

... Including The Carbon Sink

Daily newspapers, professional journals, and the popular press regularly carry articles about global climate change, global warming, greenhouse gasses (GHGs), CO₂ emissions, carbon sequestration, carbon credits and the Kyoto Protocol. Some people question if these issues are substantive or just environmental hype. Either way, what is the role of one natural resource professional or landowner in this global debate? Well, we hope that this issue of *Inside Agroforestry* helps to explain some of the components making up the carbon debate and where they're headed.

As the Carbon Story unfolds it is important to remember that the primary focus of producers and resource professionals

Trees, shrubs, grasses, and soil serve as carbon sinks, storing atmospheric CO₂. In addition to conservation benefits, agroforestry practices help increase the global carbon sink capacity, curbing the overflow of excess emissions.



remains profit and natural resource management, not carbon storage. Even so, financial credit for storing or "sequestering" carbon in soils, grasses, trees, and shrubs may become an important factor in helping landowners achieve both economic and conservation goals.



Working Trees: Windbreaks for Carbon in the U.S.



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Greg Ruark, NAC Director

Farmers use windbreaks to accomplish a multitude of objectives. Among these are the reduction of crop water stress to improve yield and quality, reduction of soil erosion, snow management, livestock protection, odor control, wildlife habitat provisions, and energy conservation around farmsteads.

If society is looking for places to store carbon, windbreaks are an obvious choice. Since a large number of landowners already appreciate the value of a

windbreak for the many benefits listed above, many are interested in discussing ways to get financial assistance for planting and maintaining a windbreak that was also designed to optimize carbon storage. The simple fact that many landowners are motivated to establish windbreaks for their own purposes, suggests that these plantings would remain in place for a long time. Due to the extensive agricultural land base, especially in the North Central U.S., large amounts of carbon can be stored by integrating more windbreak plantings into the agricultural landscape.

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NAC Director's Corner

A commentary on the status of agroforestry by Center Director, Dr. Greg Ruark

Agroforestry and the Carbon Cycle

International concerns over the increasing atmospheric carbon dioxide level and its potential effects on climate has grown dramatically in recent years. The discussions are complex and for some aspects contentious. Numerous bills are being drafted in the U.S. Congress that raise options for payment to farmers for carbon related activities (www.thomas.loc.gov). In America some private sector utilities companies are already actively purchasing carbon in the agriculture and forestry sectors (www.carboncenter.net). This issue of *Inside Agroforestry* focuses on the carbon debate and its relationship to agroforestry.

Carbon based energy sources like coal, gas, and oil all originated from the conversion of sunlight energy by plants. A dominant consideration for rebalancing the global carbon cycle is to find ways to promote the increased growth of trees and shrubs. Since agricultural activities occur on approximately half of the land in the contiguous U.S., much of the opportunity to sequester carbon can occur through agroforestry opportunities on farms and ranches.

Windbreaks – Windbreaks store carbon while also protecting farmsteads, livestock, roads, people, soils, and crops. Field windbreaks reduce evaporation and plant transpiration rates such that per field crop yields have been shown to increase for most crops from five to 50 percent, even though a portion of the field has been planted to trees. Research has documented optimal tree planting levels to be from three to six percent of the cropped field area. Additional CO₂ reductions can occur from: lower heating costs for farmsteads, lower cost of snow

removal, reduced need for crop fertilizer, lower winter feeding demands of livestock, and improved water use efficiency

Riparian Forest Buffers – Trees grow rapidly, storing carbon, in riparian zones due to favorable moisture and nutrient conditions. When suitable trees and shrubs grow in these moist environments they can filter out excess nutrients, pesticides, animal wastes, and sediments coming from adjacent agricultural or urban activities.

Silvopasture – Timber/grazing systems managed on the same area of land have been shown to be practical and economically profitable. In areas like the Southeastern U.S., loblolly pine silvopasture systems produce significantly more carbon above- and below-ground when both the tree and grass components are properly managed, than does land managed solely as a pasture or forest.

Short Rotation Woody Crops (SRWC) - Low prices for traditional crops have increased the interest of farmers in fast-growing woody crops, like hybrid poplar and willow trees, for fuel and fiber. These SRWC systems provide a way of increasing on-farm income, while also being designed to treat agricultural, livestock, community, and industrial wastes. The rapid growth of SRWC results in high rates of nutrient uptake and large amounts of carbon storage over rotation lengths as short as five to 15 years. Net carbon benefits are realized if the wood fiber is used for solid wood products or biofuel



www.unl.edu/nac



new look: with MACROMEDIA FLASH
new content: timely topics, site map
new publications: carbon brochure,
AFTA and RC&D reports

NEW Center for Subtropical Agroforestry

A new Center for Subtropical Agroforestry has been created to take on research, extension, education and training activities focused on biophysical, environmental, and economic aspects of agroforestry. The new Center is located at the University of Florida-Gainesville and is led by Dr. P.K. Nair. Several other investigators and collaborators from Universities in the Southeast and the Virgin Islands are partners. The Center will draw upon an advisory committee consisting of representatives from NAC, academic, government, and non-governmental agencies. Landowners will help monitor and evaluate projects.

