MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FORESTRY



# MINNESOTA

# NURSERY AND TREE IMPROVEMENT PROGRAM

February 1, 1983

## ACKNOWLEDGEMENTS

This program document was prepared by the Minnesota Department of Natural Resources, Division of Forestry in cooperation with the University of Minnesota, College of Forestry.

The Division of Forestry greatfully acknowledges the time and assistance given by Dr. Carl Mohn and Mr. Robert Stine of the College of Forestry in the preparation of this document.

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## EXECUTIVE SUMMARY

The forest tree nurseries maintained by the Minnesota Department of Natural Resources, Division of Forestry, produce a significant proportion of the tree planting stock used in the state each year. Public concerns over tree quality and nursery production capabilities have resulted in the inclusion of Section 13 in the Forest Resource Management Act of 1982. This section calls for submission of a nursery operations and tree improvement plan to the legislature by February 1, 1983. This document was prepared in response to that charge, and presents the findings of the University of Minnesota scientists and Division of Forestry professionals who studied the issues involved.

### Tree Improvement Program

A long-term tree improvement plan was developed for the Department of Natural Resources, Division of Forestry and published in 1981. This plan was reviewed during the latter part of 1982, and program priorities were adjusted based on newly acquired information. This new information was: improved estimates of long-term DNR seed needs; a series of benefit-cost analyses covering various improvement approaches available for the six highest priority species; and experience in operational and biological limitations gained since the original program was initiated in 1981.

Based on this new information, species priorities in the improvement program were altered slightly, and the approaches chosen for improvement of each species were further refined. The species involved in the program and their priority are as follows:

Category I (highest priority)

| | |
|---|---|
| Red (Norway) Pine | White Spruce |
| Jack Pine | Black Spruce |

Category II (second priority)

| | |
|---|---|
| Black Walnut | Scotch Pine |
| Poplars | White Pine |
| Larch (native and European) | |

The specific improvement approaches chosen include: seed source control; grafted seed orchards; and seedling seed orchards. These three activities offer the greatest opportunities for both genetic and economic gain, within a reasonable time frame and budget.

The question of forest tree seed certification was also addressed during the 1982 plan review. Based on the current limited commercial exchange of reproductive material in Minnesota, it is recommended that seed certification not be implemented at this time. However, as more genetically improved material becomes available in the 1990's, seed certification should be considered. The certification system should be developed

by the Director of the Division of Forestry, with input by all members of the Minnesota forestry community.

## Modern Nursery Operations

Modern nursery techniques are being implemented at the state forest nurseries. Improvements are needed and are being made in four major areas. These areas are: bareroot seedling production; containerized seedling production; seedling packaging and shipping; and a computerized information system for nursery management. Activities designed to enhance nursery productivity and stock quality include: improved seed extraction, storage and viability testing; improved irrigation systems and scheduling; increased use of cultural amendments; and less labor intensive, more efficient forms of seedling packaging and handling.

Containerized nursery operations offer increased efficiency in seed utilization, and opportunities for producing stock for the successful reforestation of lowlands. However, containerized operations also represent a substantial new capital investment which the state may not have the needed financial capacity to undertake during the next few years. Limited quantities of containerized stock are being grown for the state by private contractors, and this stock is being evaluated for its usefulness in state plantings. If these evaluations prove the value of containerized stock, it is suggested that the state forest nurseries enter into long-term (4 to 6 year) agreements with private vendors to produce containerized planting stock, predominantly for lowland planting in Minnesota.

Contractual agreements with nursery tree seedling users were also reviewed and three areas of improvement were identified. The first improvement would be the elimination of an unlimited tree order alteration and cancellation policy in favor of a policy which allows such action for only thirty days after ordering, and which charges a service fee for such actions. The second suggested improvement calls for establishing long-term, cash in advance ordering procedures so that the nurseries could effectively enter into production of special-order stock for customers. Finally, the third improvement calls for the revision of Minnesota Statutes 89.37, Subd. 1, to allow for the interstate trade of nursery stock between state departments of natural resources, when that stock is not needed in the state in which it was produced.

## Benefits, Costs and Finances

A detailed financial and economic analysis was conducted to establish the surcharges and user fees necessary to place the nurseries on a fully self-supporting financial basis. The results of this analysis indicate that a surcharge of $3.80 per 1,000 seedlings would place the tree improvement program on a fully self-supporting basis by as early as fiscal year 1985. By increasing the production fees for unimproved nursery stock from the current level of $60.00 per thousand to $69.49 per thousand, the nurseries could also be placed on a self-supporting basis by fiscal year 1985. However, there is some uncertainty over the effects that charging all purchasers, including public agencies who formerly received trees free, will have on nursery stock demand and production. Therefore, it is recom-

mended that the nursery program itself not be placed on a self-supporting basis until fiscal year 1986, when the effects of the charging policy enacted in 1982 are more fully known.

Once it is fully operational, the self-support policy will save the State General Fund an estimated $520,000 per year in the form of reduced appropriations for running the nurseries. In total, it is estimated that a switch to a self-support policy, beginning in fiscal 1984 and completed in fiscal 1986, would provide net benefits to the state in excess of $8,000,000 by the turn of the century.

