Inside Agroforestry

USDA

Forest Service, Rocky Mountain Research Station
Natural Resources Conservation Service

Is Agroforestry a Solution to the Southeast's Poultry Waste Overload?

This alley cropping system of double rows of 12-year-old loblolly pine separated by 30 foot alleys of fescue grass at the University of Georgia Dempsey Research Farm in Griffin, Georgia serves as a test site for the disposal of poultry litter.

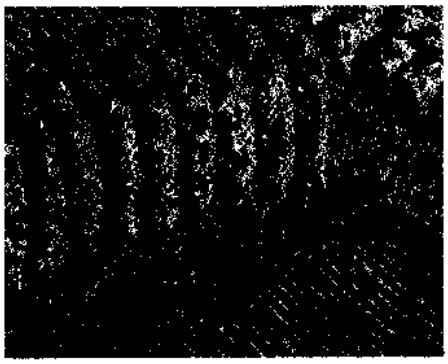
Sixty percent of the poultry that reaches our tables, or is consumed following a drive through one of our popular fast food restaurants, is produced in five southeastern states: Alabama, Arkansas, Georgia, Mississippi, and North Carolina. This adds up to an annual production of over 19 billion pounds of broiler chicken — and just under 50 billion pounds of litter. Since many poultry production facilities are concentrated on small farms having limited acreage, disposal of this waste is a common problem.

Poultry litter contains high levels of nitrogen, phosphorus, potassium, calcium, magnesium, and many trace elements. This valuable source of nutrients has the potential to support crop production, as well as enhance the chemical and physical properties of soil. Currently, about 90 percent of the poultry litter produced is applied to agricultural land as a low cost alternative to mineral fertilizers, while the remaining 10 percent is used primarily in animal feed. However, the crop and pasture lands within this poultry producing region are approaching full utilization. The continuous application of poultry litter can result in excessive nutrient loads which can have negative environmental consequences. For example, a study conducted in Georgia found that four percent of domestic wells, less than 100 feet deep, in poultry producing regions were contaminated with nitrate. Continuation

(See Poultry on page 3

Editor's Note... *IA* Focus is "Special Applications"

This issue of Inside Agroforestry focuses on "special applications" of agroforestry. Special application practices are tree and shrub plantings that may be used to help solve special farm concerns such as disposal of animal wastes and filtering irrigation tailwater. Some may also produce a short- or long-rotation woody crop. Special multi-row "timberbelts" can be managed both to protect crops or livestock and to produce hardwood timber or a short-rotation woody crop for fuel or fiber. All agroforestry practices can be enhanced to provide wildlife habitat too.



Christmas trees.

Inside This Issue

Comments from the Center Leadership

A commentary on the status of agroforestry as reported by NRCS Lead Agroforester, Bruce Wight

Expanding the Boundaries of Agroforestry

We all have first impressions of the benefits of the different agroforestry practices. For example, when we think of windbreaks, we may first think of wind erosion or crop protection. But, have you thought about using windbreak technology to reduce noise or odors? Silvopasture is normally designed for producing both forage for livestock as well as wood products. But, how about designing that same tree and grass area for quail management? Special applications may also include using agroforestry practices for multiple purposes. Windbreaks could be designed for both wind protection and also include species that could be harvested for some product. In Australia and New Zealand, this type of application is called a "timberbelt." A silvopasture, alley cropping, or windbreak system could also be used for applying wastewater from livestock facilities, irrigation return flows, or municipal waste treatment. These are all "special applications" of different agroforestry technologies.

We hope this issue will stimulate your own thinking about how agroforestry and its related technologies might have "special applications" in your own area. ...Remember, keep your blinders off and your mind open when thinking about agroforestry.

—Bruce Wight

This issue of *Inside Agroforestry* is devoted to examples of "new twists" to familiar agroforestry applications. Livestock waste utilization is a continuing and growing challenge. The agroforestry projects from Idaho with dairy wastewater and the use of poultry litter in Georgia are both testing new alternatives to make the best use of the wastewater and/or nutrients from these livestock facilities while also providing either resource protection and/or an economic product.