A Conversation About Carbon Credits



Tim King, Director of Carbon Technology Transfer Center
Janet Kidder, Pacific Rim RC&D Assistant

Editors Note: Numerous utility companies have begun to buy carbon offset credits to make up for their CO₂ emissions. This is a fictitious conversation depicting one of several possible scenarios on how carbon credits may come to be bought and sold. It could take place in Any-Small-Town, America. Imagine Wayne and Art, two landowners, gathering in the café for a morning cup of coffee. In walks Rich, a local Resource Conservation & Development (RC&D) Council Member...

Art and Wayne: Hey Rich. How's winter been treatin' you?

Rich: Pretty good. As soon as the weather breaks I'll be out in the field again.

Art: I've been busy feeding livestock and getting my records together for tax season.

Wayne: Hey, I'm glad we ran into you. What is all this talk about carbon that we keep hearing so much about?

Rich: Carbon, well actually carbon dioxide (CO₂) is one of the gases that is contributing to the greenhouse effect that is changing our climate.

Art: Well, aren't factories and power

plants to blame? What can we do to make a difference?

Rich: Well, they are major contributors, but you and I produce CO₂ emissions just by driving our vehicles and heating our homes. Everyone needs to try and reduce the amount of greenhouse gas they produce. This can be accomplished by burning cleaner fuel and reducing the amount of driving that we do.

Another way you can make a difference is to store carbon so it doesn't get into the atmosphere. Over the years farmers have tilled the soil and cleared permanent vegetation. These practices release large amounts of carbon into the atmosphere. Storing carbon in the soil as organic matter and in permanent vegetation helps limit the amount of CO₂ in the atmosphere.

Wayne: Well, Rich, you know as well as I do that in order to produce a crop we need to till the soil and burn fuel.

Rich: That's right Wayne. But you can store carbon by increasing the organic matter in the soil by switching to farming methods like reduced tillage. Rotating crops and incorporating small grains, and applying amendments, like compost and manure, can also increase the amount of carbon in the soil. All of these can help, but the biggest

gains can be made by planting permanent vegetation.

Wayne: That sounds good, but I don't want to take more land out of production for the good of the environment. I've already done my part.

Rich: Not all of your land is prime farmland. Some of your marginal land would be better off covered with permanent vegetation to reduce erosion. There are numerous agroforestry practices you could use. Windbreaks reduce evaporation and water stress on crops so much that the increased production in adjacent fields often offsets the loss of land to trees and can potentially provide wood products. Riparian buffer strips can help improve water quality in your pond. Some of your drainage ways would be better off in grass to keep those gullies from forming and reducing those repairs you have to make every time you hit them with your farm equipment.

You may also be able to get paid for storing carbon. While there are currently no requirements for companies to reduce CO₂ emissions, some companies are looking at their alternatives. And, one alternative is to "purchase" carbon emission reduction credits (CERC) from people like you.

Wayne: So, big companies may want to buy carbon that is stored on my farm? Now we're talking! How can I start "growing" carbon?

Rich: Companies are already identifying and developing procedures for various management activities and methods that might qualify for CERC's.

If this system comes into being, it looks



With all of this talk about carbon, a key challenge has been to reduce duplication of effort and streamline procedures of operations for carbon producers, sellers, administrators, marketers, brokers, and buyers. The newly formed National Carbon Technology Transfer Center is located in Spokane, WA and its goal is to coordinate this effort. Visit their web site to see how partners from across the nation and internationally are working to achieve this goal. The site also contains a wealth of information on many carbon topics including: growing carbon, carbon sequestration, the carbon cycle, and the carbon offset program.

www.carboncenter.net

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W I L L O W

A Renewable Energy Source Is Growing On Western New York Farms

Carefully selected hybrid willow bioenergy crops help supply fuel that can be co-fired with coal in electric power plants. Renewable energy resources, like willow and poplar can help ease concern about global warming and air pollution, provide rural economic development opportunities by designing alternative uses for farmland, and reduce the need to depend on imported energy.

Market

Bioenergy crops are attractive to the power generation industry because they can help reduce emissions at the power plant. Co-firing wood with coal reduces sulfur emissions, and under certain conditions can also reduce nitrous oxide emissions. Willow biomass crops are considered carbon dioxide neutral because the growing crops absorb as much CO₂ as is released during production and burning of the fuel. This aspect will become increasingly important with the increasing concern over global warming and the need to constrain levels of atmospheric carbon.

Why Willow?

Many people perceive that willow is not a good choice for firewood and question why it would be grown for fuel. While willow does not compare well on a volume or per cord basis to other woods such as maple and beech, it does in fact provide as much energy or BTU's on a weight basis. So, although it is not a good choice for a wood stove (which would require frequent loading), it is an excellent choice as a fuel crop for power plants.

