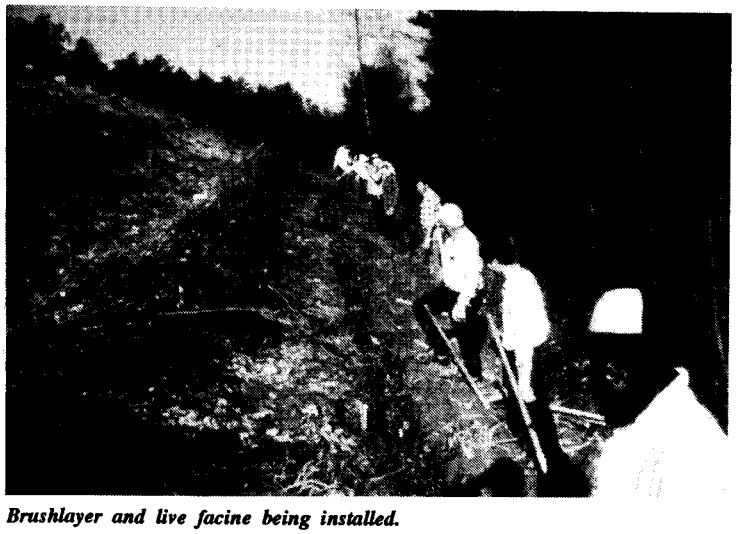
Soil bioengineering combines mechanical, biological, and ecological concepts and requires an interdisciplinary design approach. When properly designed, soil bioengineering techniques not only help to stabilize slopes, but also improve infiltration, filter runoff, transpire excess moisture, moderate ground temperatures, improve habitat, and enhance aesthetics. These techniques also minimize site disturbance and the need for large equipment, which can also help to minimize negative environmental impacts.

There are numerous soil bioengineering techniques. They all utilize dormant cuttings of indigenous plant materials. Species that root easily from cuttings, such as willow and dogwood shrubs, are used and can be harvested from local sources. Soil bioengineering techniques include live staking, brush mattress, brushlayer, live fascine, and branchpacking. There are also several techniques that can be used in combination with conventional engineering; these include live cribwalls, joint plantings, vegetated rock gabions, and vegetated rock walls. The inert structural component provides immediate slope protection, but as the plants grow, the roots become the key structural component.

An assessment of soil mechanics, hydrology, geology, climate, and other site conditions is needed to design the appropriate soil bioengineering techniques. Once designed, skilled installers are needed for construction and the site should be monitored for survivability. Even though installation is labor intensive, construction costs have been 1/2 to 2/3 the cost of conventional engineering solutions.

The Soil Conservation Service recognizes soil bioengineering techniques as a potential component in planning resource conservation systems. Initial efforts to develop technical information include Chapter 18 of the Engineering Field Handbook titled "Soil Bioengineering for Upland Slope Protection and Erosion Reduction." Chapter 16 on streambank and shoreline protection is also being updated to include soil bioengineering information. The agency is also evaluating several demonstration projects to gain information that will lead to the development of design guidelines.

With increasing public concern to find more environmentally sensitive engineering solutions, soil bioengineering will continue to grow in popularity. It will not replace conventional engineering solutions as there are many situations where soil bioengineering techniques are inappropriate. However, there are many opportunities where these techniques can be used in conjunction with conventional engineering to reduce costs and add environmental value.



Brushlayer and live facine being installed.

Three months after installation.

Soldier Creek Riparian Restoration Project

In November, 1992, Jerry Wohler, who owns land in Shawnee County, Kansas, contacted the Shawnee County Nonpoint Source Coordinator regarding a streambank stabilization problem. He had cropped land adjacent to Soldier Creek and due to a lack of riparian vegetation, approximately 500 feet of streambank on the five acre site was eroding and contributing a heavy sediment load into the creek. Cultivation to the edge of the bank was aggravating the problem. Wohler was concerned about losing access to a portion of the site, since the eroding streambank was only 50 feet away from the property line.

The 15- to 20-foot cedar trees were installed in an overlapped fashion and anchored with a duckbill anchor four- to five-feet into the bank.

