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MINNESOTA STATE UNIVERSITY, MANKATO

SHORT ROTATION WOODY CROPS:

A role for the state of Minnesota

Final Report and Recommendations
Rural Policy Panel on SRWCs

Seeking Solutions for Greater Minnesota's Future

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Acknowledgements

The Center for Rural Policy and Development established the Rural Policy Panel on Short Rotation Woody Crops in November 2000 to examine the status of agroforestry initiatives in Minnesota and to explore the potential role of state involvement in the future development of such crops. This report is the culmination of the panel's work and deliberations.

The Center would sincerely like to thank all of the panel members for the time and effort they have contributed to this project:

- **Tracy Beckman**, U.S. Department of Agriculture, Farm Services Agency
- **Bill Berguson**, UMD Natural Resources Research Institute
- **Wayne Edgerton**, Minnesota Department of Natural Resources
- **Alan Ek**, University of Minnesota, Department of Forest Resources
- **Don Frerichs**, Minnesota Department of Commerce
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Disclaimer: The participation of state agency staff on this panel should not be interpreted as an endorsement for budget recommendations by the Ventura Administration.

Executive Summary

Vision statement: To develop a comprehensive, coordinated, environmentally sound agroforestry policy for Minnesota that recognizes the needs of Minnesota's agriculture, forest products and energy industries, as well as the needs of the state's rural landowners, growers and communities.

The potential of short rotation woody crops
Several social and economic factors are converging at this time to suggest that Minnesota should seriously consider the development of a comprehensive state policy on short rotation woody crops (SRWCs). These factors include a projected shortage of harvest-age aspen in Minnesota's forests, the potential emergence of a biomass industry that will use SRWCs to generate electricity, and the desire to provide Minnesota farmers with opportunities to diversify their income sources.

SRWCs, trees such as hybrid poplar, hybrid willow and cottonwood, can be grown on Minnesota's farms like a row crop and are ready for harvest in fewer than fifteen years, compared to 40 to 60 years for a natural stand of aspen. SRWCs also have the potential for use in biomass power generation, and can serve as an alternative crop for farmers seeking new options for their land. In the forest products industry, Minnesota is facing what is predicted to be a serious shortage of harvest-size aspen trees within the next 15 years. Aspen is the primary source of timber for Minnesota's forest products industry, which provides 61,000 jobs for Minnesotans and contributes $7.8 billion to the state's economy. Short rotation woody crops, particularly hybrid poplar, are considered a suitable substitute for aspen in the manufacture of paper and oriented strand board.

At present, the forest products industry harvests 2.3 million cords of aspen per year to support current levels of production, but both the University of Minnesota and the Minnesota Department of Natural Resources project that the available aspen supply will drop sharply over the decade from 2014 to 2025 due to an impending age-class deficit. At the same time, prices for timber are increasing and are expected to continue to increase while aspen of optimal size and age becomes more difficult to obtain.

Currently, over 20,000 acres in Minnesota are under active cultivation as agroforestry plantations. Some of these acres are owned and managed by industry, while the rest are cultivated by private landowners, many of whom are working with researchers to monitor their crops' progress. At this time, however, there is no statewide coordinated strategy among land management agencies to further the development of this crop.

The purpose of the Rural Policy Panel on Short Rotation Woody Crops was to:

- Identify the incentives and barriers affecting the production of short rotation woody crops and the emergence of an agroforestry industry in Minnesota, and
- Discuss what role the state should play in supporting the emergence of an agroforestry industry in the state.

The result of the panel's work has been the following set of recommendations, which fall into four categories: the creation of a state-funded assistance program for growers of SRWCs; environmental protection; providing technical assistance to growers; and enhancing research on SRWCs. These recommendations are summarized as follows:

Creating a financial assistance program

Goal: **Minnesota farmers and landowners should have access to an appropriate public/private finance mechanism that recognizes the unique circumstances created by a crop with a growing cycle of up to 15 years.**

The panel recommends a program containing the following elements:

- ***Environmentally sound eligibility criteria.***
- ***A contractual agreement and management plan between the state and the grower.***
- ***An initial payment to help growers defray startup costs.***
- ***Annual payments to growers.***
- ***The state should explore opportunities for growers to obtain crop insurance for SRWCs.***
- ***Encouraging industry involvement.***

Environmental protection

Goal: **To maximize the benefits of growing SRWCs, public policy should direct SRWC production to the best possible sites for these trees while protecting regions and wildlife habitats where their planting could have an adverse effect.**

- ***Emphasis should be placed on growing short rotation woody crops in Minnesota's "transition zone" and eastward.***
- ***Avoid planting on or near native prairie/grasslands.***
- ***Develop a set of best management practices.***
- ***The program should include a public awareness and information campaign.***

Providing technical assistance

Goal: **To increase the probability of a successful crop and minimize risk, Minnesota growers need access to knowledgeable technical assistance and support.**

- ***Technical assistance should be available to all growers of SRWCs statewide.***
- ***The state should identify agencies and organizations currently involved in and offering technical assistance, then build upon that structure using the resources in place.***
- ***Support a technical assistance structure and capability that will be able to develop as the demand for its services increases.***
- ***Create a program to train those who will be providing technical assistance.***

Enhancing research and knowledge of SRWCs

Goal: **Current research in the field of SRWCs for pulp and as an energy source should be enhanced and consistent with a comprehensive agroforestry program.**

- ***Continue and expand funding of the work in progress to address more areas of the state and the current research needs on plant materials and growing technologies.***
- ***Seek more scientist and interest group input and funding to identify and quantify environmental benefits and impacts.***
- ***Work toward the development of best management practices that address grower success and environmental issues.***
- ***Improve the understanding of timber supply, economic and employment issues at the grower, industry and regional levels, including markets and marketing mechanisms.***
- ***Develop a mechanism to improve technical assistance via web and workshop mechanisms.***
- ***In funding this research, focus on needs by region and the functional strengths of the organizations currently participating. Emphasis should be placed on maximizing research capabilities (e.g., depth of staffing and resources) and communication of findings to participating organizations.***

Introduction

Recent advances in breeding fast-growing trees have made it possible to grow wood fiber using methods similar to those used to grow traditional agricultural crops. These trees, known collectively as short rotation woody crops, or SRWCs, include varieties such as hybrid willow, hybrid poplar and cottonwood. Today, the convergence of several social and economic factors suggests that Minnesota should seriously consider the development of a comprehensive state policy regarding SRWCs. These factors include a projected shortage of harvest-age aspen in Minnesota's forests, the potential emergence of a biomass industry that will use SRWCs to generate electricity, and the desire to provide Minnesota farmers with opportunities to diversify their income sources.