These special applications vary from being very conceptual to proven. For example, using trees to help modify odors from confined livestock facilities is still conceptual. This idea has been raised numerous times privately and in state legislatures. We at the National Agroforestry Center realized there was not enough information available to say that specially designed windbreaks or other tree plantings could help with this concern. Consequently, we are collaborating with Iowa State University to examine the feasibility. In contrast, the use of trees and shrubs as visual screens between livestock facilities and suburban neighbors is a proven approach. One hog producer told me his windbreak helped, at least psychologically, with his neighbors. The trees showed his good faith in trying to be a responsible neighbor. He thought the theory "Out of sight, out of mind" might work in his situation.

We hope this issue will stimulate your own thinking about how agroforestry and its related technologies might have "special applications" in your own area. If you have examples of other creative applications of agroforestry technologies, we would like to hear from you. Remember, keep your blinders off and your mind open when thinking about agroforestry.

Greg Ruark, NAC's New Director

Dr. Greg Ruark has been selected as the Center's new Director.

Ruark comes from the Forest Service's National headquarters in Washington, D.C., where he served as a member of the Policy, Planning, and Information Research Staff. Since joining the Forest Service in 1985, he has worked at the Southeastern Research Station in North Carolina, and with the Forest Environment Research Staff in Washington, D.C. In addition, he spent 16 months with the Office of Science and Technology Policy at the White House.

Ruark is co-author of the United Nations Global Biodiversity Assessment - Summary for Policy Makers, and has been a U.S. negotiator for forest biodiversity issues. He is also co-author of the USDA Sustainable Agriculture Working Group Report of 1996, and is a member of the USDA Interagency Agroforestry Working Group.

Ruark holds B.S. and M.S. Degrees from the University of Massachusetts, and a Ph.D. from the University of Wisconsin in soil science and forest ecology.

Ruark, his wife Ginny, and their two children will be moving to Lincoln, Nebraska in June.

Dr. Greg Ruark, NAC Director.

"Leaf" The Noise Out

Sometimes it's called racket, clamor, commotion, or clatter. Whatever you want to call it, noise can be a problem because it's an unpleasant, unexpected, or undesired sound. It can be loud, it can be low. It can be harsh, it can be soft. No matter what, if it's undesirable, it's noise. Noise can cause anxiety, tension, or even illness and many people are looking for ways to alleviate the problem.

Picture this. Suppose you had been living in a relatively quiet area for years when a new four-lane road was built near your home. The noise rises to uncomfortable levels. It's worse at night when there are less background noises that normally temper the sounds. You are aggravated and annoyed. You have two choices, you can move or you can try to control the noise to a tolerable limit. Let's discuss the latter scenario and see if there might be some way we can control the noise and improve the aesthetics of the neighborhood at the same time.

Trees and shrubs to the rescue? Plant "noise buffers." Yes, there is potential for plants to help but the species selected (type, foliage, shape, density, etc.) and the planting design used must be chosen carefully/correctly. Trees and shrubs can reduce noise five to ten decibels (reduces noise approximately 50% to the human ear). "Rules of thumb"or generalized recommendations to reduce noise with tree/shrub plantings include:

1) For best results plant close to the noise source rather than close to area to be protected.

2) When possible use taller plants with dense foliage

3) Plant trees/shrubs as close together as the species will allow and not be overly inhibited.

- plant foliage should persist at ground level and up.

4) Evergreen varieties will give better year- round protection.

5) To reduce heavy vehicle noise in suburban or rural areas plant:(see graphic).

