

Working Trees for Treating Waste

A natural alternative for using nutrients from livestock and farm operations, municipalities, and industries.

Excess nutrients and other chemicals from agricultural, municipal, and industrial operations impact surface and ground water quality. Plant science and engineering have combined forces forming a natural partnership between treating waste and growing trees. The technology of putting fast growing trees to work recycling nutrients from solid and liquid waste is available and increasingly being adopted. This waste treatment approach has emerged as an alternative to other more expensive treatment technologies, such as constructed treatment plants.

What to do? Turn waste into a product by applying it to trees. This waste is actually a nutrient and water source for trees. Trees absorb excess nutrients and breakdown harmful chemicals, providing a natural cleaning process for soil and water resources. A major advantage is that trees can be used for a variety of products generating extra income that can potentially diversify the rural economy. Tree plantings also provide visual, noise, and odor buffers, while directly aiding in reducing atmospheric carbon dioxide by storing carbon in the wood and soil.



These hybrid poplars are nourished by wastewater from an industrial plant.



The increase in atmospheric carbon dioxide levels has become a worldwide concern. Trees use carbon dioxide for growth and store large amounts of carbon in wood tissue, both above and below ground.

Is it right for your operation?

This publication addresses the concept of using trees to treat waste and also some key management questions to ask yourself before trees are put to work as your natural solution to water pollution.

On Agricultural Land . . .



Irrigation Tailwater

Excess irrigation water applied to crops contains high levels of nutrients (nitrogen, phosphorous, potassium), pesticides, and other compounds. Unless treated, this contaminated water will eventually reach surface and ground water. Trees can be planted to intercept this drainage water, or the water can be diverted, stored in a pond, and then applied to tree plantations. The trees can recycle this water, use many excess nutrients, and break down hazardous pesticides and other compounds. Tree species selection, irrigation water management, and soil and water quality monitoring are important planning elements to assure tree plantations accomplish their multiple purposes.



Animal Waste

Livestock operations, such as dairies, hog confinements, cattle feedlots, and poultry barns, generate both solid and liquid waste. Applying this waste to tree plantations is recognized as a treatment alternative throughout the United States. These tree plantations can also serve as a visual buffer to livestock operations and can reduce the drift of odors. Tree species need to be tolerant of high salt and sodium levels. Monitoring soil and ground water nutrient and pathogen levels will be important to protect water quality, where high levels of nutrients are applied to limited acreage (maximum loading). Treat the greatest number of acres possible to achieve a return on your investment from the harvest of wood products. It is important to use qualified technical assistance, conservation planning, and obtain appropriate permits.

Development and Site Management

Productive tree plantations used to recycle waste require close attention to tree establishment, stand management, and irrigation system design and monitoring. Since these working tree plantations are dual purpose plantings, it is important that adequate tree growth occurs to both sufficiently use the waste and produce a wood product. Below are some key planning considerations:

Soils/site — The best sites have deep loamy soil for good root development, as highly porous soil can contaminate ground water. Suitability of soils/site depends on tree species selected. Other considerations include slope, proximity to surface water, and proximity to people.

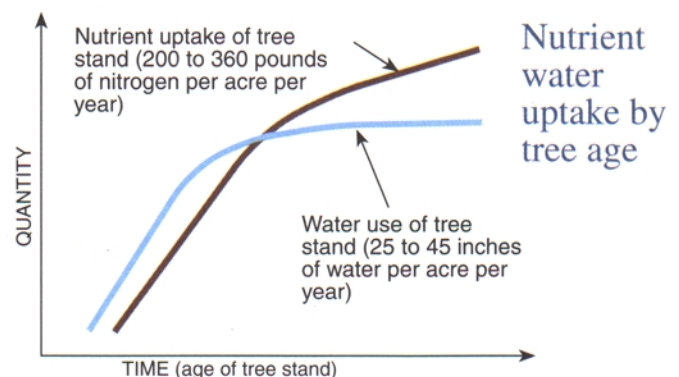
Tree species selection — Trees should be suited to the soil and have growth characteristics conducive to high nutrient uptake. Wood product qualities can be important selection criteria.

Tree spacing — Spacing affects future tree size and wood product potential as well as how rapidly the canopy will close.