Current trends in timber supplies in Minnesota strongly indicate a coming shortage of harvest-age aspen. Research collected for this report projects that within the next 15 years, aspen supply levels will drop well below what is currently needed by the forest products industry. Such a shortage, and the resulting rise in timber prices, could have a serious effect on the industry as a whole and on those who depend on the industry.

Today, Minnesota's forest products industry employs more than 61,000 people, 28,100 in primary processing and 32,900 in secondary manufacturing (Minnesota DNR, 2000). The industry generated gross sales of $7.8 billion (Minnesota Forest Industry, 1998). Statewide, total harvest levels for all species have increased from 2.3 million cords in 1980 to 4.9 million cords in 1995. SRWCs are considered to be a suitable substitute for aspen and their production could contribute to filling the gap expected in the annual aspen harvest.

SRWCs are also under consideration for use in biomass power generation. According to a September 2000 report published by the Minnesota Department of Commerce ("Keeping the Lights On"), Minnesota will need up to an additional 5,000 megawatts of power by 2006 to avoid blackouts and to stabilize prices. The report also stated that Minnesota's power suppliers should be looking for energy technologies that pollute less, increase the diversity of energy supplies, and ensure that future generations have access to energy resources. SRWCs planted for energy generated by whole tree burning, ethanol or residue burning could fulfill part of the state's renewable energy mandate.

Finally, there is the reality that Minnesota's farm operators continue to be under significant financial stress. Low commodity prices for the past few years have accelerated an ongoing trend toward fewer and larger farm operations. In fact, without a series of both federal and state direct emergency payments to farmers, Minnesota's agricultural economy would be at risk of collapsing. While the production of SRWCs is not a financial cure for Minnesota farmers, it will give farmers an opportunity to place some agricultural lands into the production of a crop that is more environmentally sound and diversifies their income stream.

This report addresses the need for Minnesota to explore the development of a comprehensive policy on short rotation woody crops and delineates a series of policy recommendations for legislative consideration.

Short rotation woody crops

What they are

SRWCs are planted in rows in a previously cultivated field that has been prepared by killing the sod with herbicide, then plowing and disking. Eight- to ten-inch cuttings are usually planted. Weed control in the form of a herbicide is usually required for the first two or three years until the trees are tall enough to shade out weed competition. Over the course of a rotation, the stand is provided with nitrogen at least once. Some

pesticide application may also be necessary in certain parts of the state, usually for cottonwood leaf beetle (Meridian Corp, 1986).

What they are not

It should be clarified that, for the purposes of this report, SRWCs are not genetically modified organisms (GMOs). Genetically modified organisms are organisms whose genetic material is modified in a way not found under natural conditions to produce an organism which exhibits a trait (or traits) that would not otherwise occur through sexual mating. The process of genetic modification, or transformation, typically involves inserting strands of DNA foreign to the genus or species of the organism being modified. *Genetically modified* trees differ from *genetically improved* trees in that genetically modified trees could not be produced through natural pollination or controlled crossing.

The general definition of GMOs and the definition adopted for this report refers only to the unique modification of DNA through transformation and does not refer to traditional genetic improvement that has been used historically to improve trees, agricultural crops or livestock production. The panel is of the opinion that while it is safe and acceptable to grow genetically improved trees, they do not endorse the use of genetically modified organisms at this time.

Growing SRWCs on cropland: Diversifying agricultural economies and stabilizing the timber supply

The potential effects of growing trees as SRWCs on agricultural land can be summarized as follows:

- If the trend in rising timber prices continues, profits from poplar will exceed returns from corn and soybeans in certain parts of the state
- Crop diversification can reduce overall farming risk
- Potential cooperative efforts to harvest and/or process the wood, in addition to growing it, could provide value-added opportunities for farmers
- SRWC plantations require less overall chemical use and soil disturbance when compared with traditional row crops
- SRWC plantations can filter agricultural runoff from fields and absorb excess nutrients
- Farm-grown wood fiber could reduce total harvest acreage from public forestlands
- Farm-grown wood fiber can provide off-site environmental benefits such as reduced downstream flooding, stabilized stream channels, and improved water quality for downstream residents

The forest products industry in Minnesota

Forestland occupies 16.7 million acres of Minnesota, roughly 31 percent of the state. Minnesota's wood industry employs more than 61,000 people, 28,100 in primary processing and 32,900 in secondary manufacturing (Minnesota DNR, 2000). The industry generated gross sales of $7.8 billion (Minnesota Forest Industry, 1998). According to a 1990s study by the University of Minnesota, 11 percent of Minnesota's $55 billion in exports can be attributed to the forest products industry. Statewide, total harvest levels for all species have increased from 2.3 million cords in 1980 to 4.9 million cords in 1995.

Over the years, growth of the forest products industry has been accompanied by increasing demands for reserving old-growth forests from harvest, for maintaining biological diversity, and for considering the

aesthetic impacts of forest management practices on the tourism industry. Given the increasing area of forest reserved from harvest or where management and harvest practices are restricted, it is not surprising that there has been substantial concern about the ability of the forest resource to sustain an expanding forest industry.

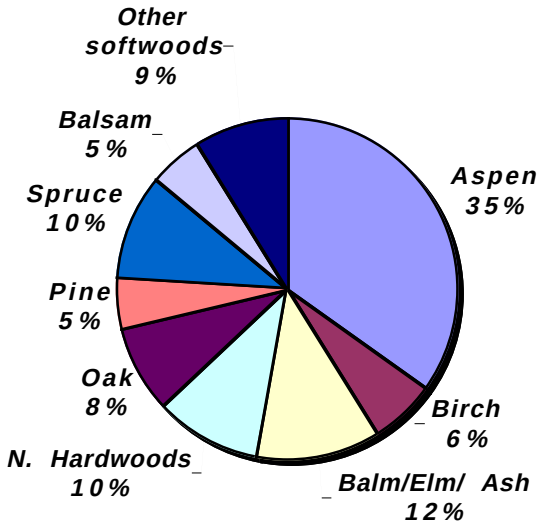

Figure 1: *Timberland by percentage of cover type.*
Source: Minnesota Department of Natural Resources

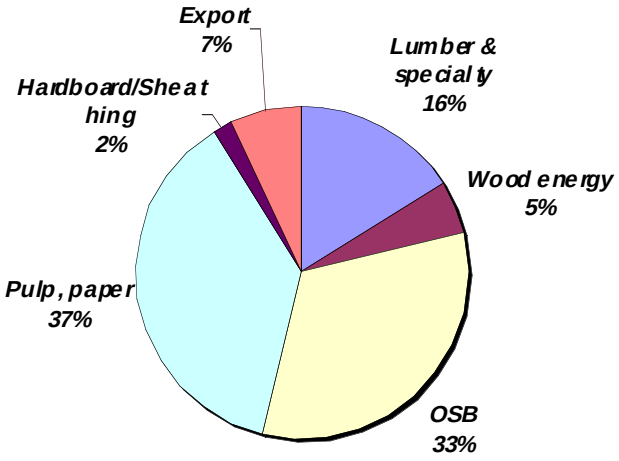

Figure 2: *Wood use by product from timber harvest in Minnesota, 1999.*
Source: Minnesota Department of Natural Resources

The importance of aspen to the forest products industry

Today, the wood products sector across the Great Lakes states is heavily dependent upon aspen (*Populus tremuloides* and *Populus grandidentata*) and balsam poplar (*Populus balsamifera*) as key sources of wood fiber for the production of pulp and oriented strand board, a widely used building material. Minnesota has 14 paper or oriented strand board mills throughout northern and central Minnesota, and aspen is the primary feedstock in many of these mills.