Recommendations and Conclusions

Thirteen recommendations have been made to assure the successful implementation of the actions, programs and policies described in this report. The reader may refer to pages 5.2 and 5.3 of this report for a complete listing of those recommendations. In summary it was concluded that the Minnesota Department of Natural Resources has a viable tree improvement plan and program which is currently being implemented. Modern nursery techniques are being implemented at the nurseries, and the full, successful implementation of those practices is dependent on the installation of a computerized information management system during the 1983 - 1985 biennium. Finally, a total self-support policy for the nurseries is feasible, can be fully implemented by July 1, 1985, and would provide benefits to the state and its people far in excess of its costs.

# CHAPTER I

## INTRODUCTION AND ORGANIZATION

The forest tree nurseries maintained by the Minnesota Department of Natural Resources, Division of Forestry, provide much of the planting stock used by both public and private landowners in Minnesota. This planting stock is used for soil and water conservation purposes and wildlife habitat improvement, as well as for reforesting Minnesota's valuable commercial woodlands. Public concerns over improved tree quality and nursery production capabilities were expressed by public and private forestry experts during the early 1970's. Throughout the 1970's these concerns continued to rise higher and higher on the public agenda of conservation items needing to be addressed by public officials.

The rise of these concerns culminated with the inclusion of Section 13 in the Forest Resource Management Act of 1982, which states in part that:

> "By February 1, 1983, the commissioner (of natural resources), with the assistance of the agricultural experiment station of the University of Minnesota, shall submit a plan to the legislature on the benefits and costs of making the nursery and tree improvement program in chapter 89 self-supporting."

This document was prepared in response to that charge, and presents the findings of the University of Minnesota scientists and Division of Forestry professionals who studied the issues involved.

## Organization and Scope

The Forest Resource Management Act of 1982 specifies that the Minnesota nursery and tree improvement plan must include at least the following elements:

(a) tree species and stand improvement;
(b) adoption of a seed certification system;
(c) development of specialized seed tree orchards;
(d) implementation of modern nursery techniques;
(e) contractual arrangements with users of tree seedlings; and
(f) an economic analysis of surcharges and user fees that would make the nursery and tree improvement program self-supporting.

Items (a), (b) and (c) may be found in Chapter II, which covers the tree improvement program. Chapter III covers nursery operations and discusses items (d) and (e), as well as suggested legislative action which would enhance the distribution of nursery tree seedlings. Chapter IV establishes the user fees and surcharges necessary to make the programs self-supporting, and discusses the benefits and costs of self-support. Finally, Chapter V presents the conclusions and recommendations of the panel of experts which studied the nursery and tree improvemet program from June through December of 1982.

This paper represents just one step in a comprehensive review and planning process for the public nursery and tree improvement programs in Minnesota. It was prepared for the following reasons:

1. to define program goals and priorities.
2. to outline specific actions needed in the program.
3. to serve as a basis for financial planning.
4. to assure continuity of program effots.

A companion volume to this document is entitled "A Tree Improvement Plan for Minnesota," and was initially drafted in 1980 and published in 1981. It presents the technical actions needed for a successful genetic tree improvement program in Minnesota. This plan was reviewed in 1982 and some substantial modifications and improvements were made to it. A revised version of the plan, incorporating the 1982 changes should be available shortly. A second companion volume will be developed which will detail the modern nursery techniques being implemented at the nurseries. The publication date of this latter volume will be dependent upon completion of the development and documentation of a computerized nursery information and operating system during the 1983 - 1985 biennium.

# CHAPTER II

## TREE IMPROVEMENT PROGRAM

The Minnesota Department of Natural Resources (DNR), Division of Forestry is one of the largest producers of tree and shrub seedlings in the upper midwest. They provide the bulk of the planting stock for all classes of land ownership in Minnesota. As such, they have the responsibility for distributing the best possible planting materials to insure the effectiveness of planting programs. This requires an aggressive genetic tree improvement program. Genetic improvement of forest trees is a widely accepted, economical and effective tool for increasing the survival of seedlings and the productivity and quality of plantings. Large scale programs of this type have been developed in many states, and such a program is certainly of value to Minnesota.

### Program Goal and Scope

The goal of the tree improvement program is to increase the productivity of public and private forest lands in Minnesota through the use of genetic principles. The program will result in the production or acquisition of genetically superior seeds, or cuttings, for use in the growing of planting stock or other regeneration activities. The target is the highest level of genetic improvement possible within the restrictions of available resources, current information and probable economic returns.

Development of a long term tree improvement plan was initiated by DNR-Forestry personnel and University of Minnesota, College of Forestry scientists in 1978. By 1979 a draft plan was available for interim use in DNR tree improvement work. A final version of this plan was published in 1981. In 1982, in response to Legislative direction provided in the Forest Resource Management Act of 1982, this tree improvement plan was reviewed and modifications were made. Those modifications, along with a summary of the viable parts of the original plan are presented here.

Three types of information were used in developing the 1982 tree improvement plan revisions. The first type of data used was improved estimates of DNR seed needs which more accurately reflect anticipated reforestation activities in the state. These data were used in the modification of species priorities, establishment of program levels, and in setting goals for the production of improved seed. A second type of information used in revising the plan was a series of discounted cash flow benefit-cost analyses. These analyses covered 40 alternative activities involving six of the highest priority tree species. Results of these analyses were used to modify species priorities and action programs for species development. The third type of information utilized in the revision process came from insight gained as the DNR initiated the 1981 plan. The insight gained on operational and biological limitations or opportunities was also used in modifying species priorities and development activities.

## Major Activities

Major activities in the tree improvement program are summarized in this section. These elements, as listed, can be viewed as sequential steps in the program, with each step providing additional genetic gain. However, the progression is very much a generalization, and species characteristics or special circumstances have led to modifications at the species level.

