Decreasing the Demand on Forests of the World: Alternative Building Possibilities in Wisconsin

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ABSTRACT

With current deforestation rates throughout the world, there is a need to lessen the demand on natural forests. They are important in biodiversity, climate regulation, aesthetics, education, and economy of the United States. Half of all timber harvested is used for construction of new buildings causing forests to diminish every day. To decrease the demand on forests, alternative building materials can be used in construction to take the place of wood. The focus on Wisconsin is based on the lack of research being done in areas that have climates with varying degrees of temperature, precipitation, and severe weather. With the states rich history of environmental progressivism, it is possible that the state government would support the use of alternative materials viable for the area. Two materials were evaluated based on cost, viability, and environmental impact and both show promise for increased use. Straw bale constructions as well as a product called RASTRA are equally viable solutions Wisconsin can use to do its part in decreasing the demand on forests of the world.

Introduction

Traditionally homes in the Midwest have been built primarily of wood. Although wood has advantageous properties as a building material, the negative effects of large scale harvesting are crucial to consider. To eliminate the demand on old growth forests, lessen the demand on second growth forests and tree plantations, alternative building materials are needed in construction to take the place of wood.

With almost half of all lumber being used for the construction of new homes in the United States and wood harvests projected to increase by over one third in the next 50 years(Wear & Greis 2002 p2), the forests are diminishing everyday. Old growth forests, which range in age of 150-800 year old trees, are still being harvested at an alarming rate of at least 70,000 acres per year (A Series of Fact Sheets on New Construction Issues n.d.). Even though these forests are important in preserving biodiversity, aesthetics, education, and economic importance to the communities which surround them, only five percent of the total original forest cover in the

United States remains old growth (U.S. Forest Service, 1997, Tables 14-15).

The Forests

There are many ways to characterize a forest. Factors such as age, location, or species are only a few. Classifying forests by general age is the most simplistic; i.e., dividing them into old growth forests, second growth forests, and monoculture plantations. Each has unique characteristics that are beneficial to humans for both monetary and aesthetic reasons.

Characteristics of old growth forests are unique. They contain trees of all ages, from saplings to trees that are hundreds of years old. With so many different types of vegetation in these forests the distribution is scattered, leaving open spaces in the canopy for sunlight to reach the forest floor. Sunlight supports the growth of fallen seeds for regeneration of a species. The lifecycle of a tree is the most important part of old growth forest. A newly fallen tree, whether from natural causes such as wind or a flood, or from insect infestation, provides habitat for a variety of species. One turned up tree can become a whole ecosystem within the forest (Tanner & Hamel, 2001 p107). Old growth forests have considerable biodiversity, or a high number of different species living in one area, but the numbers of each species stays relatively low. The food web is very complex because one species can be dependent on many other species for survival as well as for keeping their own population in check. This happens in not only old growth forests, but in regeneration or second growth forests to a lesser extent.

Second growth forests have grown in an area that was once disrupted either by human or natural causes such as a forest fire, and then left undisturbed over a long period of time. The main difference between old growth and second growth is the age of the trees, giving the second growth forests a single canopy layer and a diversity of species. However, second growth forests are important since 87% of remaining forest cover in the U.S. is less than one hundred years old (U.S. Forest Service, 1997, Table 14-15). These forests should not be forgotten during preservation efforts because of their potential to succession into old growth forests. An example of this is the Sylvania Wilderness in the Ottawa National Forest, which now includes approximately 1 million acres. It was bought in 1928 by the National Forest Reservation Commission specifically to allow low impact recreation and habitat for animals, as well as to allow the area to continue its natural succession (Ottawa National Forest n.d.).

Tree plantations are another type of forest cover being used for construction. These plantations remove natural stands of forests and replace

them with a monoculture: i.e., rows of fast growing trees that are all the same species. These replace biodiversity and habitat with a high quantity of fast growing trees for harvest. Although these trees are meant to take the pressure off natural stands of forests, there are instances where this is not the case. Most plantations are on a twenty year cycle of planting and harvesting, however the time in between harvesting, the natural forests are being harvested to supply the demand for wood, and then replaced with a monoculture. In Chile, for example, most of their original forests have been harvested and replaced with plantations due to an increased international market for low quality hardwood (Clapp 2001, p341). Despite the importance of these forests, there is much economic incentive to replace slow-growing natural forests with fast-growing plantations that can be sold internationally.