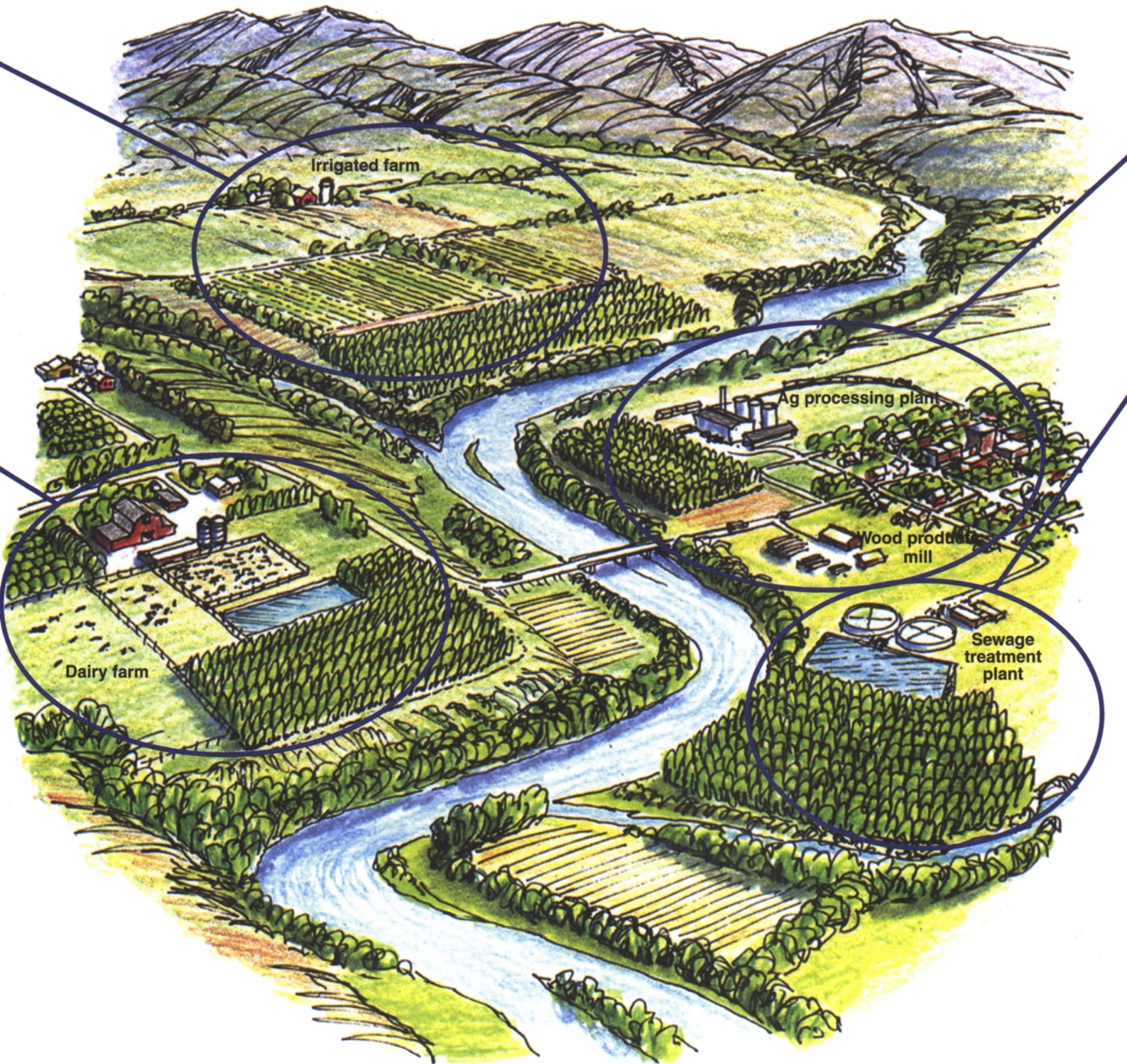
Stand establishment — Proper site preparation, planting, and maintenance are essential to maximize tree growth. Three to five years of weed control are needed to establish trees, depending on species and initial spacing.

Management — The tree plantation should be protected from animals (livestock, deer, mice/voles) during establishment. Eventually, the trees may need to be thinned and pruned if high quality sawlogs are an intended product.

Irrigation system design/monitoring — The quantity and quality of waste being applied is important. The delivery system must efficiently apply the waste to maximize waste/nutrient uptake. Monitoring nutrient loading rates and water requirements of the trees is important for sustainable tree growth while protecting ground water quality.



Putting trees to work on waste and waste water. . .



... In Communities

Municipal and Industrial Waste

Management of municipal and industrial effluent and biosolids is becoming increasingly challenged, as stricter regulations to improve water quality are imposed within our Nation's rivers, lakes, and ground water. The beneficial use of municipal and industrial wastes in tree plantations is one of the innovative approaches being developed. The trees use nutrients in the effluent and biosolids that would otherwise contribute to the problem of nutrient loading in the streams. In addition, the plantations enhance landscape aesthetics, and generate income from the production of wood products.