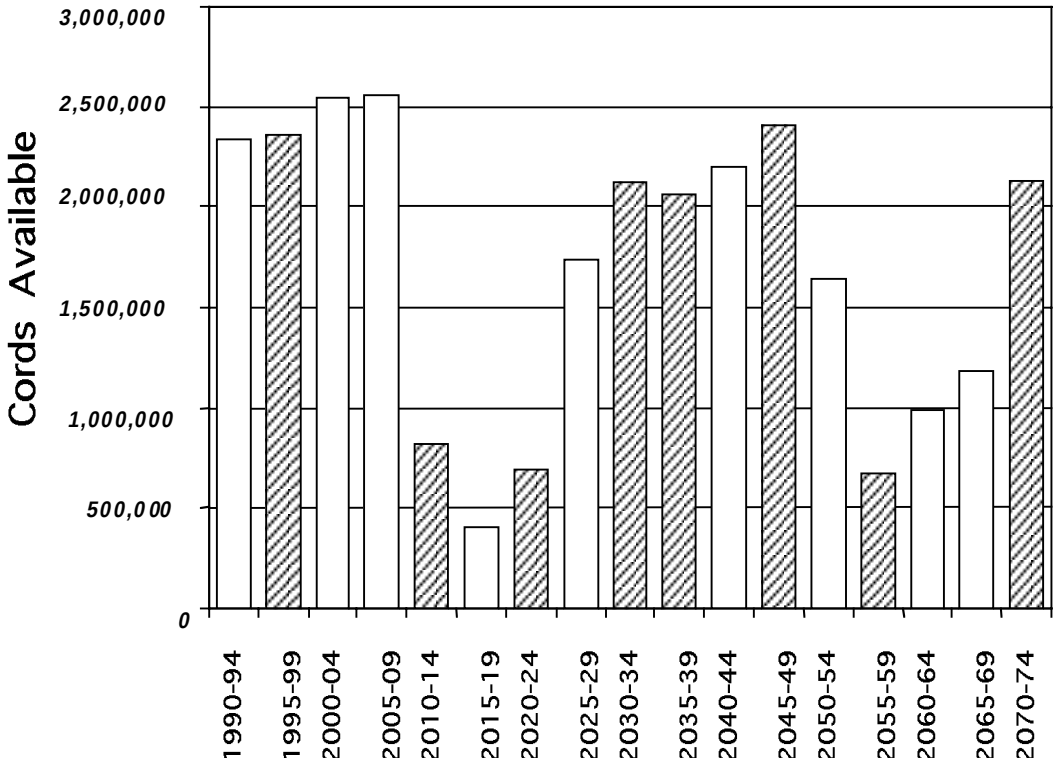

Figure 3: *Projected availability of timber, 1990 to 2074.*
Source: Center for Integrated Natural Resources and Agricultural Management

The future timber supply

Research conducted by the University of Minnesota, the Minnesota Department of Natural Resources and the forest products industry, indicate that Minnesota is facing a shortage of aspen within the next two decades, with similar trends across the upper Midwest. The shortage is caused by an "age-class imbalance" of aspen. Mature aspen and poplar forests have been largely harvested since the late 1970s, leaving many young stands and few older ones. As a result, mature aspen available for harvest in the future is expected to become increasingly scarce and inaccessible, while demand is projected to increase (Minnesota DNR, 1997). In fact, the supply of aspen is expected to fall well below the level needed to support current harvesting levels of 2.3 million cords of aspen per year. Figure 3 illustrates the available timber projected between 1990 and 2074.

The shortfall of aspen of harvestable age (between 40 and 60 years of age) is apparent. The model used for this report was based on the Minnesota Generic Environmental Impact Study (GEIS), conducted to address the impacts of increased timber harvesting in Minnesota (Jaakko Pöyry 1992). Assuming a harvest level of 2.5 million cords of aspen per year, based on DNR estimates, researchers estimate a supply shortfall of at least 1.5 million cords per year starting in 2014 and continuing for about 15 years. After a brief recovery, the supply is projected to drop back to a shortfall of between 0.5 million and 1.5 million cords per year, assuming current management practices continue.

Figure 4 displays supply estimates by age group from the Minnesota Department of Natural Resources. As in Figure 3, the future deficit of mature aspen is apparent.

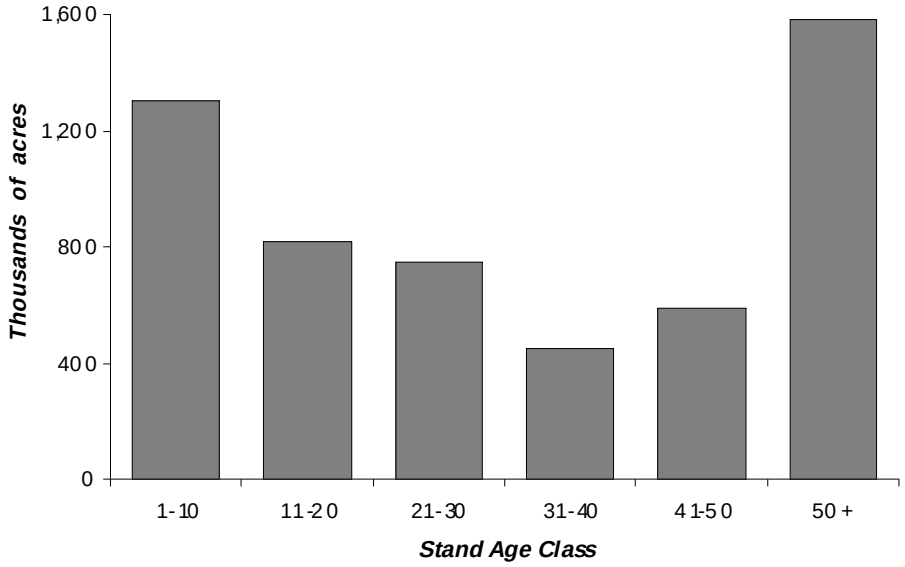

Figure 4: *Aspen and balm type availability, distribution by age group, 2000.*
Source: Minnesota Department of Natural Resources