Willow trees have been selected for their ease of establishment, rapid growth, strong coppicing ability (the stumps resprout when cut), and disease resistance. Once established, willows fully occupy the site and are a low maintenance crop compared to annual crops. Coppice harvesting every three years allows multiple harvests from the same rootstock, so fields do not have to be replanted for 21 years or seven harvests. Willow crops produce five to seven oven-dry tons per acre per year, or 15 to 21 oven-dry tons per acre at harvest. These advantages make willow a promising bioenergy crop.

Willow Biomass as an Energy Source

Willow biomass is a clean, versatile wood energy source with potential as a fuel for generating electricity. It can be burned directly, co-fired with coal, gasified for use in gas turbines, or converted into liquid fuels. For every unit of energy invested in the production and conversion of willow biomass to electricity, 20 to 30 units of energy are produced. Willow's ability to effectively capture and convert sunlight to biomass is a major factor in this positive energy balance. The balance could double over the next decade as yields increase and the production system is optimized.

Production System

Willow biomass plantations in New York are adapted from a commercial system used in Sweden, where there are more than 35,000 acres of willow energy plantations. The system is based on double-row plantings of approximately 6,200 trees per acre. Trees are cut after the first year to promote sprouting. Harvesting then occurs every three to four years in the winter after leaves fall from the trees. Modified corn or sugar cane harvesters, or specially designed machines that cut and chip the willows in one process, are used to harvest the crop. Plants resprout following each harvest, which makes willow biomass crops perennial with a life span of about 20 years, or six to seven rotations.

Other Benefits

Willow crops can also provide multiple non-market benefits. Cornell University's Department of Ornithology is conducting studies on bird diversity in willow crops. Thirty-four bird species have been seen and seven of these have been found nesting in the willow plantings. Harvesting occurs in the winter months when birds are not nesting. Furthermore, willows attract successional species, birds that choose habitats of fields changing into forest. These birds are accustomed to finding new nesting sites every few years or even every season.

To Find Out More

Visit SUNY College of Environmental Science and Forestry's Willow Biomass web site: www.esf.edu/willow. For more information on the Willow Bioenergy Project, contact Stacie Edick, Biomass Field Representative, stedick@nynorwich.fsc.usda.gov.

Three-year-old willow on seven-year-old rootstacks. Photo courtesy of SUNY-ESF.

Article adapted from "A New Renewable Energy Source Growing On Western New York Farms" by Stacie Edick and Tim Volk. The New York Forest Owner Volume 37: Number 5, September/October, 1999. pp 6-8.



Emerging Hybrid Poplar Technologies

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It's not true anymore! When you hear the words "hybrid poplar" they no longer refer to those tall, skinny Lombardy poplars that were once planted for visual screens. No, now days, hybrid poplar usually means cottonwood or aspen. They are the fastest growing, temperate-region, tree species in the world. And, because of their high nutrient uptake ability, poplar plantations are currently being used to treat municipal, industrial, and livestock waste, landfill leachate, and stormwater runoff. All this while being used to store carbon too! Much of the technology is still in its infancy, but that is quickly changing. More information on the benefits of poplars and their many uses follows.



















Poplar Growth

On good sites, hybrid poplar can rival the growth of many tropical tree species. In the Pacific Northwest on deep alluvial soils with ample ground water, hybrid poplars have exhibited height growth of 15 feet-per-year with annual diameter growth averaging 1.5 inches. It is not uncommon for 10-year-old trees on average sites to reach heights of 70 feet and diameters of 12 inches. It is because of these growth rates that hybrid poplars were first used for energy plantations and chip production for paper manufacturing. In the last three years, testing of hybrid poplars has shown that they can also be used for veneer and solid wood products. This information has led some companies and landowners to establish poplar plantations. When grown for these high value products, poplars are usually planted at wide spacing (e.g. 14 feet by 14 feet) and managed with a pruning regime that produces a 20 foot, knot-free log. The economic return from these veneer quality logs can provide substantial income for farmers and landowners even from woodlots of less than 40 acres.

Poplar Breeding

The wide-spread, coordinated breeding efforts by universities, government agencies, and private timber products companies over the past two decades have led to the economic success of hybrid poplar management. Organizations involved in

Common Parents and Hybrids Being Tested and Developed and Their Geographic Suitability.

Common Populus Species	West	Northern Plains	Midwest	Northeast	Southeast
<i>P. trichocarpa</i> (black cottonwood)					
<i>P. deltoides</i> (eastern cottonwood)					
<i>P. trichocarpa</i> (black cottonwood) X <i>P. deltoides</i> (eastern cottonwood)					?
<i>P. deltoides</i> (eastern cottonwood) X <i>P. nigra</i> (European black poplar)					
<i>P. nigra</i> (European black poplar) X <i>P. maximowiczii</i> (Oriental species)					
<i>P. deltoides</i> (eastern cottonwood) X <i>P. maximowiczii</i> (Oriental species)					
 Poplar species suitable	? Looks promising, but too early for recommendation				

hybrid poplar breeding research include the universities of Washington State, Iowa State, and Minnesota, the U.S. Forest Service Institute of Forest Genetics in Rhinelander, Wisconsin, The Department of Energy's Oak Ridge National Lab, and forest products companies like Fort James, WESTVACO, and Boise Cascade.