Seed Source Selection and Control of Seedling Distribution - The DNR distributes planting stock throughout Minnesota, a large state with a diversity of environments. This diversity requires a variety of genetic materials for many species. The establishment of seed source zones coupled with the distribution of planting stock in a manner consistent with seed origin is a first step towards utilizing genetic variation. It is a relatively inexpensive measure which will reduce the probability of severe losses due to climatic extremes. It can also provide substantial improvement of the genetic quality of planting stock for many species.

Seed Production Area Development - Seed production areas are natural stands or plantations managed for the production of seed. Heavy thinning, fertilization, insect control and other measures are used to increase seed production. Natural stands used for seed production areas are located in preferred seed collection zones; plantations, if they are used, are derived from seed from such zones. Genetic gain from seed production areas is comparable to that obtained from control of seed sources. These areas should be viewed as a way to economically produce desirable seed rather than a primary means of increasing genetic gain. However, in the development of seed production areas there is some possibility of genetic gain by carefully selecting stands, or plantations, and the individual trees left after thinning to produce seed.

First Generation Seed Orchard - Seed orchards are plantings where selected materials are grown so they interpollinate and produce genetically improved seed. It is in the seed orchard that favorable genetic characteristics are packaged for use. They are the production units of advanced phases of tree improvement programs with sexually propagated species. First generation orchards usually contain materials obtained directly from natural populations. These materials are normally selected on the basis of their phenotype. Orchards can be of several types. Many factors are considered, but the choice usually depends upon economics and the biology of the species.

Seedling Seed Orchards - These orchards are usually established using open-pollinated seeds collected from trees selected because of their favorable phenotype. Establishment costs for these orchards are relatively low, and the approach is favored in species which flower early when grown from seed.

Clonal Seed Orchards - These plantings are established using seedlings produced by vegetatively propagating selected trees. The most common means of propagation is grafting, and each selected tree is represented in the orchard many times. The approach is normally tied to very intensive field selection, and relatively small numbers of trees from natural populations are used in the orchards. It is most frequently used with species which

can be grafted easily and whose grafts flower earlier than seedlings normally would. The establishment costs are moderately high due to the expense of the propagation procedures.

Advanced Generation Seed Orchard - Once first generation seed orchards have begun to flower, efforts can be directed towards obtaining additional genetic gain by a new round of selection. Selection is carried out in populations derived from first generation programs, and a new series of seedling and clonal seed orchards is established.

## Projected Seed Needs

Updated seed need projections for high priority species are presented in Table 2.1. These projections are tied to anticipated regeneration activities in the state. Maximum needs reflect the amount of seed required for the regeneration of all lands harvested at cutting levels equal to the Annual Allowable Cut.

In Table 2.1, needs for reproductive materials for the nursery and direct seeding purposes are separated. As a general rule, the returns from tree improvement programs will be highest when improved materials are used in conjunction with nursery or containerized seedling production. In matching the emphasis of the tree improvement program to seed needs, projected nursery seed needs were given the most weight.

The revised estimates for seed needs indicated some substantial changes from those used to formulate the original tree improvement plan. If only the nursery seed needs are considered, the 1981 plan should be modified to substantially reduce the efforts with Red Pine and Jack Pine and increase the efforts devoted to producing improved seed of Black Spruce and Larch. Changes in anticipated seed needs for other species were relatively small.

## Economic Analysis

An obvious weakness in the 1981 plan was the subjective methods used to establish species priorities and to allocate resources to the alternative approaches for obtaining genetic improvement in a particular species. While it was recognized that tree improvement resources should be allocated in proportion to expected returns to the forestry program, limited knowledge precluded a detailed economic evaluation of alternatives. In the 1982 review, an effort was made to develop a more objective basis for determining program emphasis. Discounted cash flow analyses were completed for various levels of those components of species plans for which reasonable estimates of costs and benefits were available.

Costs were determined by listing, by year of occurrence, all activities necessary to establish and maintain a particular project. Costs in current dollars were then assigned to the items by using Division of Forestry average values for tasks which were comparable to normal forestry operations, or by estimating labor and material costs for tasks peculiar to tree improvement work. Estimated costs were assumed to be increasing over time at rates 2.6 to 8.7 percent above the inflation rate. Cumulative pro-

TABLE 2.1

Estimated Maximum Annual Seed Needs: 1983 to 2000*

| SPECIES | NURSERY NEEDS | DIRECT SEEDLING NEEDS | TOTAL NEEDS |
|---|---|---|---|
| Red (Norway) Pine | 485 lbs seed | 95 lbs seed | 580 lbs seed |
| Black Spruce | 245 lbs seed | 705 lbs seed | 950 lbs seed |
| White Spruce | 320 lbs seed | 85 lbs seed | 405 lbs seed |
| Jack Pine | 280 lbs seed | 135 lbs seed | 415 lbs seed |
| Larch | 250 lbs seed | 115 lbs seed | 365 lbs seed |
| White Pine | 205 lbs seed | 35 lbs seed | 240 lbs seed |
| Black Walnut | 580 bushels of nuts | ---------- | 580 bushels of nuts |
| Scotch Pine | 20 lbs seed | ---------- | 20 lbs seed |
| Poplar | 198 thousand whips | ---------- | 198 thousand whips |

* Maximum needs are based on fully regenerating all lands if timber harvesting is at a rate equal to the Annual Allowable Cut for non-federal lands in Minnesota, as calculated by the DNR.

gram costs were then discounted to the present using a 4.4 percent discount rate. Discounted cumulative returns were based on the value of increased stumpage produced as a result of using seedlings grown from improved seed. Estimates of increased yield were projected using the genetic gain and seed production values of the 1981 plan. Values were discounted from the year of harvest, using normal plantation rotations and an increase in stumpage value 2.1 percent above the normal inflation rate. These cash flow analyses were limited to six species for which programs had been developed in some detail by the 1981 plan, or by subsequent species project plans.