The Nonpoint Source Coordinator contacted Rick Davis, Environmental Planning Consultant for the Kansas Department of Health and Environment, who coordinated what is now called the Soldier Creek Riparian Restoration Project. Representatives from several state and federal agencies, including the Kansas Department of Health and Environment, Shawnee County Conservation District, Soil Conservation Service, Kansas Department of Wildlife and Parks, State Conservation Commission, and Kansas State and Extension Forestry, visited the site to discuss possible solutions. They encouraged Wohler to consider long-range management objectives for the site, in addition to the immediate need for streambank stabilization. Wohler expressed an interest in timber production and wildlife habitat and a plan was developed. According to Davis, the primary purpose of the project is streambank stabilization. But, by also generating a cost-effective means to treat streambanks, landowners might be more willing to look at solutions. With alternative objectives, such as timber production and wildlife habitat, the perception of taking agricultural land "out of production" for the landowner is minimized.

The planning process of this project was something that Davis was particularly careful with and proud of. Planning the project from a mulit-agency perspective has provided several benefits. First, it has provided a unified, ecosystem approach rather than individual, unrelated management plans developed by separate agencies. Second, a design and management system was established that offered a series of checks and balances. And third, a planning process was established so that participating agencies can respond to future projects more quickly and efficiently.

The Restoration Project was installed in three phases that started in December, 1993 and were all finished by the end of March, 1994. The first phase of the design consisted of installing a tree revetment along the toe of the bank for two purposes. The cedar tree revetment not only traps sediment from the slumping bank, but also as it washes down the stream. Sediment deposited behind the revetment allows seed from pioneer species such as willow and cottonwood to become established. Trees for the revetment were cut about 1 1/2 miles from the site on property owned by Wohler. The 15- to 20-foot cedar trees were planted in an overlapped fashion and anchored with a duckbill anchor four- to five-feet into the bank.

Site after tree revetment was installed

The second phase consisted of placing dormant willow stakes on the slope to establish deep rooting. The stakes were placed on a four-foot spacing and planted two feet deep. Establishing this extensive root system quickly was imperative to stabilizing the slope.

The third phase of the restoration project consisted of planting the site to grass, shrubs, and trees to provide a varied habitat. A variety of deciduous trees were selected for species diversity and timber production. Patches of native grass and deciduous shrubs will provide additional species diversity for wildlife habitat.

The restoration project on Wohlers land to date has been so positive that the landowner to the south, Randy Wolf, has also contacted Davis to initiate a similar project on his land. Davis feels that this is a great opportunity since Wolf also has an outside bend of the stream similar to Wohlers. However, since the slope on Wolf's land is not as dramatic and the area is slightly different, the design will vary. Davis plans to use dormant willow stakes, without a tree revetment, to provide immediate stabilization on the bank. Several rows of trees will be planted above the bank for long-term stabilization.

The varied treatments of the two sites will provide an opportunity to compare streambank stabilization methods. Both sites will then serve as demonstration projects and will be used for field days to train agency personnel and encourage landowners to do riparian restoration work in the future.

Much of the credit for the success of the Soldier Creek Riparian Restoration Project goes to Rick Davis. He was instrumental in the planning, coordination, and implementation of the first project and continues to oversee future progress of the next phase. Thank you, Rick!

(Nurseries from page 2)

the same time, they began propagating native wetland plants for the conservation and restoration market. In an excellent example of innovation, they decided to combine the two projects. The constructed wetland treatment ponds will serve three functions. They will: 1) biologically remove nitrates and phosphates from greenhouse irrigation water; 2) serve as a growing area for the propagation of wetland plants; and 3) function as a seed production area. Currently, several riparian plants are under culture including *Carex spp., Juncus spp., Scripus spp.,* and *Eleocharis spp.* The future for constructed wetlands is high because a variety of other municipal and agricultural wastes can be biologically treated and nurseries will be asked to produce planting stock for these projects.