Poplars and Wastewater

In the last three years traditional forestry use of hybrid poplar has been expanded to designs that provide environmental benefits. Most recently poplar plantations have been used to treat wastewater from dairies, other animal feeding operations, municipal sewage, landfill leachates, and industrial processing. Rapidly growing poplars take up large amounts of water, nitrogen, phosphorus, and other nutrients.

The extensive fine root system provides an ideal filtering mechanism for wastewater. Applying wastewater to hybrid poplars can cost significantly less than conventional engineering treatment methods. The costs are even lower when the trees are later harvested and sold. Wastewater treatment solutions using hybrid poplars are environmentally sound solutions that can improve public relations while also enhancing aesthetics and reducing odor.

Poplars and Carbon

Poplar plantations are starting to receive attention as a method to absorb and store carbon (referred to as carbon sequestration). While all green plants are capable of sequestering carbon through photosyn-

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Carbon dioxide (CO₂) in the atmosphere helps keep the earth warm by trapping the sun's energy and slowing its escape back into space. This heat trapping ability is called the "greenhouse effect", and it is necessary to prevent the earth from becoming inhospitably cold. Although the largest concern is over CO₂, several gases are known to trap heat. In the past 150 years since the beginning of the industrial age, the level of atmospheric CO₂ has risen at an alarming rate. Carbon dioxide is produced whenever fossil fuels, such as coal or oil, are burned in power stations or gasoline is consumed in cars. America, with four percent of the world's population, accounts for a quarter of the world's total emissions. Since

1850, concentrations of CO₂ have increased from 285 to 366 parts per million, or nearly 30 percent.

There is scientific consensus that the high CO₂ level is beginning to trap more heat. Historical records constructed from ice cores, tree rings, and fossils document that the average global temperature has risen more in the last century than at any time in the past 10,000 years. Although there is little dispute that an increase in global temperature will alter climate, the specific impacts are greatly debated. Some regions could be affected more than others and many scientists feel that the occurrence of extreme weather events

the



The United Nations Framework Convention on Climate Change (UNFCCC)

In 1992, at what has been termed the "Earth Summit" in Rio de Janeiro, Brazil, the U.S signed onto the United Nations Framework Convention on Climate Change (UNFCCC) along with about 170 other nations. The U.S Senate later ratified the UNFCCC, thereby giving it treaty status and making it a legal commitment under U.S. law. However this Convention merely called for non-binding actions. The UNFCCC has both political and science components.

Conference of Parties (COP) - This is the policy and decision-making body of the UNFCCC. Initially the COP approach was to call upon nations for non-binding actions and general goals. However, this approach has proven to be inefficient. As the science underlying global climate change has become more definitive, the COP has moved to negotiate legally binding commitments of specific reduction targets and timetables for each nation.

Intergovernmental Panel on Climate Change (IPCC) - This is the science advisory body of the United Nations and it provides technical support to the COP. It was established in 1988 by the United Nations and the World Meteorological Society. It is comprised of over 3000 scientists from around the world and conducts assessments of the current state of scientific, technical, and economic knowledge on climate change, its causes, impacts, and mitigation strategies.

1990
1992
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 2000

1990
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Kyoto Protocol

In their escalating efforts to prompt international action on climate change, the COP met in Japan in 1997 and created the Kyoto Protocol. It calls for industrialized nations to meet targets for reducing greenhouse gas emissions by at least five percent from their 1990 levels for the first accounting period of 2008-2012. The U.S. commitment under the Protocol calls for a seven percent reduction in emissions. Developing countries are exempted from targets for now. To help meet its mandated target an industrialized country could employ the so-called "Clean Development Mechanism", which allows them to produce financial credits to developing countries to invest in emission reduction projects. Although the U.S. has signed the Protocol, the Senate has not ratified it.

The Protocol recognizes that reducing the rate of atmospheric CO₂ level increases can be achieved by both the reduction of activities that consume fossil fuels and by activities that result in the planting of vegetation. Within the Kyoto Protocol there are two primary articles related to forestry and agriculture. They are:

Article 3.3 - refers to direct human-induced land use change and forestry activities, limited to afforestation, reforestation, and deforestation since 1990.

Article 3.4 - refers very generally to human-induced activities and could be interpreted to embrace all other carbon activities related to forest, agriculture, and rangeland. This could include sustainable forest management, storage in forest products, wood recycling, farm tillage methods, and grazing practices.

The most contentious debate is over Article 3.4. The U.S. would like to see mitigation practice, such as increased soil carbon and reduced tillage, included. The U.S is also arguing to have other forestry benefits included, like getting credit for forest management. Countries with large populations relative to their forest and agriculture land base, such as the European Union, see very limited opportunities for activities on farms or in forests, as compared with countries

like hurricanes, floods, and droughts could become more frequent and intense.