Statistics show that there are more trees on earth now than there ever were, however the statistics do not differentiate between diverse natural forests and single species tree farms, making the numbers very misleading to the general public (Edminster n.d. p2). They should not be lumped together because they do not hold the same value. From an economic standpoint, plantations contribute money to the economy, but from an ecological standpoint, they offer little benefit. The worth of a natural forest to humans is almost immeasurable because it offers biodiversity, climate regulation, aesthetics, and research opportunities. Measurable importance of a natural forest, like our national forests shows economic benefits such as the contribution of amounts of money to our economy and the provision of many jobs.

Importance of the Forests Biodiversity

Humans, as well as species that thrive in a forest, depend on biological diversity. Ecosystem function is directly related to the amount of species within it because the higher the amount of diversity, the healthier the forest is. It is difficult for a monoculture of trees to combat disease or infestation if they are all being attacked by the same organism. For instance, in Kenya, Guatemalan Cypress (Cupressus lusitanica) was planted profitably for many years before the cyprus aphid (Cinara cupressi) eliminated it as a viable plantation species (Clapp 2001 p.349). When there is an abundance of a single species, it is easier for it to be attacked by a single predator. Diversity ensures that the other organisms around an infected one will be virtually untouched. Diverse forests are better able to withstand disturbances and recover fully from them than are monoculture plantations. They also provide a better environment for a variety of living things to create soil, pollinate plants, and detoxify pollutants (Adler 1995 p.326).

Not only are healthy forests important to animals, but to humans as well. For example we depend on wild species from the forest. If rainforest diversity is preserved, a host of plants and animals could give humans a variety of substances capable of producing life saving drugs. With such a diverse number of species, there is a great likelihood that many of them produce toxins within their systems that can be used to fight diseases. In 1992 the *United Nations Chronicle* pointed out that only 1% of all rainforest plants have been screened for medicinal value, and that the high rate of deforestation could potentially be destroying "irreplaceable cures for devastating diseases"(Biodiversity, 1992 p52), giving us reasons to worry that someday these resources may be gone forever.

Climate Regulation

There is evidence that suggests removing forests over large areas can affect regional weather conditions (Coulombe 2001, p2). Forests help moderate surrounding climates by reducing wind speed, wind chill, evaporation, soil erosion, and soil compaction. Trees give off oxygen that all animals need to survive, as well as absorbing all of the carbon dioxide humans create by burning fossil fuels that run our cars and industries. Dr. James Tanner, a leading expert who contributed enormous amounts of information on old growth forests of the southern United States, once wrote, "We do not know enough to understand the ecology of rain forests and not nearly enough to plan intelligently for the tremendous human changes occurring in tropical regions"(Tanner & Halmes 2001, p2). Most scientists do believe, however, that the consequences will be grave.

Aesthetics

The beauty of a forest cannot be measured in numerical value, but with in amount of joy, peacefulness, awe, or excitement it can bring to a person. This is especially important to anyone who has ever seen a 500 year old tree, walked through a rainforest, or even watched them in amazement on television. Year after year people flock to national forests to see the towering redwoods, ancient cedars, and all of the animals that flourish within the forests around them.

The amount of visitors to national forests in one year is astonishing. The USDA Forest Service reported over 214 million visits to Forest Service lands, waters, and recreation sites in 2001, and that is just the United States alone (USDA Forest Service, 2002 p1). If one country has that many visitors, the amount of visitors to parks all over the world are in the billions (USDA Forest Service, 2002). The number of people visiting National

Forests demonstrates how important they are to society for recreation, scenery, and the experiencing of wildlife.

Economy

Increasingly, economists and scientists are bringing attention to the value of forests from a numerical aspect. They are starting to see how incredibly forests are contributing to new businesses in rural areas where forests have been preserved. They are bringing in new recreation opportunities and even high technology companies to support communities with jobs and revenue that were once based in timber (Preserving America's Ancient Forests, n.d.p1). They seem to be flocking to areas that have a high standard of living associated with the abundant recreational activities found in and around a well maintained forest.

As mentioned previously, forests provide a variety of services to society including flood control, purification of air and water, recreation and cultural values. Traditionally these services were not included in economic assessments of forests; only the amount of money the lumber would bring is calculated. It has been estimated that National Forests alone provide services to the public worth $4.7 trillion per year (Economic Case against Logging, n.d.). Another team of scientists and economists who published an article in *Science* magazine (2002) estimated the aggregate value of all of nature's services to be between $18 and $61 trillion per year. These numbers combine all of the potential problems that could occur due to the loss of natural forests and include the cost of flood damages, water purification, recreation revenue, and the elimination of any other service that a forest provides to society.