The benefit cost data must be used with considerable caution. Because of the tentative nature of cost estimates and returns, the benefit cost ratios should be considered as an indication of the order of returns from various activities, not as specific values. In addition, choices among activities are subject to limitations associated with the sequential nature of tree improvement work, and some procedures cannot be initiated until others are in an advanced stage of development. With these limitations in mind, the data was used extensively in modifying the priorities and emphasis of the 1981 plan.

## Species Priorities

The resources available for Minnesota's tree improvement program will not permit intensive work with all of the 20 plus species produced by the DNR nurseries. Even if funding were available, the advisability of such an extensive program is questionable. Tree improvement should be carried out

within the context of the total forestry program, and resources allocated to this type of work should be in proportion to the expected returns. With some species the response to intensive improvement work may be so small, or the value of gain so limited, that resources would be better directed to other aspects of the genetic improvement program, or to other forestry activities. Choices among species and traits are inevitable and priorities are needed to insure choices which provide the greatest long-term benefit to the forestry program.

The development of priorities for this program was a subjective process because of limited knowledge and the large number of factors involved. By drawing on the available data and the experience of a variety of specialists, a preliminary ranking suitable for planning was obtained. This ranking reflects the relative value of improved materials to the state's forestry program and the biological feasibility of achieving genetic improvement.

The program review, particularly the cash flow analyses, led to the assignment of species to two priority groups:

Category I - Highest priority species; work with these species will be continued and expanded with the objective of providing improved seed at a level which meets or exceeds the minimum nursery needs as soon as is practical.

| | |
|---|---|
| Red (Norway) Pine | White Spruce |
| Jack Pine | Black Spruce |

Category II - Second priority species, work with these species will be continued and expanded where feasible, but not at the expense of progress with species in Category I.

| | |
|---|---|
| Black Walnut | Scotch Pine |
| Poplars | Larch (European and Native) |
| White Pine | |

## Species Plans - Category I and II

There are a number of alternatives available for genetic improvement of each species (seed source control, seed orchards, seed production areas, etc.). The alternatives outlined below are those which best balance seed need, economic return, and biological limitations.

In general, the minimum goal for each species is to provide all seed needed by the nursery from seed orchards. The remaining needs should be provided by source identified (or better) seed. In some cases the planned orchards will not meet the nursery seed needs, or replacement orchards will be needed in the early part of the next century to supplement or maintain production. Rather than attempting to plan that far in the future, proposals for new orchard development will be delayed until more exact seed needs and experience from existing orchards are available.

Red Pine remains a high priority species in the tree improvement program although the new estimate of seed need is less than that projected in the 1981 improvement plan. All the improvement alternatives for Red Pine are attractive, and the following three have been chosen as most effective.

| Alternative | Effective Date | Genetic Gain |
|---|---|---|
| a) complete seed source control | 1985 | 1% |
| b) 25 acres seedling seed orchard | 1981 | 5% |
| c) 75 acres seed production area | 1995 | 2% |

Seed Production - lbs/year

Goal: 580 lbs seed/year

| Time Frame | Seedling Seed Orchard | Seed Prod. Area | Source Identified |
|---|---|---|---|
| 1985-1995 | - | - | 580 |
| 1996-2000 | 50 | 100 | 430 |
| 2001-2005 | 75 | 250 | 255 |
| 2006-2010 | 125 | 350 | 105 |

Benefit/Cost Analysis

| Time Frame | Alternative | Benefit Cost Ratio |
|---|---|---|
| 1985-2005 | Seed Source Control | 56.7 |
| 1981-2024 | Seedling Seed Orchard | 4.2 |
| 1990-2012 | Seed Production Area | 11.3 |
| | Total Program | 10.7 |

Establishment of the seed production areas will be dependent on satisfactory results from studies now under way aimed at increasing cone production and efficiency of cone harvest techniques. If the results of the present studies are not promising, seed requirements will be reviewed and new alternatives developed.

Jack Pine remains a first priority species with an expanded estimate of seed needs. The seed production and benefit/cost analyses are shown below. It is evident that seed source control in Jack Pine is very critical and should receive top priority, and that other alternatives are cost effective. The following program is planned to obtain Jack Pine improvement.

| Alternative | Effective Date | Genetic Gain |
|---|---|---|
| a) complete seed source center | 1985 | 3% |
| b) 16 acres seedling seed orchards | 1984 | 8% |
| c) 30 acres open-pollinated second generation seed orchards | 1992 | 13% |

Seed Production - lbs seed/year

Goal: 415 lbs seed/year

| Time Frame | 1st Generation Seed Orchard | 2nd Generation Seed Orchard | Source Identified |
|---|---|---|---|
| 1985-1990 | - | - | 415 |
| 1991-1995 | 25 | - | 390 |
| 1996-2000 | 60 | 10 | 345 |
| 2001-2005 | 80 | 45 | 290 |
| 2006-2010 | - | 150 | 265 |

Benefit/Cost Analysis

| Time Frame | Alternative | Benefit Cost Ratio |
|---|---|---|
| 1985-2010 | Seed Source Control | 807.8 |
| 1982-2007 | 1st Gen. Seed Orchard | 6.5 |
| 1992-2017 | 2nd Gen. Seed Orchard | 16.2 |
| | Total Program | 10.3 |

New seed orchards will be required around the year 2000 to continue to meet the minimum nursery need. This situation will be addressed at a later date as more experience with seed orchards is gained and as the exact need for Jack Pine seeds can be more fully identified.