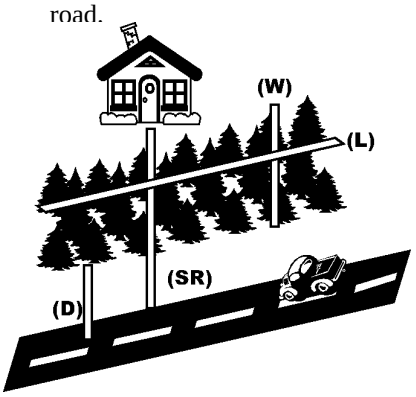
- 65-100 foot-wide belts of trees (W).
- edge within 60-80 feet of road center (D).
- center trees should mature at a minimum of 45 feet tall.

6) To reduce noise of moderate traffic in communities plant:

- 20 - 50 foot-wide belts of trees (W).
- edge within 20-50 feet of road center (D).
- use 6-8 foot shrubs next to road and back up tree rows to a minimum of 15-20 feet tall.

7) The length of the buffer (L) should be twice as long as the distance from source to the recipient (SR).

- The buffer should also extend equal distance both directions parallel to road.



Trees and shrubs can buffer noise effectively. Make certain the soils will support plants effectively and that the plants chosen are compatible with the site and their intended use.

(Poultry from page 1)

and expansion of the industry will depend on the development of alternative uses for poultry litter.

Fortunately, the poultry-producing region of the Southeast is also one of our most important wood producing regions. A tree and pasture system which combines fescue grass and pine trees may be a useful alternative to the application of poultry litter to crop or pasture land. Computer simulations suggest that less nitrogen would be leached from such a system than from either crop land or pasture and that income from sale of pine stumpage may be gained with little loss in pasture production. Unfortunately, little experimental information is available with which to test these simulation results.

In 1997, a unique study was launched by researchers at the University of Georgia with support from the National Agroforestry Center and the U.S. Poultry and Egg Association. Professors Larry Morris of the Daniel B. Warnell School of Forestry, Miguel Caberra of the Crop and Soil Science Department, and Parshall Bush of Cooperative Extension, along with graduate student Vineta Terauds, are collaborating on a project to investigate use of poultry litter in pine plantations and in agroforests. Three systems are being evaluated and compared: fescue pasture, pine plantation, and pasture with trees. This latter system consists of double rows of planted loblolly pine separated by 30 foot alleys of fescue. Uptake of nitrogen by the pines and grass, losses through ammonia volatilization and denitrification, soil accumulation, and leaching are being assessed following different rates of litter application. Results from this study will be used to calibrate models of nitrogen dynamics and to evaluate management costs and potential revenue from the three management systems.

For more information, contact Larry Morris at *lmorris@arches.uga.edu.*

References: "Land Application of Livestock and Poultry Manure by C. Hammond, B. Segars, and C. Gould., "Poultry Manure Management: Environmentally Sound Options," by P.A. Moore Jr., T.C. Daniel, A.N. Sharpley, and C.W. Wood., and "Nitrate Contamination of Domestic Wells in Georgia" by A.W. Tyson, P. Bush, R. Perkins, and W. Gegars.

Applying poultry litter to agroforestry plantings has a promising future. Here a student assistant collects intact soil cores with a Gidding's probe from a pasture receiving experimental applications of poultry litter.

Poplar Plantation to Help Dispose of Dairy Production Wastewater

Though still in the planning stages, efforts are being made to improve Patty and Jim Weirsma's dairy production facility in Buhl, Idaho through an innovative, special application of agroforestry. The windbreaks planted in March have begun to bud and will eventually provide noise and odor control, and protection from winds. But the block of poplar trees to be planted just south of the dairy operation in the next few months is where the special application lies.

According to Rich Yankey, NRCS District Conservationist in Twin Falls, Idaho, this 15 to 20 acre plantation-style planting will contain several varieties of poplar clones in an effort to find the best ones for the southern Idaho climate. The primary reason for the planting will be a testing ground for applying dairy wastewater. This system will mix dairy wastewater with irrigation water, being careful to find the right mix and not overload the poplars with nutrients.

"Poplar trees were selected because they have the ability to use large volumes of water and nutrients," Yankey said. "By having the poplars use the nutrients, there is less chance for polluting groundwater."