One problem especially associated with heavy logging is flood damage. When a large section of forest is clear cut, the soil in that area becomes unstable because there is no root system holding it in place. If a heavy rain occurs, the soil can easily wash away and cause landslides that damage roads, bridges and structures downhill. The Pacific Northwest floods of 1996 forced the Forest Service to spend $100 million dollars to repair the damages (Economic Case against Logging n.d.).

National Forests contribute more money and jobs to the United States economy than the timber industry. Not only is the revenue sustainable, it keeps people in jobs for longer periods of time than logging. In the Pacific Northwest, as amounts of forest in Oregon and Washington that were available to harvest decreased, there was job loss in the timber industry. However, in that area there was a net increase in jobs the following year in other sectors of the economy (Hanson, 2000 p3). Hunting, fishing, and recreation in the National Forests contribute 30 times

more income to the economy and create almost 40 times more jobs than logging the forests (Hanson, 2000, p2).

The money from federal timber subsidies for logging in National Forests could be put to an alternative use which would provide a larger benefit to the economy. If the subsidies were directed to the workers who were laid off because of the decreased logging, there could be $30, 000 for each of them for job retraining and forest restoration: an amount higher than the average worker's salary. After each worker is paid to get retrained, there would still be enough money left over to save taxpayers several million dollars (Hanson 2002, p2).

Harvesting forests is not economically sustainable. They are a renewable resource, but not at the rate they are being harvested. This suggests the importance of our National Forests for recreation, hunting, fishing, and jobs, rather than timber harvest.

Research/Education

Forests are essential to the education of all ages, as well as for scientists who study and analyze these same forests. Some stands of forest are currently being used for research areas for the USDA Forest Service, and are contributing to ecological research (Tanner & Hamel, 2001 p107-108). There is an almost endless potential for research of forest ecology because of the complexity of its systems. Original habitat is needed if humans are to better understand the ecology of native species. Mentioned above, there is not enough known about the effects of high deforestation, in rainforests for example, to predict long term what will happen. Scientists know on a smaller scale how deforestation affects communities, plants, and animals, but more research is needed in natural forests to fully understand what impacts will surface in the future.

Why Wisconsin?

There are many alternative building materials available worldwide, but Wisconsin was chosen for this study because few non-wood materials are specific to this area besides brick and concrete. The climate is harsh with long cold winters and hot humid summers, making research in alternative materials limited. In contrast, much research has been done on materials viable in the Southwest because of its hot, dry climate and natural limitation of wood availability, making information and research for Wisconsin a necessity. Wisconsin also offers hope of political progressivism in supporting non-wood materials because of the state's rich history of environmental activism and leadership. Government support for

alternatives would make alternative materials easier for the public to learn about and obtain.

Climate

Wisconsin's climate is harsh and sometimes unpredictable. Nearly all areas of the state receive between 30-34 inches of rain per year, mostly during the growing season. Winter brings 40 inches of snow in the southern part of the state, up to 100 inches in the northeastern region and can last from early November to April. The temperature can fluctuate considerably from winter to summer. The average temperature is between 39 and 50 degrees F. In the summer the temperatures peak in the 90's and in the winter drop down to -30 degrees F or lower, not including wind chill, especially in the north. Records for summer have hit 114 F and minus 55 F in winter creating an enormous contrast in temperature from season to season. With such drastic changes in temperatures and humidity, thunderstorms are very common in summer months, averaging 30-40 per year. These storms can bring hail, lightning, high winds, and occasional tornadoes (Retter 2003).

Environmental Progressivism

Wisconsin heralds some of history's greatest leaders in environmental stewardship and activism. John Muir, originally from Scotland, moved to Wisconsin and grew up on a rural farm. As an adult he attended the University of Wisconsin, published many books, and was the founder of the Sierra club as well as the National Parks system. Aldo Leopold, author of *Sand County Almanac*, also grew up in rural Wisconsin and attended the University of Wisconsin, at which he later taught. His books provide readers with his deep ecology philosophy and appreciation of the land and forests. The founder of Earth Day, Gaylord Nelson, was also a Wisconsinite. He inaugurated a national day for the purpose of planting trees and creating environmental awareness. World renowned architect Frank Lloyd Wright lived in Wisconsin for the early part of his life and also attended the University of Wisconsin in Madison. His views on designing and building were organically based, because he believed that a building should blend with its surroundings and look natural.