White Spruce will remain a Category I species. The estimated need for seed is larger than projected in 1981, and a number of new activities must be initiated to meet this need.

| Alternative | Effective Date | Genetic Gain |
|---|---|---|
| a) complete seed source control | 1985 | 3% |
| b) 20 acres grafted seed orchard (existing) | 1982 | 8% |
| c) 20 acres grafted seed orchard (new) | 1990 | 8% |
| d) 40 acres control-pollinated second generation seed orchard | 1985 | 22% |
| e) 40 acres seed production area | 1990 | 8% |

Seed Production - lbs/year

Goal: 405 lbs seed/year

| Time Frame | Existing Grafted Seed orchard | New Grafted Seed Orchard | Seed Prod. Area | Con.- Poll. 2nd Gen. Seed Orchard | Source Identified |
|---|---|---|---|---|---|
| 1983-1995 | 25 | - | - | - | 380 |
| 1996-2000 | 55 | 15 | - | - | 335 |
| 2001-2005 | 65 | 30 | 25 | - | 285 |
| 2006-2010 | 65 | 50 | 65 | 10 | 215 |
| 2011-2015 | 50 | 65 | 120 | 40 | 130 |
| 2016-2020 | 25 | 65 | 120 | 75 | 120 |

Benefit/Cost Analysis

| Time Frame | Alternative | Benefit Cost Ratio |
|---|---|---|
| 1985-2025 | Seed Source Control | 291.0 |
| 1982-2022 | Grafted Seed Orchard (Existing) | 10.7 |
| 1990-2030 | Grafted Seed Orchard (New) | 10.7 |
| 1985-2025 | 2nd Gen. Seed Orchard | 16.4 |
| 1990-2030 | Seed Production Area | 34.6 |
| | Total Program | 28.5 |

White Pine, despite an anticipated increase in planting activity and a favorable cost benefit analysis, has remained in Category II due to field foresters fears over losses from Blister Rust disease. The activities needed to meet the demand for White Pine seed are listed below.

| Alternative | Effective Date | Genetic Gain |
|---|---|---|
| a) complete seed source control | 1985 | N/A |
| b) 5 acre grafted seed orchard | 1985 | 20 |
| c) 5 acre seedling seed orchard | 1986 | N/A |

Seed Production - lbs/year

Goal: 240 lbs seed/year

| Time Frame | Grafted Seed Orchard | Seedling Seed Orchard | Source Identified |
|---|---|---|---|
| 1985-1990 | - | - | 240 |
| 1991-1995 | 3 | - | 237 |
| 1996-2000 | 6 | 3 | 231 |
| 2001-2005 | 19 | 6 | 215 |
| 2006-2010 | 38 | 19 | 183 |
| 2011-2015 | 57 | 38 | 145 |

Benefit/Cost Analysis

| Time Frame | Alternative | Benefit Cost Ratio |
|---|---|---|
| 1985-2025 | Seed Source Control | N/A |
| 1985-2018 | Grafted Seed Orchard | 13.9 |
| 1986-2026 | Seedling Seed Orchard | N/A |
| Total Program | | N/A |

Seed from the grafted orchard will be used on sites with a high Blister Rust hazard rating. The primary objective will be to find strains of White Pine which exhibit a resistance to that disease. Other sites will be planted using source identified or seedling seed orchard seed.

Black Walnut has remained in Category II despite its high value and high benefit/cost ratio.* The current program, detailed in the 1981 - 1982 Annual Work Plan, consists of a five acre grafted seed orchard to be established using scion material from outstanding trees in southeastern Minnesota and neighboring states. To meet the anticipated need, an additional five acres of grafted orchard will be added every five years until a total of 25 acres are established.

| Alternative | | Effective Date | Genetic Gain |
|---|---|---|---|
| a) | 5 acre grafted seed orchard | 1985 | 7% |
| b) | 5 acre grafted seed orchard | 1990 | 7% |
| c) | 5 acre grafted seed orchard | 1995 | 7% |
| d) | 5 acre grafted seed orchard | 2000 | 7% |
| e) | 5 acre grafted seed orchard | 2005 | 7% |

Seed Production - bushels of nuts/year

Goal: 580 bushels of nuts

| Time Frame | 1985 Orchard | 1990 Orchard | 1995 Orchard | 2000 Orchard | 2005 Orchard | Source Identified |
|---|---|---|---|---|---|---|
| 1985-1990 | - | - | - | - | - | 580 |
| 1991-1995 | 2 | - | - | - | - | 578 |
| 1996-2000 | 40 | 2 | - | - | - | 538 |
| 2001-2005 | 60 | 40 | 2 | - | - | 578 |
| 2006-2010 | 60 | 60 | 40 | 2 | - | 418 |
| 2011-2015 | 60 | 60 | 60 | 40 | 2 | 358 |
| 2016-2020 | 60 | 60 | 60 | 60 | 40 | 300 |

Benefit/Cost Analysis

| Time Frame | Alternative | Benefit Cost Ratio |
|---|---|---|
| 1985-2025 | Grafted Seed Orchard | 17.6 |
| 1990-2030 | Grafted Seed Orchard | 17.6 |
| 1995-2035 | Grafted Seed Orchard | 17.6 |
| 2000-2040 | Grafted Seed Orchard | 17.6 |
| 2005-2045 | Grafted Seed Orchard | 17.6 |
| Total Program | | 17.6 |

* This is because of the species limited planting range within Minnesota.