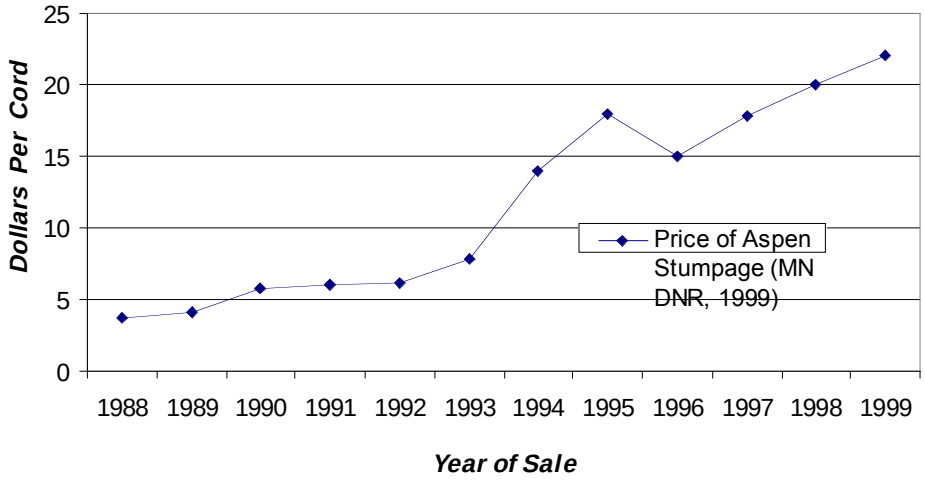

Figure 5: *Price of aspen per cord in Minnesota.*
Source: Minnesota Department of Natural Resources

At the same time, the price of aspen is increasing. Figure 5 shows how the price of aspen stumpage in Minnesota increased from an average stumpage price of $4 a cord in the late 1980s to more than $23 a cord in 1999. The price of nearly pure aspen has risen to over $30 a cord. During the summer of 2000, a few sales of "summer wood" were recorded at more than $45 per cord (personal communication with Aitkin and St. Louis County Land Departments), and one sale went for over $60 per cord (Star Tribune, October 26, 2000).

Hybrid poplar, the SRWC most commonly grown in Minnesota, is expected to be similar in quality to nearly pure aspen (Minnesota DNR, 1998). Given these price trends, it is reasonable to expect that a plantation of poplar of uniform quality and easy access could match or exceed the price of aspen in the season of peak demand.

As in most states with public forests, there is significant controversy in Minnesota over harvesting timber from public forestlands. At the national level, harvesting levels on National Forests have decreased by 70 percent over the last 10 years (USDA Forest Service, 1999). Furthermore, demand is increasing dramatically for non-timber uses, including recreational opportunities, wildlife habitat, and riparian buffers to protect and/or enhance water quality, habitat preservation or enhancement for rare and endangered species and/or increased biodiversity.

Consequently, the anticipated deficit in harvest-age aspen material in the near future could cause prices to increase to a point where paper and OSB industries cannot maintain profitability. The forest products industry is accustomed to fluctuations in the market place, but prolonged periods of tight profit margins could eventually lead to plant closings, resulting in a significant economic impact regionally. Besides the loss of jobs, plant closings would result in loss of tax revenue to the state and an increase of government expenditures on job retraining and unemployment claims.

Strategies to increase timber supply

Probably the most market-oriented way to alleviate this problem would be to increase the timber supply in a manner that would stabilize both the supply and price. Holding down the cost of raw material would help keep the forest products industry competitive in the world market and maintain the stability of the industry in Minnesota.

There are several ways to increase the timber supply. Each one would augment the supply, but no one method would be a complete solution.

- *Increase paper recycling:* With 50 percent of all paper being recycled now, there is little room for expansion.
- *Import fiber from other states or countries:* With a similar supply crunch in Wisconsin and stiff export policies in Canada, this option should not be counted on to contribute much. Shipping wood from overseas could alleviate some of the supply shortage, but higher shipping costs and higher world wood prices would not help bring prices down.
- *Use of other species to substitute for aspen:* Substitution would require costly replacement of equipment, but industry is beginning to increase the use of alternate species such as birch.
- *Reducing harvest levels and/or eliminating industries:* Reducing harvest levels could mitigate the projected shortfall somewhat, but the decreased supply would probably result in some plant closings.
- *Increase production and/or yields from traditional forestlands:* Intensifying certain management practices could result in higher yields, but would not be enough to solve the projected shortfall in the near term.

Producing wood fiber on agricultural land: A viable solution

Producing wood fiber in short-rotation production systems is another alternative. Filling the projected aspen shortfall 100 percent would require planting 330,000 to 660,000 acres of SRWCs so that 33,000 to 66,000 acres could be harvested in each year of a 10-year rotation. While it is unlikely that this much land could be put into production, at least right away, SRWC production could fill enough of that gap to help stabilize the wood supply.

There is a considerable amount of land that could be economically and agronomically suitable for SRWCs. Federal set-aside programs such as the Conservation Reserve Program have idled many acres of agricultural land in Minnesota. In addition, many acres are not suited agronomically or financially to traditional crops. If the subsidies of the 1996 Farm Bill and subsequent emergency bills were factored out of farm income, land prices would probably decrease, inducing more farmers to begin converting acres to alternative crops such as SRWCs.

The potential economic impacts of growing poplar

Successful SRWC crops would have economic impacts extending far beyond the farm itself. Growers could profit from producing the crop, existing industries could use the material to sustain their manufacturing operations, and new industry could take advantage of this supply of raw material. SRWCs would also create value-added processing opportunities.

The establishment of a significant amount of acres of a new crop would, in essence, create a new industry, which could have significant regional economic impacts. For example, a stable supply of wood with easy access may attract new industries that make paneling, plywood and molding or produce electricity through biomass power.

The establishment of many acres of SRWCs would also likely result in the creation of small businesses to manage and harvest the plantations. These businesses could include agronomists, foresters and consultants to advise landowners on planting and maintenance procedures, truckers to haul wood to the plant, and nurseries to grow the planting stock.

Farm grown wood will result in more value added processing within the state than is usually experienced with traditional crops such as corn and soybeans. Corn and soybeans often go straight from the field to a railroad car or barge and is shipped out of state and sold on national and international markets. Wood, on the other hand, is expensive to transport long distances and requires significant processing and handling to convert it to a usable product. This means that more Minnesota jobs are likely to be created from an acre of SRWC than from an acre of corn, because more people in Minnesota are involved with the crop before it reaches the consumer in its final form.