The state also has a great past in environmental protection Wisconsin passed many innovative laws that were the first of their type in the nation. In 1933 the United States first large-scale act of conserving water and soil was led by Wisconsin, it was also the first state to ban DDT(1970) (Wisconsin's Firsts, n.d.). The state was aware of the importance of recycling and enacted a widespread law that was funded

from a broad-base business tax in 1990, the first of its kind. Given Wisconsin's past leadership in environmental awareness, government support for using alternative materials is not out of the question.

The Wisconsin State Budget already shows an increased effort in environmental awareness. The legislature has adopted what they call "Smart Growth" legislation. It is a comprehensive plan that includes plans for taking actions to improve communities. It includes a plan to result in healthier communities that balance growth with environmental protection. This plan hopes to preserve open spaces and critical habitat as well as water and air qualities (Comprehensive Planning 2001). One of their principles of smart growth is encouraging the community to contribute to development decisions. This provides the public a voice in what is important to them in planning their city and has potential for citizens to request aid in building environmentally friendly houses.

Currently the Department of Natural Resources in Wisconsin and Bureau of Community Financial Assistance offers grants and financial assistance to local governments and interested groups to develop and support projects that protect public health and the environment (Plan Implementation Tools n.d.). These programs offer environmental loans for drinking water, wastewater, and Brownfield projects which aim to clean up a contaminated site and use it for education or recreational use. These programs have Environmental Financial Assistance available, which provides grants for runoff pollution, recycling, lakes, rivers, and flood control. Thirdly, the DNR and the Bureau of Community Financial Assistance offer Land and Recreation Financial Assistance. This grant program offers assistance for conservation, restoration, and stewardship. Although these programs are not specifically accommodated to the home builder or buyer, they show steps taken toward funding for environmental protection, and the program is almost limitless in expansion.

Alternative Possibilities

Despite the harsh climate in Wisconsin there are materials available that can meet the needs of Wisconsin just as effectively as traditionally used wood. Two alternative materials were evaluated based on Wisconsin's climate, economy, and the product's environmental impact. Straw bale construction, an older technology, and a product called RASTRA, a newer technology, show much promise in all aspects of this evaluation. The use of these materials in Wisconsin would continue the movement toward lessening the demand on forests of the world.

Straw Bale Construction

Straw bale construction has a deep history in the great plains of the United States. It was first used as a building product in Nebraska during the 1890's; some of the homes are still standing today. The bales were used because of their ease of construction, durability, and insulation qualities (Morgan 1999 p1). Straw was also a readily available resource, being a byproduct of grain production. The seed head was harvested leaving the plant stalk behind that was then cut and turned into bales. Bales could be made out of wheat, oats, and barley. These resources are still available today and the U.S. Department of Agriculture estimates that American farmers harvest enough grain in one year to supply straw for four million 2,000 square foot houses, which is almost quadruple the amount of houses actually constructed (House of Straw 1995 p3).

Constructing a home is done in three steps: laying a foundation, stacking the bales, and plastering. A foundation is poured just as it is for any other building and has usually a concrete and foam insulation to prevent frost. Then depending on what type of construction is chosen, a load bearing or non-load bearing frame may be put up. For load bearing structures, the weight of the roof is carried by the bales and plaster versus the non-load bearing, in which the frame carries most of the weight and is constructed out of wood beams and trusses. Both are equal in stability; however building inspectors better understand the process of the non-load bearing structure, giving it a better advantage for home inspection. The bales are stacked after a water barrier is placed between the foundation and first layer of bales. Most bales are skewered on metal posts up to the height of the ceiling and poultry netting is stapled around the walls. This secures them and adds stiffness for plastering, on which two to three coats are applied. The plaster covering can be applied by hand or by sprayer depending on choice. This seals the outside from pests, wind, water, and acts as a fire protectant (Morgan 1999 p1-2).

Buildings range from simple to complex depending on how much room is desired as well as the owner's budget. The cost of building this type of home is estimated at $50 a square foot, making an average-sized home (1700 sq.ft) approximately $85,000. This is assuming the owner contributes to the labor of putting up walls, which with a construction crew can be put up in one day, and plastering the outside. Not only can the builder save money by contributing to the labor, but once the home is finished, it will be two to three times better at insulating than conventional homes, saving him/her a significant amount in heating and cooling costs (House of Straw 1995, p5). Saving money on utility bills not only helps the consumer, but also the environment. Cutting down on energy use protects

the atmosphere from released fossil fuel emissions. The use of straw as a building material also cuts down on carbon emissions since most waste straw is burned, releasing gases into the air that contribute to global warming.