Black Spruce has low economic returns on some tree improvement activities, however, it remains a Category I species because of its importance as a raw material for Minnesota's pulpwood paper industry. There is a very large demand for Black Spruce seed for direct seeding purposes which will be met using source identified material. A portion of the nursery needs will be met by first and second generation seed orchard seed with the remaining being source identified.

| Alternative | Effective Date | Genetic Gain |
|---|---|---|
| a) complete seed source control | 1985 | 3% |
| b) 3 acre first generation seedling seed orchard | 1982 | 8% |
| c) 16 acre second generation seedling seed orchard | 1990 | 14% |

Seed Production - lbs seed/year

Goal: 950 lbs seed/year

| Time Frame | 1st Gen. Seedling Seed Orchard | 2nd Gen. Seedling Seed Orchard | Source Identified |
|---|---|---|---|
| 1985-1990 | 2 | - | 948 |
| 1991-1995 | 3 | - | 947 |
| 1996-2000 | 6 | 8 | 936 |
| 2001-2005 | 7 | 12 | 931 |
| 2006-2010 | - | 24 | 926 |

Benefit/Cost Analysis*

| Time Frame | Alternative | Benefit Cost Ratio |
|---|---|---|
| 1985-2025 | Seed Source Control | 219.9 |
| 1982-2007 | 1st Gen. Seed Orchard | 1.1 |
| 1990-2015 | 2nd Gen. Seed Orchard | 3.9 |
| | Total Program | 24.5 |

* Assumes 30% of seeds produce seedlings. Current nursery program produces only one seedling per ten seeds (10%). The increased output can be gained through more effective seeding regimes, such as those found in containerized seedling operations.

Other Category II Species: No economic analyses were run for the remaining Category II species, which are Scotch Pine, Larch, and Poplars. Improvement programs for these species will remain as presented in the 1981 plan or annual workplans. Estimated costs of the existing improvement programs for all species appear in Table 2.2.

TABLE 2.2

ANNUAL COSTS, TREE IMPROVEMENT PROGRAM

| Item | | Cost |
|---|---|---|
| DNR Tree Improvement Specialist (salary and fringe) | | $34,100 |
| College of Forestry Res. and Devel. (contract) | | 20,000 |
| DNR Forestry Field Operations (indirect and administrative costs) | | 12,000 |
| Improved Tree Activities | | |
| Red Pine | $3,050 | |
| Jack Pine | 3,230 | |
| White Pine | 2,300 | |
| Scotch Pine | 1,500 | |
| White Spruce | 1,680 | |
| Black Spruce | 540 | |
| Black Walnut | 2,360 | |
| Larch (Tamarack) | 1,500 | |
| | | 16,200 * |
| Annual Total | | $82,300 |

* Annual species costs are based on five year averages of estimated expenses, as developed in the cash flow analyses.

Seed Certification

The purpose of certifying forest tree reproductive materials is to properly identify materials as to species or species and cultivar, and by source or source and origin. Origin is defined as the location of the indigenous parents, and source means the location of the immediate parents, which may be indigenous or non-indigenous. While certification, as it relates to forest trees, is relatively new, several western and southeastern states have active certification programs.

The positive identification of reproductive materials which certification provides is most critical when there is considerable commerce in such materials.

Those states which are actively certifying forest tree reproductive materials are concentrated in regions in which there is a significant forest tree seed industry, and well developed tree improvement programs. Certification in these states is carried out by an official seed certification agency such as a Crop Improvement Association, State Plant Board or Department of Agriculture. Certification standards are typically established by statutes based on recommendation made to the proper authority by interested groups (seed or planting stock buyers and sellers) and professional foresters.

Certification contributes to planted seedling costs. Costs of certification vary with species because of differences in seed yield per bushel of cones, seedling yield per pound of seed, and with the specific procedures used in the program. Typically the costs are modest. For example, in the Pacific Northwest average reported certification costs per acre planted are $0.105 cents for red cedar and $1.01 for Sugar Pine.

The benefits of an active certification program in Minnesota are undetermined, but potentially quite large. The current situation raises serious questions about the value of immediately implementing such a program. Relatively little commercial exchange of seed occurs within the state, because most large users acquire seed by purchasing cones and extracting seed in their own facilities. Unless there is a change in the procurement procedures, certification's impact on seed quality would be small relative to the other forms of control users choose to implement. In Minnesota relatively little material other than "origin identified" seedlings is expected to be available over the next few years, and the major vendor of seedlings in the state is and probably will remain the DNR. That organization is in a position to exercise a high level of control over the genetic makeup of the materials it produces and distributes, and such control is called for in the tree improvement plan. Assuming effective control over seed acquisition and seedling distribution, a formal certification program would have little value to consumers.