There are two ways to manage atmospheric CO₂ concentrations, and both approaches will need to be used extensively to deal with this issue. One way is to reduce the amount of fossil fuel that is used and the other is to increase activities that absorb CO₂. However, even with widespread adoption of both approaches the global concentration of CO₂ will still continue to rise, but will do so at a lesser rate. There is considerable debate revolving around the role of agriculture and forestry in helping to absorb atmospheric CO₂.

Technically, both can increase the long-term storage or “sequestering” of carbon through changes in management practices, like reduced tillage that can increase soil carbon levels and the planting of long-lived vegetation like trees and shrubs.

The debate on the carbon cycle has taken on international importance and has the potential to affect not only the environment, but the economies of nations. To understand the origins of this debate and its potential impacts on agriculture and forestry in the U.S., it is useful to understand the formal organizational structure that has been established internationally to structure the debate, establish policy, and set specific reduction targets and timetables.

full carbon accounting DEBATE: a primer by Greg Ruark

protocol \$ industrial output Kyoto volume \$

like the U.S., Russia, and Canada. A “full carbon accounting” system would allow credit for forests that are relatively young and growing significantly in terms of both wood volume and carbon.

Due to the unprecedented economic growth during the last decade, U.S. emissions from the use of fossil fuels are currently about 16 percent higher than they were in 1990 and are projected to be 30 percent above 1990 levels by 2010. If the Senate were to ratify the Protocol, it would attain treaty status and become a legal commitment under the laws of our nation. As currently written, the Kyoto Protocol does not include targets for large developing countries like China, India, and Mexico, even though they have expanding economies and may soon become the leading emitters of carbon, as well as major competitors in world markets.

Bottom line: The Kyoto Protocol currently allows carbon credit for afforestation and reforestation (planting or replanting of trees and shrubs) that has occurred since 1990 or will occur in the future. Still under debate is whether to allow credit for carbon absorbed due to forest management. Agricultural practices that increase soil carbon levels, like reduced tillage, are also not presently allowed, but are being vigorously argued for inclusion by the U.S. and others. In the final analysis, agriculture and forestry are simply so important to the global carbon cycle, and offer many cost effective ways to offset emissions from the continued use of fossil fuels that it is almost inevitable that they will be part of the solution. The Kyoto Protocol is unlikely to be enacted internationally without U.S. participation. The protocol is “a work in progress.” Many provisions remain to be worked out before it would likely be considered by the U.S. Senate for ratification.

Special Report on Land Use, Land-Use Changes and Forestry (SR-LULUCF)

1990
1992
1997
2000

This report was released by the IPCC in June 2000 to assist nations in developing agreements and action programs to address climate change. The report examines the scientific and technical understanding of the global carbon cycle in relation to land use, agricultural and forestry activities. The report can be downloaded at www.ipcc.ch/pub/reports.

Over the last 150 years of land use changes, primarily from the conversion of forests to other land uses, have contributed about one-third of the total carbon emissions to the atmosphere, as compared with two-thirds from the burning of fossil fuels and the production of cement. However, during the last two decades terrestrial systems have stabilized and become net carbon “sinks”, with losses in carbon due to land use, land use change, and forestry practices in the tropics being more than offset by carbon gains from these activities in temperate and boreal systems.

A basic conclusion of the report is that agriculture and forestry activities provide an opportunity to increase the uptake of carbon from the atmosphere into the terrestrial biosphere through afforestation, reforestation and improved forest, cropland, and range-land management activities. However, a consistent set of definitions and accounting procedures, coupled with a measuring and monitoring system, are needed to allow governments to accurately reflect the exchanges of carbon between the terrestrial biosphere and the atmosphere.



Don't Leave Pivot Corners "Empty"

"Farm" Fast-Growing Poplars and Produce a Product

Gary Kuhn
NAC Agroforester

So what do you do with that little bit of land that is left on the corners of irrigated circle pivots anyway? "Why not plant trees?" ask Ted and David Melgren, farmers from the Columbia Basin Region in Washington State. The Melgren's pivot-irrigated farm, located just east of Othello attracts lots of long glances as drivers pass by. That's because they planted 28 acres (seven acres per corner) of hybrid poplars in the corners of a center pivot field. Water is supplied to the trees by drip irrigation. The tree stands range from four- to five-years-old, are spaced 18 feet by 18 feet apart, are pruned to 18 feet, and are between 30 and 50 feet tall. Diameters range from eight to 10 inches and should average 14 to 16 inches by age 10. These plantings originated because the Melgren's were tired of fighting weeds in the pivot corners of their wheat, potato, sugar beet, and onion fields. Grass is planted between the rows to help control weeds during establishment.

In June, 2000, the Melgren's met with foresters from the Natural Resources Conservation Service (NRCS) and the USDA National Agroforestry Center (NAC) to discuss additional incentive opportunities, future management, and marketing alternatives. Some of these include carbon credits for poplar plantations, incorporating additional agroforestry practices, such as harvesting the grass between the rows for hay/forage, and helping to develop poplar growers associations to distribute

Poplar stands in pivot corners provide a viable economic product, wildlife habitat, some wind protection for crops, and an aesthetic quality to the landscape.

information on poplar culture and markets.