Benefits and Opportunities



Economic—A direct economic benefit is obtained from the sale of wood products. Wood products can be in the form of chips, fuelwood, mulch, veneer, lumber, paneling, molding, and specialty products. This helps offset the cost of treatment, making it less expensive than most structural treatment alternatives.

Aesthetic—The visual environment can be improved by providing a buffer to adjacent land uses. Also, the tree plantation can help reduce the drifting of odors to neighbors and communities.

Environmental—Working trees protect water quality and safeguard clean water supplies for communities, fish, wildlife, recreation, and people. Tree plantations provide wildlife habitat for a variety of birds and animals. The tree canopy catches dust particles and air pollutants, thereby improving air quality. Trees store carbon dioxide in their wood as they grow, and can contribute greatly to reducing atmospheric carbon dioxide levels. Carbon credits, whose value will be market based, may be sold to industries and utilities. The amount of carbon dioxide stored in a tree plantation will depend on the species, growth rate, age, and management.



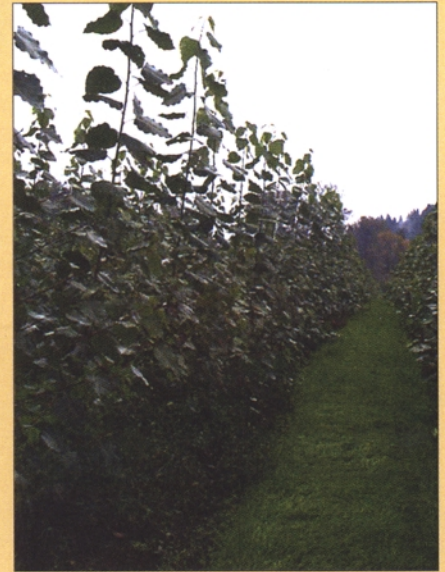
Waste from one species can benefit another.

Trees require sunlight, carbon dioxide, water, and nutrients to grow. Waste from municipal sewage treatment plants, livestock operations, irrigated farming operations, and industrial processing contains nutrients that can be used by trees. Trees can often be substituted for more costly engineered practices.

Of the nutrients commonly found in these wastes, large amounts of nitrogen, phosphorus, potassium, magnesium, calcium, and sulphur are needed by trees in large quantities.

The nutrients taken up are distributed throughout cells in the tree, with the highest concentration ending up in the leaves. The leaves conduct photosynthesis, the process by which sunlight is used to convert carbon dioxide into sugars that accumulate primarily in the wood. Year after year, as the tree grows, nutrients are stored in the wood of branches, stems, and roots. Rapidly growing trees provide a better sink for these wastes than older trees.

In addition to the benefit of using the nutrients from wastes, the trees can be harvested after six to 15 years, depending on species and climate. Products derived from the wood can provide a substantial cash return to the landowner or operator.



Fast growing trees, such as hybrid poplars, can take up large amounts of nutrients, making them ideal for treating wastes.

Which trees?