Genetically improved materials will become available in quantity in the future and certification could be critical to its effective use. It is recommended that serious consideration be given to developing and implementing a forest tree reproductive materials certification program by the early 1990's. A proposal for such a program should be developed under the leadership of the Director of the Division of Forestry with input from the Minnesota forestry community. It is recommended that the Minnesota plan be developed in a way which makes it consistent with the scheme for Control of Forest Reproductive Materials Moving in International Trade established by the Organization for Economic Cooperation and Developed (OECD) in 1974.

CHAPTER III

# NURSERY OPERATING PROGRAM

In 1982 the state nurseries distributed more than 21 million trees which were planted on about 23,300 acres, and provided seed for direct seeding on over 4,000 acres. Activities in this area are accelerating, with 1983 nursery seedling shipments targeted for 28 million trees. By the year 2000, the annual need for state produced planting stock is expected to reach 48 million seedlings, with the potential for regenerating 53,000 acres. In addition, by the year 2000, the state is expected to be involved in the direct seeding of 15,000 acres of forests annually. With changes in demand of this magnitude it is absolutely necessary that the nurseries be operated in the most economical and efficient manner possible.

## Species Selection and Production

Species selection for nursery operations was based upon past and current demands by the private sector, Minnesota counties, and the various divisions of the Minnesota Department of Natural Resources. This selection of species to be grown in the nurseries can be subdivided into three major groups, as follows:

| | | |
|---|---|---|
| Conifers: | Red (Norway) Pine | Black Spruce |
| | White Pine | Colorado Spruce |
| | Jack Pine | White Cedar |
| | Scotch Pine | Red Cedar |
| | Tamarack (Larch) | Norway Spruce |
| | European Larch | Balsam Fir |
| | White Spruce | |
| Hardwoods: | Black Walnut | Honeysuckle |
| | Red Oak | Ginnala Maple |
| | White Ash | Caragana |
| | Green Ash | Russian Olive |
| | Soft (Silver) Maple | Wild Plum |
| | Poplar | |
| Transplants: | Norway Pine | Colorado Spruce |

The current (fall 1982) seeding plan calls for planting 27.7 million conifers, 1.8 million hardwoods, and 1.4 million transplants. Future projections for seeding plans are:

| | |
|---|---|
| Fall 1983 - 1985 inclusive: | 30.0 million conifers |
| | 2.0 million hardwoods |
| | 1.5 million transplants |
| Fall 1986 - 1990 inclusive: | 35.0 million conifers |
| | 2.0 million hardwoods |
| | 1.5 million transplants |

| | |
|---|---|
| Fall 1991 - 2000 inclusive: | 43.7 million conifers |
| | 3.8 million hardwoods |
| | 1.5 million transplants |

Modern Nursery Techniques

Implementation of modern nursery techniques may be divided into three major catagories or areas where improvements will be centered. The three areas are bareroot seedling production, containerized tree seedling production, and nursery management records.

Bareroot seedling production begins with seed extraction, and testing of the seed for viability (capacity to germinate). A maximum number of seeds from each cone must be retrieved during the extraction process. A new (1981) Despatch Cone Oven is now being used for the heating and opening of the cones. The cones are then tumbled and gravity separated to retrieve the sound seeds. It is becoming apparent that new equipment such as a seed x-ray unit, seed counter, and other laboratory testing devices are needed to complete the seed testing and processing cycle. Seed storage techniques are becoming more and more important. When stored under the right conditions of temperature and humidity, some seeds may be stored for 7 to 10 years. This allows a bank of seed to be stored, which can then be used during years when fresh seed crops are poor. A computerized seed source data information system needs to be developed. This will allow the nurseries to maintain records on each seed lot by species, seed source zone, viability and other factors. This information would then be used to maximize seedling production, and to assure that seedlings are returned to the zone where the seeds originally came from.

Seeding at the nurseries is generally being done in the fall of each year. This seeding is currently being done with eight-row seed drills. Work needs to be done to provide better monitoring and control of seed bed densities. Seed bed density directly affects seedling production and growth, as well as useable nursery bed space and operating costs. At present, poor density control has led to excessive seeding costs for Black Spruce and Norway Pine, and has resulted in the nurseries not recovering as many seedlings per pound of seed as they should. Improved seed testing along with better, more readily accessable seed source information will help to correct these problems in future years.

Improvements in the irrigation systems at both nurseries were implemented during the past two years. These improvements consist of above ground aluminum irrigation lines with Rainbird sprinkler heads for use on the younger seedling beds, and a self-propelled water gun system for use on the older seedling and transplant beds. Work will be started on monitoring the irrigation regimes for each nursery bed to allow the maximum uptake of water by the trees. Moisture retention curves will be developed at each nursery to identify ideal irrigation timing. In addition, plant moisture stress meters will be used to test for drought conditions in the nursery stock should weather conditions change sufficiently to affect the water retention schedules developed for normal irrigation operations.

Cultural amendments are very important in bareroot seedling production. The testing and analyzing of these amendments are on-going procedures, and empahsis will be placed on improving them in the future. Some of these cultural amendments and activities are: weed control herbicides, disease and fungi control, fertilization, and root pruning. At the same time that the cultural amendments are being analyzed and tested, seedling growth will be monitored. This monitoring will include: expanded use of the moisture stress meter, tree tissue analysis and soil analysis for nutrient deficiency, and tree seedling inventory and mortality studies.