In one pivot corner, the tree canopy is beginning to shade the ground and has reduced the



David and Ted Melgren of Othello, Washington between a 10-inch-diameter, five-year-old poplar planting in one of their pivot corners.

need for weed control so the Melgrens recently planted ponderosa pine in the understory to further enhance wind protection, aesthetics and wildlife habitat. Because of the tree pruning and wider spacing, there is plenty of sunlight for the pine. The Melgrens' plan is that once the poplars are cut at age 10, the pines will be well established in the corners for aesthetics and wildlife.

Since Othello usually receives only about eight inches of precipitation per year there aren't many trees around. Melgrens' trees not only produce a viable economic product they also provide some wind protection to the crop in the pivot. Additional benefits of the poplars are that they add an aesthetic quality to the landscape and produce wildlife habitat.

"You have to really want the trees and be able to devote time to care and management," commented David. They initially struggled with weed control, supplying adequate water, and girdling damage from voles. But, as they say, hindsight is 20/20. And while it is true that Ted and David could have benefited from technical information on poplar culture and management earlier in their establishment efforts, their first-hand experience will prove valuable to future irrigated poplar production, especially in the Northwest region.



Carbon

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The following scenarios describe the potential for carbon storage in tree stems and branches over a 20-year period. Roots are not included, but would likely add from 15 to 25 percent to the totals. In addition, windbreaks typically function effectively for 50 to 70 years and would continue to accumulate carbon over the life of the planting.

Field Windbreaks

Field windbreaks reduce evaporation and plant transpiration rates such that crop yields in a field are typically increased, even though a portion of the field has been converted to windbreaks. Research has estimated the optimal tree planting levels at between three and six percent of the cropped field area. There are 210 million acres of cropland unprotected by windbreaks in the North Central U.S. and of this, 30 million acres are subjected to wind erosion in excess of the soil loss tolerance rate. Each million acres of planted windbreak would represent 200 million trees storing

Within 20 years field windbreak storage could exceed 215 million metric tons of CO₂



21.2 million metric tons of carbon dioxide (CO₂) at age 20.

In addition to carbon stored in windbreak trees, the protection provided by the windbreak results in energy savings from reduced fuel use. In the case of field windbreaks, land removed from agricultural production results in less fuel use. Based on an average of five gallons of diesel fuel per acre for most crops, planting 60,000 acres to windbreaks would reduce fuel consumption by 300,000 gallons annually.

Planting windbreaks around these 300,000 unprotected farms would result in 120 million trees (approximately 400 trees per home) storing 13 million metric tons of CO₂ within 20 years.



Farmstead Windbreaks

Of the more than 800,000 farms in the North Central U.S., over 300,000 have no wind protection. For farmsteads located in cold climates, windbreaks have been shown to reduce home heating requirements by 10 to 20 percent. Assuming an average home uses 2,350 gallons of propane per heating season, a 15 percent savings would reduce annual demand by 10.6 million gallons. While this benefit would not begin until the windbreak reached an effective height (about 10 years) it would continue throughout the remaining life of the windbreak, typically 40 to 50 years. Over this period fuel savings in excess of 290 million gallons could be expected.

Living Snowfences

In North Dakota, South Dakota, Nebraska, Minnesota, and Iowa there are over 460,000 miles of roadway. Many of these would benefit from protection with a living snowfence. Properly designed living snowfences can dramatically reduce the need to plow and re-plow roadways. Assuming a 1/3 reduction in snow removal costs, fuel usage for every 1,000 miles of protected roads could be reduced by 320,000 gallons annually.



For each 1,000 miles of roads protected by windbreaks two million conifers could be planted to store 175,000 metric tons of CO₂ within 20 years.



Conversation

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like the first thing you would have to do is to determine how much carbon you already have on your farm. All above- and below-ground vegetation, including mineralized and organic matter in the soil, and soil organisms must be taken into account to determine your carbon baseline. Then you will need a management plan to show how much carbon you can expect to store for a given time-frame. It is the difference between the base line and the projection that becomes your carbon offset and will be the basis for carbon credit payment.

Art: *That sounds complicated. How am I supposed to do all of that?*

Rich: It is going to be complicated to evaluate various carbon projects, each requires a different plan that must be presented in a large enough quantity to justify registration, verification, and authentication. Some feel that there is going to be a whole network developed to run and market carbon credits. Carbon credit project managers would assist landowners with specific carbon-types and present management plans and acres to a 'third party' (Aggregator) who would group the projects by type and register the acres so that a buyer knows what they are getting. A carbon broker (CERC Creator) would then be able to market carbon either directly to companies seeking credits or on the open market.

Wayne: *What do you mean by authentication?*

Rich: The marketing of CERC's could be part of a worldwide trade system using a Registry to track and identify credits in order to protect both you and the buyer. Once a project manager has determined your baseline, management plans, and estimated carbon a third party (probably a State-wide Organization) would review the carbon baseline measurements and calculations for accuracy. Once the project is authenticated as a feasible project the acres, management plan, and all calculations would be entered into a third party registry (Regional-National-International).