RASTRA

RASTRA is a relatively new material when compared to straw bale construction. The first ideas for this product did not come until 1968 when a few engineers wanted to design a whole new system of constructing a building. Their main concerns were simplicity, quality, strength, and affordability. What we know now as an Insulated Concrete Form (ICF), category into which RASTRA falls, did not exist about thirty-five years ago. A German based company had the first mixture of polystyrene (Styrofoam) and cement, but was struggling to find an economic use for it. After more research and experimentation, the first RASTRA elements were used to create a barn in the mountains of Austria in 1972 (RASTRA 2003). This material is now available and used worldwide. For Wisconsin there is a distributor in White Bear Lake, Minnesota who serves both states (Ojczyk 2004).

The structure of this material is composed of THASTYRON, which is eighty five percent post consumer recycled Styrofoam (RASTRA 2003). This serves as the frame used for walls, leaving the inside hollow to be filled with concrete. Two types of panels are used when building: load-bearing pieces for walls and END elements for corners and terminating wall sections. The company claims, “If you were able to play with LEGO as a child, you are able now to build a RASTRA house” (RASTRA 2003). The panels can be shaped to any form using tools normally used for wood and making it easy to carve window and door spaces. The elements however cannot be used in every aspect of the building and wood is needed for ledgers, I-joists, trusses, plywood decking, and interior walls (Ojczyk 2004).

Pricing out a home using this material involves many variables. The factory is located in Arizona making shipping an added cost of approximately $2,000-$2,500. A builder also needs to factor in the price for wood products that are needed with construction. Although minimal, it is needed for roof support and interior walls as mentioned previously. Joseph Ojczyk, a representative from White Bear Lake, Minnesota estimated the cost per wall square foot to be about $14 for a 1,700 to 2,000 square foot home (Ojczyk 2004), which includes shipping and labor costs.

Discussion

There has been success in using straw bale construction and RASTRA because of their price, effectiveness, and the positive contributions they make to the environment. Both save home owners money on heating and cooling bills as well as create beautiful spaces to live. Just one home made out of an alternative building material decreases the need for one acre of forest (A Series of Fact Sheets n.d.). Straw bales and RASTRA are economically advantageous because they are long lasting and endure a variety of weather conditions. The many straw bale homes built in Nebraska are still standing even after enduring long cold winters, tornadoes, and severe thunderstorms typical of the whole Midwest. RASTRA has been used all over the world in every type of climate and considering most of the material is Styrofoam (non-biodegradable), the structures are able to last a long time.

Wisconsin, in particular, has had much success with using alternative materials. The Clear Water Folk School in Washburn, Wisconsin has courses in design and construction for straw bale homes. If taking a course is not an option due to availability or time constraints, many books, articles, and videos are available on how to build, design, and work with city building codes. They can be useful to a first time or experienced builder.

RASTRA has also had great success with home builders in the Midwest. However, since the distributors are quite new in White Bear Lake, Minnesota, not many homes have been built in the area. Currently there is one home being constructed in St. Cloud, Minnesota and one being planned in Green Bay, Wisconsin (Ojczyk 2004). To see the success of this material in harsh climates, one can look back to where the first structures were built using this material. As mentioned previously, the first structure was built in the mountains of Austria, enduring harsher conditions from snow than does Wisconsin. Climates like Wisconsin's range from countries in Europe to Japan, where this material has been used effectively.

Although these materials have been used successfully, their use is not widespread throughout the state. To promote the use of these materials, policies may need to be set with state governments to allow some financial assistance to anyone who wants to build a home made of non-wood products. This would encourage the public to seek this assistance if they are looking to build a new home and would show the importance of decreasing the demand on wood products.

Decreasing deforestation rates by using alternative materials can play a key role in preserving the forests of the world. Old growth and second growth forests aid in climate regulation and improve the economy of the United States, as well as serve as a tool for research and education.

To decrease the demand on these areas, Wisconsin can do its part by using non-wood materials that are well suited to the climate, such as straw bale or RASTRA, which are known for their insulating properties, reasonable cost, and availability.

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