Due to the lay of the land and the location of the waste storage pond, coordinators have found the irrigation system to be a challenge. "The lagoon, unfortunately, is downhill from the woodlot," Yankey said. "Hence, the wastewater will be pumped through a pipe across the road. It will go around most of the corrals and buildings. After it crosses the road, it will be piped to the upper end of the woodlot. It will exit the pipe into a structure which will also have access to irrigation water. In that structure, we can mix the wastewater and irrigation water together." *(See graphic.)*

This demonstration may be one of the first of its kind. According to Yankey, using poplar trees for recycling nutrients has been used in other industries but has not yet been used by dairies.

The project, when on the ground and fully functional, will provide benefits of visual screening and odor control and will offer an environmentally acceptable use for the dairy wastewater. In addition, the fast growing poplars will be harvested to produce products such as pulp, firewood, or small pieces of lumber for molding. The product chosen for production will determine the length of time before the first harvest.

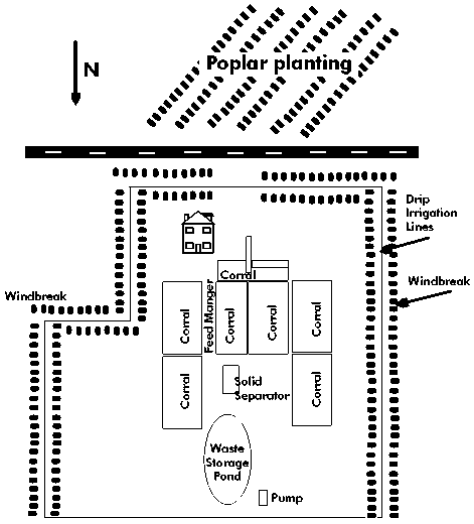
"This is the key point of this project, to determine what is the best product to produce, what are the estimated returns, and how much can be spent on the investments," Yankey said. "Those are the things we are hoping to learn from the project."

"This is very much in the experimental stages," Yankey said. "We will be trying to get into a cycle where we will have some newly-planted young trees, some mid-sized trees still growing, and some mature trees ready for harvest."

Yankey says that the poplars have a very rapid growth rate. They usually grow 3 to 4 feet in height the first year and an additional 4 to 6 feet each year thereafter.

Additionally, Yankey said that this project is function-first. "One thing that dairies have to do *now* is properly dispose of their wastewater, even though a lot of the economics are not now known."

Because of innovative thinking and thoughtful planning, it is likely that the Weirsma Dairy project will be a successful special application of agroforestry. The dairy has not only found a way to dispose of the wastewater, but could earn additional income from the project.



Weirsma dairy production facility. Note the waste storage pond and location of poplar planting.

Don't Forget About Our Displays...

The Center has three portable displays for you to use on a loan basis. The only cost to you is shipment to the next user. They are wonderful informational aids to use at meetings, fairs, workshops, field days, or just in your office. Two Working Trees for Agriculture Displays and One Working Trees for Communities Display are available. They all have an accompanying brochure.

Contact Clover Shelton for more information or to reserve a display at 402-437-5178 ext. 14.

Poplar Trees May Be One City's Solution to Meeting Regulatory Requirements

by Jeff Nuss, Agricultural/Water Resource Engineer, CH2MHill, Portland, Oregon

State of Oregon regulations that restrict summer discharge of city treatment plant wastewater into streams have been recently revised. The new regulations have placed challenges before several municipalities and private companies. They must look to other, cost effective means of effluent management and disposal.

The City of Woodburn, Oregon is dealing with this challenge by developing a "special agroforestry application" project. City planners have designed a long term strategy that considers effluent/biosolids an asset, not a liability. By recognizing the value of biosolids, planners looked to ways to use them for profit and dispose of them at the same time. In 1995, city planners developed a seven-acre "poplar tree reuse system" demonstration and test site. Over the past three years the demonstration has been in operation, evaluating the viability of the system and analyzing design criteria.