Wayne: *How would I prove that these changes are working so that I can get paid?*

Rich: To make this process work a third party (state-wide Organization) could periodically check the actual carbon against the management projection and report back to the carbon broker. Adjustments may need to be made in your management plan if you're not meeting your goal or your payment may need to be increased if you're exceeding your goal.

Wayne: *What if after all is said and done, there is a fire or other natural disaster? Will I have to pay for the additional carbon that is lost as well as my base-line carbon?*

Rich: That could be a problem. However, it sounds like in this system that the carbon credit broker would work with a third party actuary to determine the risk factor and provide insurance for any loss of carbon.

Wayne: *Sounds like I might be interested. Where do I go for more information?*

Rich: This is still pretty new and there is a lot that has to be worked out yet. There's new information coming out all the time. A good place to start though is at the recently developed Carbon Technology Transfer Center. Their web site is: www.carboncenter.net; phone: 509-893-8065, or e-mail: janel@pacrimrc-d.com or tim@carboncenter.net



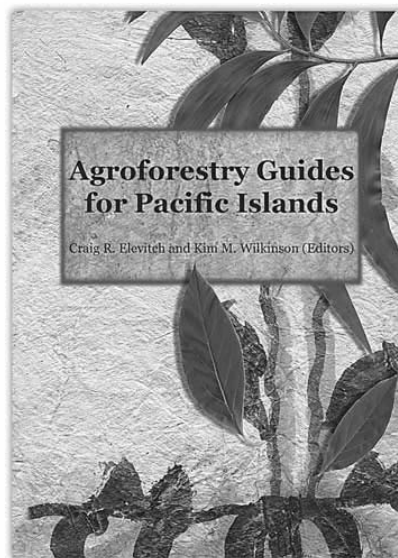
For more information on climate change visit the World Resources Institute website at www.wri.org/wri/climate. One article of particular interest is "A Climate and Environmental Strategy for U.S. Agriculture" by Paul Faeth and Suzie Greenhalgh. This can be found at www.wri.org/wri/sustag/break_green.html.



Biotechnical Streambank Protection Measures Workshop

April 4-5, 2001

A two-day workshop will be held at Arbor Day Farm in Nebraska City, Nebraska. The workshop will consist of one day of classroom instruction followed by a day in the field learning how to install the measures. For more information e-mail Nancy at: nhammond@fs.fed.us or fax her at 402-437-5712 to request a registration form.



"Wow! It is like having an agroforestry library and librarian at your finger tips. The book is well researched and organized and the individual self-contained chapters will be of great value for extension and education."

Agricultural Development in the American Pacific (ADAP) Project
James R. Hollyer,
Project Manager:
University of Hawaii,
Honolulu, Hawaii

Now Available!

The Pacific Islands have a rich tradition of agroforestry, building diverse and highly productive agricultural systems with a variety of strategies and species. *Agroforestry Guides for Pacific Islands* is now available and provides user-friendly, practical information on planning and installing a number of important agroforestry practices. The book draws on both time-tested, traditional Pacific Island agroforestry strategies and modern research in the region. *Agroforestry Guides for Pacific Islands* is written by and for agroforestry practitioners, field-level extension workers, and farmers.

Agroforestry Guides for Pacific Islands is published by Permanent Agriculture Resources (PAR) with support from the Western Region Sustainable Agriculture Research and Education (WSARE) Program.

Individual guides can be downloaded from the internet at: www.agroforestry.net. Or, contact PAR at: P.O. Box 428, Holualoa, HI 96725; Phone: 808-324-4427; e-mail: par@agroforestry.net

Poplar

continued from page 5

thesis, hybrid poplars can store a large amount of carbon in their wood in a short period of time. There is also good evidence that poplars significantly increase soil carbon, thus providing another long-term carbon storage system. As companies look to become “carbon neutral,” they may begin paying farmers and landowners to grow hybrid poplars for carbon sequestration. A company is considered to be “carbon neutral” when the amount of carbon dioxide released into the atmosphere during their operations is offset by some atmospheric carbon dioxide absorption method like a poplar plantation.

Poplars and Water Quality

Clean water continues to be a major issue in the United States. One way to improve and maintain water quality in wetlands, lakes, and streams is to plant vegetative buffers that include hybrid poplars. Poplars are native and well adapted to many of these riparian areas. The plants in vegetative buffers, including poplars, help stabilize stream banks, take up excess nutrients and break down pesticides in surface and sub-surface water from adjacent cultivated fields before they reach streams or other bodies of water. When poplars are used they can be harvested in 8 to 10 years. For example, if a 50 to 80 feet wide buffer is applied using hybrid poplar, a 20 to 30 feet wide zone immediately next to the stream could be left unharvested to protect water quality. The remaining 30 to 50 feet wide portion of the buffer could then be managed for periodic harvesting and income for the farmer.