Ecosystem restoration: Restoring damaged ecosystems is another obvious market for plant materials from forest and conservation nurseries. Exciting changes are starting to occur. For example, micropropagation technology is being used to produce plants for fire rehabilitation. For example, frequent fires have changed the dominant species composition on rangeland in southern Idaho by eliminating native shrubs, such as bitterbrush and mountain big sage, and favoring weed species. The Forest Research Nursery at the University of Idaho is propagating two species of bitterbrush that are "fire resistant." They sprout readily after fire. Using the latest technology, seedlings of these special ecotypes are being mass produced and will eventually be used to help restore these degraded rangelands.

Enhancing wildlife habitat: Natural resource managers are beginning to manage habitat for many nongame species, especially those which are threatened, sensitive, or endangered. When the objective is to reestablish a functioning, self-sustaining ecosystem, key plants must be identified, propagated, and outplanted to create a community with specific compositional and structural features. For example, riparian habitat along the San Luis Rey river in southern California is being restored to encourage the recovery of an endangered bird - the least Bell's vireo. Restoration ecologists carefully surveyed the plant community, then contracted with nurseries to produce stock for the project. Six different trees and a variety of other plants were propagated. Initial surveys indicate that the project was successful as pairs of least Bell's vireos have been spotted in the restored habitat.

"In an effort to increase biodiversity levels, natural resource specialists are using nursery stock for innovative planting projects..."

Rehabilitation of recreation sites: Recreation is one of the most rapidly-growing uses of wildlands and due to resource damage at many high-use sites, rehabilitation has become necessary. Recreation sites in quaking aspen stands are a notable example. Although aspen trees are highly desirable from an aesthetic viewpoint, they have thin bark and are easily damaged by campers. Fungi invade the wounds, causing cankers and killing the trees. In Colorado, campgrounds in aspen stands are being rehabilitated by interplanting with conifer stock. Increasing the plant diversity of these stands makes them more resistant to camper abuse and subsequent pest problems.

Forest health: The forest health issue will undoubtedly have a profound impact on how we manage our forests in the future. The role of forest and conservation nurseries has not been fully realized yet, but nurseries are already participating in several projects. In the Deschutes National Forest in central Oregon, over 750,000 acres of lodgepole pine forests have been decimated by the mountain pine beetle. Absence of fire in the Blue Mountains in Northeastern Oregon has also converted many stands from open savannahs of large ponderosa pine to thickets of smaller Douglas-fir and grand fir that are being defoliated by the western spruce budworm. Forest managers realize that they need to lower stocking levels and increase species diversity by converting these stands back to pine and western larch. Unfortunately, letting natural fires burn or using prescribed burning could severely damage the existing trees because of the high fuel loads that have developed. In addition, air pollution concerns make large scale burning politically unacceptable in many areas. Salvage logging and thinning will solve the stand density problem, but increasing stand diversity will require interplanting and underplanting. The public will not want to wait decades or even centuries for natural reproduction, so planting nursery stock will be the fastest and most efficient way to increase species diversity. Creating landscapes with a mosaic of different species and age classes will increase overall forest health and will help lower the potential for disastrous pest outbreaks.

As you can see, forest and conservation nurseries are being asked to play a greater role in implementing biodiversity and ecosystem management programs. They are willing and able to respond to any need for plant materials for a wide variety of natural resource uses. Although nurseries have been traditionally associated with timber management and reforestation, they should be viewed in a wider context — as a vital part of all vegetation management activities.

Source: adapted from Biodiversity and Ecosystem Management: The Role of Forest and Conservation Nurseries, Landis, T. et al, 1992 Proceedings, Western Forest Nursery Association GTR RM-221.

Bug Killing Cherry Trees

The benefits of trees are many — but cherry trees that kill insects? It's true, according to Montana State University professor George Evans. Evans was experimenting with black cherry trees, a species that is being found to prosper when planted in dryland areas of the inland Northwest, just as it does naturally in the wetter areas of the Midwest and East. To his surprise, Evans found the cherry leaves in his experimental plots relatively untouched compared with the leaves of other trees that had been munched by hordes of grasshoppers. More surprising, he found grasshoppers around the cherry trees laying on their backs kicking or already dead. Apparently the leaf of black cherry is toxic to grasshoppers. Preliminary surveys indicate that four of five grasshoppers unlucky enough to ingest the leaf end up in grasshopper heaven.

Source: Arbor Day, January/February, 1991