Using information gathered from the demonstration project and recommendations from the state regulatory agency, a preliminary, full scale poplar tree reuse system design will soon be implemented. Plans call for the first stage of development to take place in 1999. It will consist of adding an additional 80 acres of poplars to the present demonstration site. Additional developments will occur in five increments, each adding 60 to 70 acres to the site. Over the next 20 years the project is expected to cover 325 acres.

Each year during July and August, the Woodburn Wastewater Treatment Plant (WWTP) will discharge a sizeable portion of its effluent to the poplar plantation instead of to the Pudding River. By utilizing the poplar tree reuse system, the WWTP will be disposing of its effluent in a safe, effective, economically-sound manner while still meeting the State's wastewater load restrictions for the river.

In addition to the effluent, biosolids and yard debris will be applied to the plantation providing additional nutrient requirements of the poplar tree system.

Finally, as a part of the overall plantation management strategy, the poplar trees will be harvested and replanted on a seven to 12 year cycle. The trees will be chipped and sold on the wood chip market to be used as fuel, pulp, or strand board. The revenue will help defray plantation capital investment and operating costs.

Residents of Woodburn have used a very progressive and innovative approach to solving their wastewater problem. They have successfully brought the sciences of civil engineering, agricultural engineering, and agroforestry together. Through this effort the city is developing a natural treatment system that produces a renewable resource (timber), cleans water, recycles nutrients, reduces costs to taxpayers, and adds aesthetic value to the area.

Wastewater is applied through a sprinkler system to the city of Woodburn, Oregon's poplar wastewater reuse demonstration site, which is in the beginning of its third year of operation.

New VIDEO Now Available on a Loan Basis

Agroforestry: Agriculture and Forestry Working Together

Presentations given by specialists cover each of the five types of agroforestry practices. Each module is 8 to 12 minutes long.

Working Trees for LIVESTOCK Brochure

New! Estimated arrival Fall, 1998. This brochure discusses how trees and livestock compliment each other economically, environmentally, and aesthetically.

Working Trees for WILDLIFE Brochure

We are in the early planning stages of producing this brochure. It will discuss how agroforestry plantings can be enhanced for wildlife.

Contact Nancy Hammond for more information at 402-437-5178 ext. 11.

Make Wildlife More Than A Consideration in Agroforestry

by Wendell Gilgert, Wildlife Biologist, USDA NRCS Wildlife Habitat Management Institute, Fort Collins,Colorado

Well designed plantings of trees, shrubs, grasses, and feedgrains provide havens for wildlife, especially in areas dominated by agriculture. Vegetation provides necessary food, shelter, and breeding and nesting sites.

Agroforestry is growing trees and shrubs in combination with crops, forage, or livestock. Often times agroforestry plantings on the farm or ranch that are intended to serve a specific function, like a field windbreak or an alley cropping system can also provide or improve wildlife habitat.

While incorporating wildlife habitat is encouraged during the planning phase of establishing any agroforestry practice, it takes a concerted effort on the part of the land manager to insure that specific fishery and wildlife needs are recognized. The assumption that because trees and shrubs are planted, wildlife habitat is automatically created, often is not true. A planting that consists of one or a few species of trees or shrubs will likely be used by wildlife generalists like crows, starlings, robins, or jays, but the needs of a variety of wildlife species lacking critical habitat will not be met.

Basic knowledge of wildlife habitat requirements assumes that three basic needs have to be met: reliable water, food, and cover. Careful planning, coupled with a wildlife needs assessment provided by state fish and wildlife or NRCS biologists, will provide specific habitat needs for a variety of wildlife at little or no extra cost to your proposed agroforestry project.

Water

Water for wildlife can be provided from a variety of natural and artificial sources. Wildlife is known to travel long distances for a reliable source of water. The closer the source is to the habitat or cover the more likely the habitat you create will support more diverse and higher populations of targeted species.

