



Environmental Effects of Woody Vegetation

In Iowa, trees and shrubs are a vital asset to life because of the aesthetic qualities from tree plantings, the economic values that the traditional forest products provide, and the conservation benefits that trees offer to the human environment. In rural locations, woody vegetation provides for man's protection and preservation. Farm windbreaks and shelterbelts supply a climatic stabilizing effect as well as wildlife shelter and habitat. Our close relationship is further demonstrated by park sites, home beautification, and roadside plantings.

However, in the transition zone from rural to the urban communities, a breakdown of green space begins, which reaches its maximum in our towns and cities. It's in our cities and towns that an unnatural environment exists. Concrete, asphalt, buildings, automobile traffic, compacted soils, and polluted air create an unnatural home for plant life. Our green space is being sacrificed for industrial expansion, housing developments, and, in general, urban sprawl on both a small scale and on a large scale.

Let's look at the effects of woody vegetation on the community environment, specifically on the temperature, air quality, and noise levels that we are exposed to.

Air Temperature

Trees, people, and buildings share some common characteristics which must be considered. So let's look at the various components of their energy budgets.

For people, heat production by metabolism is an important component in their energy budget.

For trees, however, metabolic heat production is insignificant. Buildings have a mechanism similar to metabolism—their heating system.

Under high temperature stress, the human body uses evaporation of perspiration as one means of maintaining a constant external temperature. Evaporation from trees is also an important cooling process through which trees benefit man; in fact, trees have been called nature's air conditioners. A single isolated tree can transpire 100 gallons of water from its leaves per day. The cooling provided by this amount of evaporation would be equivalent to five average room air conditioners running 20 hours per day.

The cooling transpiration process also helps maintain a healthy environment. One hundred mature trees catch about 77,000 gallons of rainwater per year¹. This process helps manage excess water flow in urbanized areas.

Radiation is another important component of energy budgets. Trees are usually most effective in improving human comfort by shielding people from direct solar radiation. What happens to the solar radiation that does not reach the ground because it is intercepted by tree canopies? There is considerable variation during the day. Ten to 25 percent is reflected back to space. A relatively larger amount of the absorbed radiation is used for transpiration, and most of the rest is used for heating the air. A small but significant amount is used for heating tree parts. The portion of solar radiation used in photosynthesis (food production) is small—about 1 percent.

Heat loss by convection (wind movement) is perhaps the main cause of human discomfort in winter. Wind can be controlled through the proper placement of trees.

In Iowa it is possible to utilize vegetation for reduction of both heating and cooling costs of homes, buildings, and other sites to which the human is exposed.

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First, within towns the planting of street trees and the creation of parks seems desirable, primarily for the shade produced but also for the evaporative cooling effect and increased property value. For example, each large front yard tree can add 1% to the house sales price².

For landscaping of trees around homes, the following tree placement is best for optimum benefits. The conifer trees to the northwest will provide protection from cold winter winds. The deciduous trees to the south provide summer shade during midday but are open to the south and the sun during the winter. Shade trees may be planted on the west to reduce late day sun and heat. On the east, a feeling of openness is created by a lawn and low shrubs, and the early morning sun is allowed to enter. Research has known shown that the average homeowner can save up to 20% on annual air-conditioning cost and save 2%-10% on winter heating costs¹.

It may be advantageous to build on wooded lots, removing just enough trees for construction. For example, locate the building site on the south or east edge of the lot.

Air Quality

Trees play a vital role in our environment, as do other green plants, through the conversion of carbon dioxide, water, and sunlight into carbohydrates and oxygen. Each acre of woodland produces enough oxygen each year to fulfill the requirements of 18 people.

Trees also have some effect in cleansing the air we breath. They act as natural filters for the air we breath. This may be especially important in our towns and cities where pollution levels are generally higher. Trees remove gaseous pollutants such as sulfur dioxide (SO₂) and carbon monoxide (CO) by absorbing them through the pores in the leaves. Particulates are trapped by leaves and twigs and washed to the ground by rainfall. Results indicate that 100 trees remove an average of 1.2 tons of CO₂ and 130 lbs of other pollutants each year¹.

Woody plants cannot act in an unlimited fashion as absorbers of acute discharges of noxious fumes because many of these substances are toxic to trees. At the present time, we lack sufficient knowledge to say which species are best or more efficient. Probably greenbelt plantings for pollution absorption will function most efficiently in reducing low levels of pollution.

Trees and Noise

Combinations of trees, shrubs, and solid barriers are effective in shielding residential areas from noise.

The degree of protection attainable is largely governed by the amount of plants and barriers used and their proximity to the source of the noise.

One way that trees are useful for noise control is reducing human annoyance by creating a masking effect through the rustling of leaves or needles by the wind. The sound of birds and other animals also creates masking in forested areas. Another noted use of trees in treating a noise problem is the creation of a visual screen to hide the source, such as a highway. Surveys have shown that in tree lined commercial districts, shoppers reported: feeling safer, more frequent shopping, longer shopping trips, willing to spend more for parking, and they were willing to spend 12% for goods in tree lined areas³.

Conifers make better visual screens than deciduous hardwoods because most conifers are evergreen and provide the benefit year-round. Some investigators claim that broad-leaved trees are effective noise controllers and conifers are not, but this is still an open question. A mix of conifers and broad-leaved trees is probably the best noise screen.

Here are a few principles about noise screens based on existing knowledge:

- (1) Don't expect widely spaced trees along city streets to absorb noise and provide a general quieting effect in a neighborhood.
- (2) Noise buffers should be close to the source, rather than halfway between the source and the receiver.
- (3) Forests will sometimes significantly reduce noise over long distances such as hundreds of yards.
- (4) Along major highways if the right of way is sufficiently wide, creation of an earth bank covered with trees may be more efficient than tree plantings by themselves.

¹ McPherson, E.G., J.R. Simpson, P.J. Peper, S.E. Maco, and Q. Xiao. 2005. *Midwest Community Tree Guide: Benefits, Costs, and Strategic Planting*. USDA Forest Service.

² Anderson, L.M. and H.K. Cordell. 1988. *Residential Property Values Improve by Landscaping With Trees*. Southern Journal of Applied Forestry, 9: 162-166.

³ Wolf, K.L. 1999. *Nature and Commerce: Human Ecology in Business Districts*. In C. Kollin, ed. Building Cities of Green: Proceedings of the 1999 National Urban Forestry Conference. Washington, D.C. American Forests, pp. 56-59.

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