Economic impacts on the farm

The most obvious economic impact of promoting poplar production would be to the grower of the crop. While growing SRWCs is not going to make many farmers wealthy, this alternative crop can provide opportunities for farmers to diversify and modestly increase their incomes.
Farmers throughout Minnesota are experiencing serious challenges as a result of low commodity prices over the last four to five years. The price of corn has been below $2 for the last four years, and government subsidies are necessary for many farmers to continue in business. If farmers can make more of a profit growing SRWC, it is logical to expect positive economic impacts at the farm level from a policy that supports this crop.

A simplified cost/benefit analysis illustrates this point. Assuming a current stumpage price of $35 and a yield of 3 cords per acre per year for the length of the rotation in an area similar to Otter Tail County, an average landowner would cover costs of production, but profits from this crop would be about equal to what he or she would make growing corn. However, if wood prices continue to rise, reaching $50 per cord when the wood is harvested ten or eleven years from now, this same farmer would be making approximately $35 more per acre per year, or an additional $3,500 in profits annually on a 100-acre field. If the state provides some level of

financial assistance, and/or the farmer economizes by using his own labor and machinery, these profits would obviously increase.

The financial feasibility of producing poplar

The potential to make a profit from any crop depends on production costs, yields, and price of the product when it is sold. For the purpose of this study, the base line "average" stumpage price today, which is the price paid to a grower if a logger would harvest and transport the crop, is assumed to be $35 a cord, although this price is probably a little lower than an average price for high quality aspen in 2000.

As discussed earlier, the financial results of growing poplar depend on a variety of factors. Therefore, in order to make a judgement on where growing poplar makes the most sense, it is necessary to estimate profits from a variety of locations throughout the state. For this analysis Clearwater, Otter Tail and Nicollet Counties were selected to represent three different agricultural regions of the state. Table 1 lists the assumptions used in calculating the expected results of growing poplar in each of these counties and the estimated profits compared to corn.

Table 1: *Assumptions for growing poplar under current wood prices and yield projections.*

	Clearwater	***Otter Tail***	***Nicollet***
Land Value	$400	$600	$2,000
Land Rental Costs	$28	$42	$140
Yields (cords per acre per year)	2.25	3	4
Length of Rotation (years)	12	11	9
Interest Rate	5 %	5 %	5 %
Inflation Rate	3 %	3 %	3 %
Current Stumpage Price	$35	$35	$35
Year 1 Production Costs	$275	$275	$275
Year 2 Maintenance Costs	$90	$90	$90
Year 3 Maintenance Costs	$40	$40	$40
Years 4 and after Maintenance Costs	$10	$10	$10
Profits from Corn (assumed to equal 25% of land rental cost)	$7	$11	$35
Profits from Poplar	***$ +3***	***$ +10***	***$ -51***

The assumptions listed above were used to calculate profits from corn and from poplar in three different parts of the state. As this table indicates, profits from poplar are slightly less than profits from corn in Clearwater and Otter Tail Counties, but are significantly less than corn in Nicollet County. In fact, in Nicollet County a grower would actually lose $51 per acre each year. This is primarily a function of land cost. Although yields are expected to increase where the soils are more productive and where the growing season is longer, these increases in yields do not make up for the significant differences in land costs.

The next step in ascertaining the financial feasibility of producing poplar is to estimate profits from poplar (in relation to profits from corn), under two different wood price scenarios. As Table 1 illustrates, at current wood prices, and without any outside financial assistance, profits from growing poplar in Clearwater and Otter Tail Counties will basically equal corn and would be significantly less than corn in Nicollet County. Therefore, because this is a new crop with untested markets and new production procedures, growers are not likely to switch to poplar if potential profits are only equal to corn.

Table 1 shows that at current stumpage prices and estimated current production costs and yields, a grower may make a little profit in Clearwater and Otter Tail Counties, but the profits would be similar to what he or she is currently making from the existing crop. Therefore, unless some of the underlying production factors change, such as expected yields, prices for wood, etc., it is unlikely that Minnesotans will plant poplar.

However, given the projected shortage in timber from traditional supplies, it is reasonable to expect that the price of pulpwood will continue to rise – given the trend of the last 20 years, and accepting the data that shows that supply pressures are only going to continue to increase.

Additionally, there is strong reason to believe that farm-grown hybrid poplar would generate a substantial price premium because of its year-round availability for harvest, easy access, and the uniformity of the wood supply. Hybrid poplar is especially attractive to forest industries because it can reduce a pervasive problem faced in the procurement of aspen wood: an inadequate amount of summer harvested aspen to keep mills running year round. Hybrid poplar on agricultural land should be accessible all year, and costs associated with road building and environmental permitting should be much less than on forested land. These advantages should bring a price premium, which can be seen, in the premium paid for aspen summer wood in recent auctions.

Table 1 also illustrates the expected profits of growing poplar compared to corn, if the price of wood continues to rise at a rate 3 percent above inflation each year. At this rate, wood prices would be approximately $50 in twelve years. In areas with yield rates and land costs similar to those found in Clearwater and Otter Tail counties, the profits from poplar would be significantly above profits from corn, but in Nicollet County profits would still be lower than corn.

The potential for biomass

SRWCs are also under consideration for use in biomass power generation. SRWCs planted for energy generated by whole tree burning, ethanol or residue burning, could fulfill part of the state's renewable energy mandate.

According to a September 2000 report published by the Minnesota Department of Commerce ("Keeping the Lights On"), Minnesota will need to have an additional 5,000 megawatts of power by 2006 to avoid blackouts and to stabilize prices. The report also stated that Minnesota's power suppliers should be looking for energy technologies that pollute less, increase the diversity of energy supplies, and ensure that future generations have access to energy resources.

Part of this search for new technologies is already in motion. In 1994, the Minnesota State Legislature struck a deal with Xcel Energy (then Northern States Power). That year Xcel made a request for permission to expand its aboveground storage capacity for nuclear waste at its Prairie Island nuclear station. The state agreed to the expansion in exchange for a number of mandates put on Xcel, one of which requires Xcel to supply 125 megawatts of power fueled by biomass, whether by constructing and operating a plant or by purchasing the energy from a supplier. The 50-megawatt biomass plant proposed for St. Peter fulfills part of the 125-megawatt mandate.

While there currently is no commercial wood fuel biomass electric generator in Minnesota, there continues to be activity and progress in that direction. Most recently, Xcel Energy entered into a power purchasing agreement with EPS/Beck Power to purchase output from a planned 50-megawatt biomass plant to be sited in Southern Minnesota. The proposed plant will burn hybrid poplar trees in their entirety, in a process trademarked as Whole Tree Energy (WTE^{TM}).

While still in its planning stage, with many questions yet to answered, the EPS/Beck Power project has been involved in large scale laboratory tests and field experiments for some time. Results from those trials yield the following:

- Fuel heat content: 8,800 Btu/LB.
- Fuel heat content per ton: 17.6 Mbtu/DT.
- Annual fuel required: 225,500 DT.