Food

Food resources can be a direct result of tree and shrub products like berries, seeds, and nuts, or they can be indirect sources like insects or other invertebrates, moss, or lichens. The kinds and variety of trees and shrubs will dictate which food resources are available. In riparian corridor plantings, planning for closer proximity of the trees and shrubs to the watercourse will enhance the chances for greater variety and volume of insects for the stream fishery.

Cover

The variety of trees and shrubs planted will directly affect cover types. Wildlife cover is often thought of in generic terms. In fact, there are very specific cover types to suit daily and seasonal needs of specific wildlife. Various cover types can be planned for, planted, and managed to maximize wildlife use. Depending on the agroforestry practice, use of trees as an overstory, shrubs as an understory, and a mixture of grasses and forbes as ground cover can provide several cover types in one location. Examples of cover types and more specific uses include:

Nest cover: A number of birds, small mammals, and insects, use trees and shrubs for nesting. Not only are the branches and leaves utilized but as the tree stand ages, or suffers damage from disease, fire, lightning or wind, cavities will be created that will also be utilized.

Brood cover: Once critters are born, cover to raise and nurture young to maturity takes on various forms. Some raptors need trees with a more open canopy, while a variety of songbirds need closed canopy or heavy brush for brood cover.

Roosting Cover: For every type of agroforestry structure, overstory and understory, there will be birds that will use them for roosting.

Escape Cover: Because agroforestry practices tend to be linear, the adjacent landuse as well as the size and extent of the practice will dictate escape cover value. All wildlife have need for escape cover. In riparian buffer plantings, trees, limbs, and branches that fall and remain in the stream provide valuable escape as well as loafing cover for a variety of fish.

Loafing Cover: Wildlife need areas where they are able to spend time in relative safety from predators and human disturbance. These areas are yet another of the habitat types essential for attracting and maintaining wildlife diversity.

Thermal Cover: In areas where there are great daily and seasonal variations, thermal cover is much more important than in mild climates. Protection from temperature variation, wind, and storms are essential in harsh environments.

While each particular species of fish or wildlife has a variety of needs, it is doubtful that any individual agroforestry practice will fill all of the habitat requirements. Nonetheless, properly conceived and applied, the practice or practices that are applied can meet or exceed a land manager's production objectives, while at the same time meeting multiple fishery and wildlife needs with little or no added expense. To meet wildlife needs we must design for them.

Windbreaks Could Help Manage Pesticide Drift

Windbreaks have long been recognized for their ability to help control soil erosion and protect crops. And, pesticides or crop protection agents for agriculture have also been a documented success story. However, the increased controversy about pesticides in the environment, plus the increasing urban nature of our farmlands, has resulted in questions about the impact of off-target movement of pesticides occurring as drift from atomized sprays. The attention given to the 1996 Farm Bill regarding agricultural air quality and problems of urbanization suggest that we have both the urgent need, and unique opportunities, to resolve these issues.

The Laboratory for Pest Control Application Technology (LPCAT), headed by Dr. Frank Hall at Ohio State University is a unique multidisciplinary laboratory focusing on pesticide use/impact assessment analyses, pesticide drift assessments using biomarkers, user risk reduction scenarios, and some new computer models assessing pesticide capture efficiency of airborne droplets by various structures/objects. According to Hall, the International Windbreaks symposia have identified tree, and other vegetative species, as valuable assets for spray drift intrusions. However, little organized data has been collected on spray capture efficiency by windbreak species, morphological parameters, plant geometries, porosity characteristics, or atmospheric and delivery system interactions from sprayed fields or orchards.

Hall's research involves interesting tracking studies on biological materials including needles (which have high capture efficiencies) and non-target organisms such as insect larvae, beetles, and bees, both flying and at rest. Needles, because of their physical characteristics, are very effective collectors of small particles, as are the wings of an insect in motion. On-going cooperation by Hall's laboratory with research colleagues in Australia, New Zealand, England, and Germany are aimed at identifying current, practical windbreak research studies that develop practical guidelines for tree heights, species, and windbreak porosities to be used as buffers in areas adjoining water and agricultural systems like field and orchard crops.