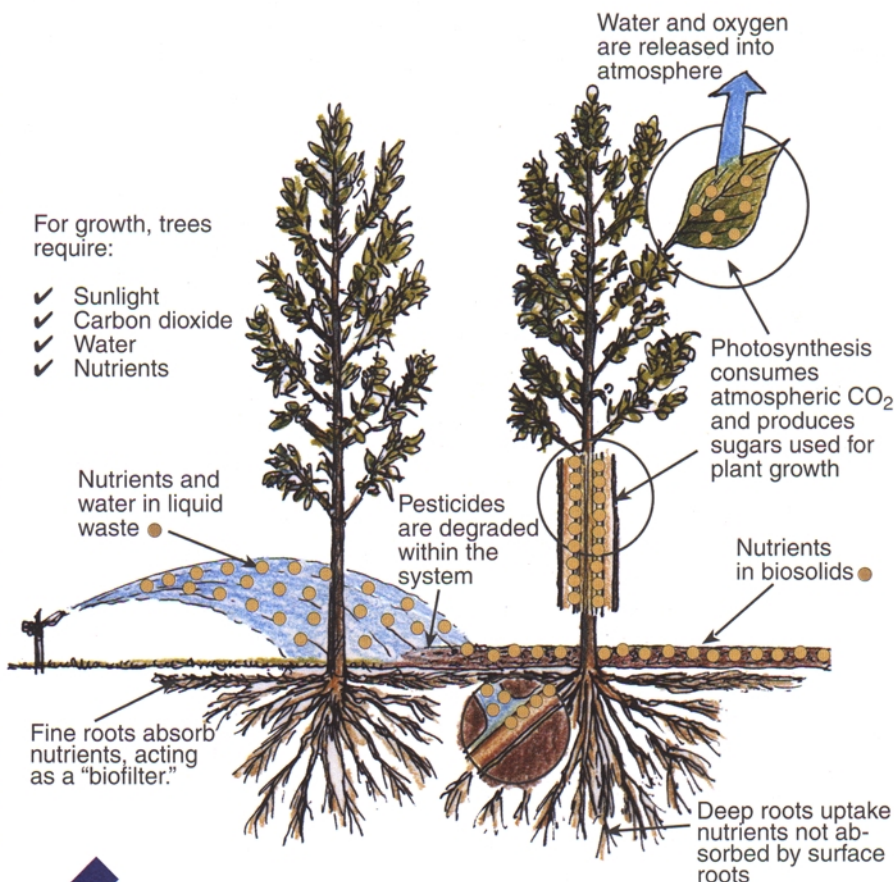
Success in using trees to remove wastes depends on the species and the length of the growing season. Trees that are well-suited for treating wastes include several species with rapid growth rates, which allow more nutrients to be absorbed than trees that grow more slowly. Extensive and deep root systems are also desirable, enabling nutrients to be effectively filtered out and keeping them from moving into ground water.

Fast growing tree species that can be planted for nutrient uptake include:

- **Hybrid poplar** (grows in many regions of the U.S.)
- **Hybrid willow** (Northeast U.S.)
- **Sweetgum, sycamore, and yellow poplar** (Mid-Atlantic and Southeast U.S.)
- **Loblolly pine** (Southeast U.S.)

Both hybrid poplar and hybrid willow are especially attractive because of their ease of regeneration.

When selecting trees for eventual harvesting, check with local mills on the potential market for wood products.



← Open to learn more

Will it work for you?

Planning considerations

In considering whether or not to use trees to treat waste in your particular situation, answer the following questions. Technical assistance is available to accurately determine some of the information.

- Do you have available land with adequate soils for tree growth?
- What is the composition and amount of the waste material?
 - Quantity (volume and/or flow rate)
 - Quality (concentration of nutrients and heavy metals)
 - Form (liquid or solid)
- Does the need for dealing with these materials coincide with the growing season? If not, is there adequate storage for waste accumulated during the winter months?
- Are you willing to commit time and resources for the planning, design, installation, and maintenance of the trees?
- What is the desired end use for the trees? (timber, aesthetics, wood chips)
 - Acreage (optimal size needed for increased profits)
 - Cooperatives (harvesting and marketing advantages)
 - Products mix

The harvesting of animal waste requires special consideration and should be part of a comprehensive nutrient management plan (CNMP). For further assistance contact your local Natural Resources Conservation Service (NRCS) field office.

Where to get more information

Developing a successful program for using trees to treat waste is not a do-it-yourself project. Specialists are available in both the public and private sectors. For more information at the national level, contact the **USDA, National Agroforestry Center (NAC)**, East Campus – UNL, Lincoln, NE 68583-0822. Telephone (402) 437-5178, or visit NAC's web site at www.unl.edu/nac.

For local assistance, contact your nearest USDA, NRCS office, County Extension Office, Soil and Water Conservation District, State Forestry agency, state water quality agency, state land grant university, and/or reputable consultants working in this field.



A partnership of the Forest Service and Natural Resources Conservation Service

This brochure was developed by the USDA National Agroforestry Center (NAC) in cooperation with Washington State University, The Upper Columbia Resource Conservation and Development Council (RC&D), and Greenwood Resources, Inc.

NAC's Mission: The USDA National Agroforestry Center is a partnership of the USDA Forest Service, Research & Development (R&D) (Rocky Mountain Research Station), and State & Private Forestry (S&PF) 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 cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.

Address: USDA National Agroforestry Center, East Campus - UNL, Lincoln, Nebraska 68583-0822. For a supply of brochures, contact Nancy Hammond, e-mail nhammond@fs.fed.us or fax (402) 437-5712. For more information on the Center, contact Rich Straight, 402-437-5178 ext. 24 or Bruce Wight, ext. 36.

The United States Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326W, Whitten Building, 14th & Independence Ave., SW, Washington, D.C., 20250-9410 or call (202) 720-5964 (voice or TDD). USDA is an equal opportunity provider and employer.