Based upon the testing and engineering calculations, the 50 megawatt WTE™ power plant will require 225,500 dry tons of whole tree biomass annually for 20 years to meet the objectives of the power purchasing agreement with Xcel Energy. Assuming the plant is fueled with 95 percent farm-grown biomass (after initial start up), a total of 214,000 dry tons of farm-grown trees will be needed annually.

As mentioned above, the proposed biomass plant has yet to be constructed, and many questions still need to be answered. Probably the largest concern is in the ability to acquire the needed trees at a reasonable price for electric generation. As this report has documented, the stumpage price for aspen has grown significantly over the past 10 years and is projected to continue to increase as the supply of available trees decline. This has the potential to create a competition for farm grown hybrid poplar between the energy and forest products industry and potentially raise the price of electric energy beyond acceptable levels.

Regardless, it is clear that there is great interest the development of clean-burning, renewable electric energy generation, and many are looking toward farm-grown hybrid poplar to fill that need.

In summary, it is reasonable to expect that if the age class deficit results in a continuation of increasing pulp prices, and/or users pay a premium for easy-access summer wood, growing poplar will be more profitable than growing corn and other traditional row crops in some parts of Minnesota. Under these assumptions, if the price of wood continues to rise, farmers may plant poplar without state action. This is possible, but there is another issue that will inhibit many farmers and landowners from considering this crop: even if poplar is profitable when returns are averaged out over the entire rotation of the crop, many farmers simply cannot go ten years without receiving any revenue from the land. Without some sort of mechanism to create a "cash-flow" throughout the rotation, it is simply not an option for many landowners. Furthermore, this is a new crop, and most farmers would consider it to be more "risky" than a traditional crop, and therefore, the potential rewards must be equally greater to compensate for the potential risks. Consequently, even if pulp prices continue to rise, small farmers and landowners may not get involved without some sort of financial incentive.

Where does growing wood fiber make the most sense?

There are a variety of factors that determine where growing poplar could make sense, from the perspective of both the grower and the buyer. These factors include profit potential, access to markets, and agronomic considerations.

As with any cropping system, the potential for profits depends on how much is spent on growing the crop (production costs), how much product is produced (yields), and the price received when the crop is sold (price). Since these factors vary throughout the state, it is logical to expect that profits from SRWCs will vary as well. Although yields are expected to increase where the soils are more productive and where the growing season is longer, these increases in yields do not always make up for the significant differences in land costs. As the earlier discussion showed, growing poplar in areas represented by Clearwater and Otter Tail Counties appears to be more financially feasible than areas like Nicollet County, with its higher land values.

Consequently, from a financial perspective, growing SRWCs makes more sense where land costs are lower, such as in the central and northwest parts of the state.

Another consideration when planting poplar is the distance to a potential market for the wood. In the future there may be biomass power plants or new manufacturing facilities to sell wood to, but today the market for poplar is limited to the 14 paper mills or OSB plants located throughout the northern and central regions of the state. If SRWCs are sold on the stump, transportation costs will be a significant consideration when the buyer makes an offer for the wood. If the wood is to be sold at the gate, transportation will be a significant cost to the grower. Therefore, it is reasonable to expect that growing SRWCs will be more profitable in areas near a paper mill or OSB plant. Currently, buyers typically try to purchase wood within 100 miles of their mill. This distance can serve as a rough guideline for estimating the areas that are close enough to a market to make growing poplar profitable.

Agronomic considerations are also a factor. For example, hybrid poplar does not grow well on the high pH soils found in extreme western Minnesota, and they may not do well on pure clay soils, like those found around Lake Superior. SRWCs are also unlikely to yield well in areas with less rainfall, such as in the southwest corner of the state.

Optimal Areas for Growing SRWCs

Obviously, if wood shortages become more pronounced, buyers will become more willing to travel further for the wood, and if new markets develop in areas where there are no markets currently, new areas could become desirable for SRWC production. When the criteria described above are analyzed, the areas of the state that appear most suited for SRWC production at this time are agricultural land in the central and northwestern parts of the state. This area is along the transition zone between what were originally the prairie and the forested parts of the state and could be generally described as areas north of I-94 and west of Highway 169 and the city of Grand Rapids. This boundary still includes significant prairie and grassland areas in a number of counties, however. Consequently, modifications would be necessary to address local concerns. Also, as most of the land east of Duluth in the Arrowhead region is already forested, this region is excluded from this "optimal area" for growing hybrid poplar.

The potential environmental impacts of growing poplar on farmland

Any discussion on the potential for SRWCs in Minnesota eventually leads to the question of ecological and environmental impacts. The impact of an SRWC can be positive, negative or neutral, depending on the environmental context in which the trees are grown.

It is important to recognize that a field of hybrid poplar is a monoculture with limited diversity, and like any other monoculture (e.g., corn, beans or wheat) it provides habitat to only a few wildlife species. When SRWCs are planted in the place of another agricultural crop, in most cases it can be expected to have little adverse environmental impact. On the other hand, SRWCs planted in the place of existing forest, brush land or grassland will result in less biodiversity, more chemical use, and less aesthetic diversity. Consequently, each planting site must be judged on the potential environmental impacts, both on site and off, that the planting will have.

Many factors interact to determine the environmental impact of SRWCs, including:

- crop species and management methods
- site characteristics (soils, slope, previous land use)
- amount of land in production
- surrounding plant and animal communities

The positive or negative effects an SRWC has on its surroundings depend largely on what kind of land the crop is located on, what plant and animal communities are present and the production methods being used. If placed away from existing grassland blocks, SRWCs replacing annual crop production can be expected to produce positive results, while SRWCs replacing natural forests can be expected to have negative effects (Beyea et al. 1991). If hybrid poplar were incorporated into an existing crop monoculture, as would likely be the case in agroforestry practices such as windbreaks, timber belts, riparian buffers, or small block plantings, most environmental impacts would be positive. Overall chemical use would decrease (tillage is only required in the first year and weed control is only required the first three years) and the aesthetic diversity of the landscape, for some individuals, would increase.

Almost all SRWCs planted to date have been located on previously cultivated farmland. Since there are many acres of "marginally productive" agricultural land in Minnesota, and since the expense of clearing existing forest would dramatically reduce the profits of growing poplar, it is unlikely that uncultivated land will be cleared for the purposes of planting poplar.