Currently, Hall is cooperating with USDA-NRCS on a global literature review for both historical and active research data on windbreaks and pesticide capture efficiency. Additional attention is being given to airflow disruption (hence pesticide drift mitigation) by downwind vegetation, and the potential to modify spray application delivery systems in high risk areas like adjoining water or houses. These studies are predicted to allow development of practical recommendations for windbreak plantings appropriate for adjoining agroforestry and agricultural operations. With increased concern about pesticides in the environment, this research thrust to utilize windbreaks/buffer zones as a cost effective risk reduction strategy is clearly one which needs to be more fully researched. Hall says, "A well-overdue series of studies which could be adapted in a wide variety of agricultural and forestry conditions by proactive farmers and foresters alike -- specific knowledge is our limiting parameter here."

For more information or interest in participating in the program, contact Dr. Hall at *Hall.1@osu.edu.*

North American Conference on Enterprise Development Through Agroforestry:

Farming the Agroforest for Specialty Products

October 4-7, 1998
Minneapolis, Minnesota

Increasing numbers of landowners and farmers across North America are interested in the emerging agroforestry practice of "forest farming" — the intentional production of valuable specialty forest products in agroforestry systems. And, for good reason. Producing specialty forest products in agroforestry systems can increase and diversify income, increase wildlife, diversify farms and landscapes, and create new opportunities for rural development, all the while protecting soil and water resources. *Agroforestry practices include windbreaks, riparian forest buffers, alley cropping, silvopastoral plantings, and forest farming.*

This international conference/trade show will provide participants with an opportunity to learn and share experiences about "cultivating" ("forest farming"), processing, marketing and retailing specialty forest products grown in temperate agroforestry systems. Sessions will focus on three major areas of specialty forest products intentionally produced through forest farming:

1) Botanicals and Medicinals (ginseng, goldenseal, witch hazel, balsam gum, black cherry bark, Mandrake root, bloodroot, and many others.)
2) Decorative and Handicraft Products (decorative greenery, cones, dried florals, ornamental plants and plant parts, decorative wood products, and many others.)
3) Forest-based Food Products (nuts, berries, herbs, oils, extracts, honey, syrups, gums, mushrooms, fruits, flavor and smoke-woods, game animals, and many others.)

Sessions will emphasize production systems, markets and marketing, and financial and environmental costs and benefits. Many practical "how-to" workshops on production and marketing also will be offered.

For more information or to be added to the mailing list, contact: Scott Josiah, CINRAM, Phone 612-624-7418; e-mail CINRAM@forestry.umn.edu

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Upcoming Events

June 22-23, 1998
Windbreak Renovation Workshop, North Platte, NE. Contact, Jon Wilson, 308-532-3611.

June 23-26, 1998
Plains & Prairie Forestry Association Annual Meeting, North Platte, NE. Contact, Dennis Adams, 402-472-5822.

October 4-7, 1998
North American Conference on Enterprise Development Through Agroforestry: Farming the Forest & Agroforest for Specialty Products, Minneapolis, MN. Contact, Scott Josiah, 612-624-7418.

October 19-21, 1998
Southern Agroforestry Conference, Huntsville, AL. Contact, Dr. Phil Cannon, 256-851-5462.

We Need Your Help...

Thank you for your help...our mailing list has been updated. To ensure that our list is correct and that our *Inside Agroforestry* and *Agroforestry Note* mailings reach you in a timely manner, take a moment to look at the address printed below to be sure it is correct. If not, please fax your correction to 402-437-5712.We hope that you enjoy *Inside Agroforestry and Agroforestry Notes.*

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Mission

The National Agroforestry Center (NAC) is a partnership of the USDA Forest Service and the USDA Natural Resources Conservation Service.The Center's purpose is to accelerate the development and application of agroforestry technologies to attain more economically, environmentally, and socially sustainable land-use systems. To accomplish its mission, the Center interacts with a national network of partners and cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.

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