Poplar-Willow Technology Network

A national network of experts have come together to provide technical support for individuals, private companies, city, county, state and federal agencies interested in using fast growing tree species for wastewater treatment and other similar types of tree-related environmental projects.

Eventually a hardcopy manual will be developed, as well as an internet website. The website will be updated and provide direct links to identified experts.

For More Information, contact: Jon D. Johnson, Ph.D., WSU-Puyallup, 7612 Pioneer Way E., Puyallup, WA 98371. Phone: 253.445.4522; e-mail: poplar@wsu.edu

Discovering Profits in Unlikely Places: Agroforestry Opportunities for Added Income

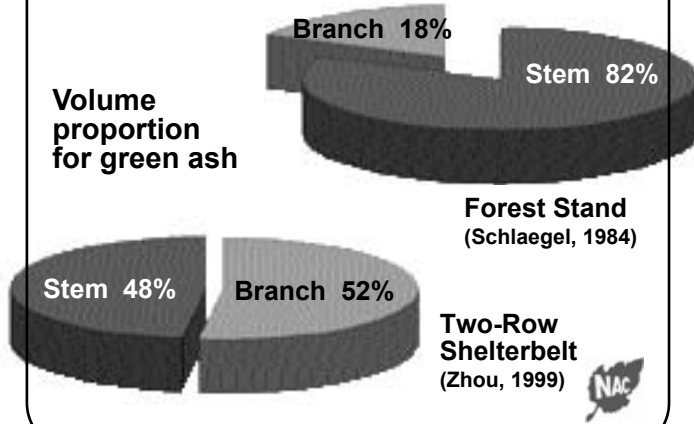
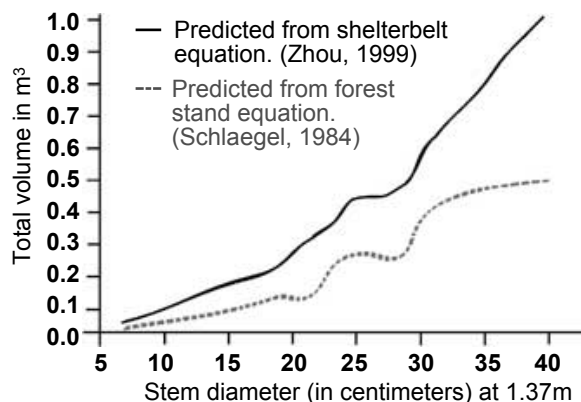
...is a new publication that helps you search for profit niches on your farm. It discusses the potential of incorporating Agroforestry practices for profit. It was written by Scott Josiah and produced by the University of Minnesota Extension Service, CINRAM, and MISA. For a copy e-mail: order@extension.umn.edu or credit card orders at 800-876-8636.



How much carbon is in a tree?

Pictured above Dr. Xinhua Zhou, University of Nebraska-Lincoln, takes measurements of a windbreak tree. This tree is part of a study to determine the distribution of mass in the above-ground portions of trees. Studies like this one are helping to quantify how much carbon is actually stored in trees and shrubs. Zhou has found that, in the species studied so far, trees grown in windbreaks contain more wood than forest grown trees of the same diameter; as much as double the amount. This can be attributed to the increased size of tree branches in windbreak-grown trees. This information can help landowners determine how to take advantage of the potential carbon credit benefits of agroforestry along with conservation and production benefits.

Above-ground volume of green ash (includes stems and branches)



Upcoming Events

March 6-8, 2001

Social Issues and the Environment,
Nebraska City, NE. Contact the
National Arbor Day Foundation,
phone: 888-448-7337.

March 28-29, 2001

*Second Carbon Sequestration and
Biomass Energy Conference*,
Sacramento, CA. Contact Jim
Vancura, phone: 530-397-7463;
James.Vancura@ca.usda.gov

April 4-5, 2001

Biotechnical Streambank Protection

Measures Workshop, Nebraska City,
NE. Contact Nancy Hammond,
fax: 402-437-5712;
nhammond@fs.fed.us;

April 7, 2001

Opportunities in Agroforestry,
LaCrosse, WI. Contact Steve, phone:
608-348-3235;
steve.bertjens@wi.usda.gov;

April 24-26, 2001

*Agroforestry and Forest Management
Learning Community Workshop*.
Arnot Forest Cornell University,

Ithaca, NY. Contact Louise Buck:
leb3@cornell.edu.

May 1-3, 2001

*Urban Wildlife Management
Conference*, Nebraska City, NE.
Contact the National Arbor Day
Foundation, phone: 888-448-7337.

August 16-18, 2001

*Seventh Conference on Agroforestry
in North America*. Regina, Sask.,
Canada. Contact John Kort, phone:
306-695-2284, kortj@em.agr.ca,
agr.ca/pfra/aftappfa.htm

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Web Site: www.unl.edu/nac

Mission

The National Agroforestry Center (NAC) is a partnership of the USDA Forest Service, Research & Development (Rocky Mountain Research Station) and State & Private Forestry 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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