Table 2: *Comparative Impacts from Fertilizers, Herbicides and Erosion.*

		Fertilizers			
	Erosion*	Nitrogen	Phosphorus	Potassium	Herbicide
Crop	(Mg ha^{-1} yr^{-1})	(kg ha^{-1} yr^{-1})	(kg ha^{-1} yr^{-1})	(kg ha^{-1} yr^{-1})	(kg ha^{-1} yr^{-1})
Corn	21.8	135	60	80	3.06
Soybeans	40.9	10	35	70	1.83
HECs**	0.2	30	50	90	0.25
SRWCs	2.0	60	30	80	0.39

Source: Wright, L.L., and W.G. Hohenstein (eds.). 1992. Biomass energy production in the United States: Opportunities and constraints. U.S. Department of Energy and U.S. Environmental Protection Agency. Draft, August 1992. Adapted from Office of Technology Assessment, U.S. Congress. 1993. Potential environmental impacts of bioenergy crop production: Background paper. Washington, D.C.: U.S. Government Printing Office.

** Erosion figures are national averages and are generally higher than typically found in Minnesota.*

***HEC: Herbaceous Energy Crop (.e.g., Switchgrass).*

Table 2 compares SRWC to conventional row crops and switchgrass (used as an herbaceous energy crop) in their impacts from fertilizers, herbicide and erosion. As Table 2 shows SRWCs had a lower environmental impact than corn or soybeans. In addition to less cultivation, both fertilizer and pesticide application were lower than the amounts typically applied to row crops.

Potential negative impacts

As discussed previously, the impacts of planting SRWCs depend on what the SRWCs replaced and what plant and animal communities surround the planting. If SRWCs were planted on land that is currently planted in native vegetation (i.e., prairie or forest), or land that is restored in a condition that supports a variety of species suitable to the site (i.e., mixed species CRP land), there would likely be adverse effects because of the loss of plant diversity and associated wildlife habitat.

The greatest impact SRWCs could have is on grassland birds, which are perhaps the best indicator of the health of the prairie ecosystem. Minnesota is at the crossroads of three great North American ecosystems: the prairie, the northern forest, and the Eastern deciduous forest (the transition zone between the other two ecosystems). Native prairie is among the most endangered ecosystems in the United States (Noss 1995). Minnesota, like most other tall grass prairie states, has lost more than 99 percent of its native tallgrass prairie (Samson and Knopf 1994), and grassland bird populations, an indicator of the health of a grassland ecosystem, have declined more than any other group of birds in North America in the last 30 years (Knopf 1994, Herkert 1995, Petejohn and Sauer 1999).

Species are more likely to survive if maintained within a functioning landscape that has not been fragmented into smaller, isolated parcels. Tree plantations can impact grassland ecosystems in numerous ways, but particularly by harboring predators and by causing grassland birds to avoid the area altogether. The composition of the surrounding landscape out to at least one-half mile is important to grassland bird management (Ribic, in press).

Due to the importance of the location of the trees, it is important that any state policy promoting the planting of SRWCs helps to guide where they are planted. Currently, there is no incentive or disincentive to guide where SRWCs are planted, and it is possible that private landowners will plant SRWCs in areas conducive to erosion, or near native prairie, resulting in negative environmental impacts. Consequently, some degree of state intervention may be in order.

Panel Recommendations

The panel's recommendations are divided into four broad areas: the creation of a state-funded assistance program for growers of SRWCs; environmental protection; providing technical assistance to growers; and enhancing research on SRWCs. The centerpiece of the recommendations is the creation of a financial assistance program designed to encourage growers to plant an additional 95,000 acres of SRWCs over the next 10 years. The specific recommendations follow.

I. Creating a financial assistance program

Goal: **Minnesota farmers and landowners should have access to an appropriate public/private finance mechanism that recognizes the unique circumstances created by a crop with a growing cycle of up to 15 years.**

Due to the long time frame involved, the largest hurdle in growing SRWCs will likely be financial, i.e., the startup costs and the lack of annual cash flow from the crop. If SRWCs are to be a viable crop for Minnesota farmers, some type of financial assistance mechanism will be needed to encourage growers. The panel recommends a program containing the following elements:

- **A contractual agreement and management plan.**

The state should require growers participating in a state SRWC financial assistance program to complete a contractual agreement and a management plan. These two documents would serve as evidence that the grower intends to plant and utilize sound management practices.

The contractual agreement and the management plan should stipulate requirements that must be met for the grower to be eligible for state cost share payments. These requirements are aimed at maximizing the crop's value and benefit to both the grower and the surrounding natural environment. The contractual agreement should contain at least the following points:

  - Payment schedule.
  - Planting schedules.
  - Legal description of site and number of acres.

The management plan should contain requirements to be met for program eligibility, including such requirements as:

  - The selected site must be approved by the state.
  - Growers cannot convert existing prairie, forest or wetland.
  - SRWCs cannot be planted within one-half mile of existing native prairie.
  - SRWCs must be planted on appropriate soils to assure success of planting.
  - The site must meet soil erosion standards related to soil type, slope, and other agronomic factors.
  - Existing CRP land cannot be converted prior to the end of contract for purposes of receiving financial assistance through this SRWC program.
  - Genetically modified organisms are excluded from this program.
  - The grower must access technical assistance from state-approved sources.
  - The site must undergo an annual inspection for at least the first three to five years to certify that the requirements are being fulfilled and the crop is being maintained.

- **An initial payment to help growers defray startup costs.**

Other than the cost of owning or renting land, the highest costs associated with planting and maintaining SRWCs are the startup costs encountered during the first year, which include acquiring the plants, tilling, herbicides and pesticides. After the third year, a well-maintained crop will have established itself and will require less investment. The panel recommends a minimum payment of $100 per acre the first year to help defray some of these initial costs.

- **Annual payments to growers.**

The absence of year-to-year cash flow could be mitigated through a program of annual payments made directly to growers. By participating in a direct payment program, growers would be provided with some income until harvest to help cover land taxes and management expenses. The payments should only be enough to minimize risk and assist in the crops' profitability, but not enough to remove all risk or guarantee profits. The panel recommends:

  - An annual payment equal to 50 percent of the weighted USDA Soil Rental Rate for that site, with a minimum of $25 per acre per year.
  - Annual payments would begin the second year of the rotation (the first year being covered by the startup cost payment) and last no longer than 10 years.
  - Eligible land parcels must be a minimum of 30 acres, with a lifetime maximum enrollment limited to 160 acres.

Use of the soil rental rate is recommended because it is already established for the entire state and most farmers are familiar with it. Because the payments are based on soil productivity and hence are proportional to annual agricultural land rents, the annual payment mechanism proposed here would not favor any particular part of the state, would encourage SRWCs in areas that are less productive for traditional crops, and would encourage private industry and cooperatives to provide technical assistance and establish forward contracts with growers, helping to stabilize the wood supply.

- **The state should explore opportunities for growers to obtain crop insurance for SRWCs.**

As with any kind of crop, there is a risk of crop failure due to unforeseen natural disasters. Crop insurance may be a means of reducing growers' aversion to risk that could prevent them from planting an SRWC. Besides serving as a safety net for growers to protect their investment, crop insurance can also serve as a guarantee to a lender if the grower chooses to obtain a loan.

- **Encourage industry involvement.**

As a complement to a financial assistance program, the state should encourage the forest products industry and energy industries to become involved in supporting the growing of SRWCs by private growers. While industry should not be recipients of state payments themselves, they should be encouraged to develop contracts with growers and provide technical assistance and payments to growers.

II. Environmental protection

Goal: **To maximize the benefits of growing SRWCs, public policy should direct SRWC production to the best possible sites for these trees while protecting regions and habitats where their planting could have an adverse effect.**

Over the years, the state of Minnesota, federal agencies and other groups have made considerable investments in preserving and protecting our natural environment. While SRWCs have their many benefits, they also have the potential for adverse effects on wildlife and plant life if they are sited in inappropriate locations. A well-designed program of site selection and monitoring would serve to protect our environmental investments.

- **Emphasis should be placed on growing short rotation woody crops in Minnesota's "transition zone" and eastward.**

To ensure a successful crop with a minimum impact on wildlife, the state should emphasize growing SRWCs in the state's transition zone and regions east of there (see general description of this area on p.15).

- **Develop a set of best management practices.**

Best management practices should be developed to address the planting and maintenance of SRWCs, including, but not restricted to, site selection, chemical use, plant species, proximity to specific sites and features that could be affected by the presence of an SRWC. BMPs should also include means for addressing unintended impacts, such as blocked drain tile and damage from animals.

- **The program should include a public awareness and information campaign.**

III. Providing technical assistance

Goal: **To increase the probability of a successful crop and minimize risk, Minnesota growers need access to knowledgeable technical assistance and support.**

Technical assistance for the grower will be a vital part of risk management and ensuring the success of the crop. SRWCs differ from forestry and require specialized management for success. At this time, there are several sources of technical assistance and information available to growers. These include the Hybrid Poplar Research Cooperative; the Minnesota Department of Natural Resources; the Agricultural Utilization Research Institute; the U of M Center for Integrated Natural Resources and Agricultural Management; U of M – Crookston; Minnesota Extension Service; WesMin Resource Conservation & Development; Minnesota Department of Agriculture; USDA Forest Service; and industry resources. If a program promoting SRWCs is successful and the number of growers increases, the current resources for technical assistance will be inadequate. Growers will require training as will those who train them. Integrated, broad-based technical assistance from the beginning is crucial and should begin before planting.

- **Technical assistance should be available to all growers of SRWCs statewide.**

All growers, whether they participate in the financial assistance program or not, should have access to knowledgeable technical assistance.

- **The state should identify agencies and organizations currently involved in and offering technical assistance, then build upon that structure using the resources in place.**

- **Support a technical assistance structure and capability that will be able to develop if and when the demand for its services increases.**

- **Create a program to train those who will be providing technical assistance.**

IV. Enhancing research and knowledge of SRWCs.

Goal: **Current research in the field of SRWCs for pulp and as an energy source should be enhanced and be consistent with a comprehensive agroforestry program.**

The legislature currently supports a university-based research cooperative developing new hybrid poplar clones suited for Minnesota soils and climate. The program researches yield based on soils and management, conducts fertilizer and herbicide trials, and provides technical support to industry, agencies and private landowners. This research is also supported by matching funds, both cash and in-kind, from industry, state agencies, the USDA Forest Service North Central Research Station and the University. Various programs in the University have also supported this effort with, for example, long-term genetic improvement programs for poplar and other species, and with economic and timber supply analyses and market studies.

- **Continue and expand funding of the work in progress to address more areas of the state and the current research needs on plant materials and growing technologies.**

Current research needs include expanding research to include more regions and soils of interest, particularly in southern Minnesota; continue and expand development and testing of improved hybrid poplar clones and expand work on other possible SRWC species and plant materials; continue and expand work on the development of growing and harvesting technologies; and examine the short- and long-term effects of chemical use and ways to reduce or minimize such applications.

- **Seek more scientist and interest group input and funding to identify and quantify environmental benefits and impacts.**

This recommendation includes site and landscape benefits and impacts; investigating the potential impact on the native plant gene pool with respect to the production of gametes by hybrid plants; and evaluating the sustainability of SRWC practices at site and landscape levels.

- **Work toward the development of best management practices that address grower success and environmental issues.**

- **Improve the understanding of timber supply, economic and employment issues at the grower, industry and regional levels, including markets and marketing mechanisms.**

- **Develop a mechanism to improve communications among researchers and technical assistance providers via web and workshop mechanisms.**

- **In funding this research, focus on needs by region and the functional strengths of the presently participating organizations. Emphasis should be placed on maximizing research capabilities (e.g., depth of staffing and resources) and communication of findings to participating organizations.**

V. Organizational and fiscal considerations

While the Rural Policy Panel on SRWCs did discuss the organizational and fiscal implications of their work, specific recommendations regarding which state agency should administer the program or total fiscal costs of the program were not made. However, some relevant thoughts that were discussed by panel members are as follows:

- While forest issues are usually directed toward the Minnesota Department of Natural Resources (DNR) and the Minnesota Forest Resources Council, "agroforestry" is defined in Minnesota statute as agriculture. This contradiction impacts decision-making regarding which agency should administer such a program. During the 2000 legislative session the legislature passed an agroforestry loan program to be administered by the Minnesota Department of Agriculture (MDA). Since both departments are clearly involved, coordination between MDA and the DNR will be essential to the success of the proposed program.

- Fiscal considerations associated with the panel's recommendations fall into four areas: the costs associated with the state's financial assistance to growers; the agency's costs of administering the program; and the costs associated with providing technical assistance and research costs. All four need to be funded for a successful program.

- **Financial Assistance to Growers:** Assuming that 5,000 acres were planted in Year 01 and 10,000 acres were planted for each of the following nine years, the total maximum costs of the proposed program over 20 years (excluding administration costs) would be $30 million. Costs would not exceed $4 million in any given year and could easily be adjusted, as it is completely dependent upon the number of acres in production.

- **Administration Costs**: The panel also recognizes that simply initiating a program and asking a state agency to administer it without adequate resources is not realistic. Consequently, administration costs must be appropriated if the program is to be successful.

- **Technical Assistance Costs:** The panel recognized that technical assistance to growers comes at a cost. There are several existing resources that are able to provide such technical assistance, including AURI, WesMin RC & D, University of Minnesota, Minnesota Department of Natural Resources, as well as private industry. As the state examines the technical assistance capacity throughout Greater Minnesota, it is important to consider the fiscal implications as well.

- **Research Costs:** Lastly, the panel recognized that research-based knowledge is essential to program success as growing technologies, plant materials, plant health and economic and environmental situations evolve. As the state examines the technical assistance capacity, it will surely be important to consider the fiscal implications of supporting research as well.

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