When the seedling stock attains a desirable size it must be lifted, grade sorted, packaged and shipped. To facilitate faster lifting a mechanical harvester was recently purchased, and will be placed in use during the spring, 1983, shipping season. The grade sorting is now being done in the field, rather then on the final packaging line. New packaging methods are now being used which need to be analyzed and monitored for their efficiency. These new methods involve packing seedlings in plastic bags and shipping these bags in cardboard boxes. Seedling survival during shipment has also been enhanced, at least for state trees, by using more refrigerated trucks, and by using refrigerated storage areas near the planting sites.

Containerized tree seedling production has been done on a relatively small scale using contract growers. Monitoring of these seedlings will be needed to determine the feasibility of continuing a container program for state land plantings. Survival checks, growth rates and other potential problems and benefits will need to be analyzed in makeing this determination. Should containerized planting appear feasible for state land conditions, much of the Black Spruce and Larch stock now grown in the nurseries would probably be contracted for in the form of containerized stock. Contracting will avoid the need for investing large amounts of capital in totally new containerized nursery facilities. At the same time, it will help to stimulate local private nurseries interested in entering the containerized field. One such operation is currently being developed in the Cohassett area. If such contracting is deemed feasible from the biological standpoint, it will be necessary to develop a long term (4 to 6 year) contract with the private growers. It is felt that this long term provision is needed to provide a degree of financial stability for the private nurserymen, who would otherwise be incurring a high capital investment and financial risk for a short term venture. Contracting on an annual basis would, under those financial conditions, result in excessively high prices for contanierized stock, and would most likely make this otherwise desirable program infeasible.

Nursery management records are essential to good nursery operations. Management records need to be placed on a computer system readily accessable to the nursery personnel. The Forest Information Systems unit in the Division of Forestry is currently planning to develop such a system for placement at the nurseries. The records which need to be put on the system are:

Fiscal Management
Capital Improvements
Equipment Management

Seeding Records
Seed Source Control Data
Seedbed Cultural Records
Tree Seedling Sales Orders
Tree Seedling Shipment Records

The Forestry Information Systems unit will shortly be reviewing a U.S. Forest Service computer program for total nursery management which may be adaptable to the state's needs. If the program proves adaptable, it will be installed for use at the nurseries.

## Budget and Financial Plan

The operating budget for Fiscal Year 1984 would be funded through appropriations from the General Fund, Boundary Waters Canoe Area Forestry Intensification Fund, and the State Forest Development Account. Receipts from nursery tree sales beginning in September, 1983, would be deposited to the Forest Management Fund, rather than the General Fund. In Fiscal Year 1985, these receipts would be appropriated from that fund and General Fund appropriations would be commensurately reduced (see Chapter IV for more detail). The operating budget for the nurseries would be broken down into four accounts. The General Operations and Management Account would cover permanent and temporary (labor service) personnel salaries, materials, supplies, seed and cone purchases, and miscellaneous expenses. The Equipment Management Account would cover maintenance and operating expenses for "Four Group" equipment, as well as having provisions for depreciation of that equipment. It would also include a sinking fund for the replacement of what is now fully depreciated, but still useable, equipment, as well as provisions for capturing use-charges on equipment when it is loaned to other DNR operations during the off-season. A third account would be the Capital Improvements Account which would include all maintenance, repair and replacement charges for the land and buildings at the nurseries. This account would also include provisions capturing depreciation at the time it occurs. The fourth and final account would be the Tree Improvement Program Account which would cover all salaries, operating expenses, and associated costs of operating a genetic tree improvement program. Table 3.1 provides a detailed breakdown of these accounts and their estimated budget amounts for nursery operations in Fiscal Year 1984.

## Contractural Arrangements

During the past five years, state nursery stock sales and shipments have averaged 94 percent of total production. While much of the over-production has resulted from changes in demand occasioned by fluctuating economic conditions, a significant proportion of the overrun has resulted from last minute cancellations of tree orders. Under the current provisions of the DNR's seedling sales contract an order for trees may be placed in September and cancelled or altered at any time up to March 1st of the next year without penalty. In many instances the alteration or cancellation is made just as the deadline approaches. During the interim period other orders for trees are received which must be turned down because all of the available stock appears to have been sold.

TABLE 3.1

ANTICIPATED NURSERY OPERATING BUDGET FOR FY 1984

| Account and Item | | Amount |
|---|---|---|
| General Operations | | |
| Permanent Salaries and Fringe | | $ 347,800 |
| Labor Service | | 913,000 |
| Salary Supplemental | | 94,600 |
| Supplies and Materials | | 267,100 |
| Utilities | | 26,800 |
| Travel and Expenses | | 5,300 |
| Seed and Cone Purchase | | 75,000 |
| Administrative Overhead | | 33,200 |
| | Account Total | $1,762,800 |
| Equipment Management | | |
| Motorized Equipment Depreciation | | $ 72,100 |
| Depreciated Equipment Sinking Fund | | 53,600 |
| Equipment Maintenance (@10% of above amounts) | | 37,700 |
| Non-Motorized Equipment Depreciation (20% rate) | | 9,000 |
| Non-Motorized Equipment Maintenance | | 900 |
| | Account Total | $ 173,300 |
| Capital Improvements | | |
| Depreciation on Buildings and Facilities | | $ 24,100 |
| Depreciation on Irrigation System | | 19,000 |
| Maintenance and Upkeep | | 4,300 |
| | Account Total | $ 47,400 |
| Tree Improvement Program | | |
| Personnel Salaries and Fringe | | $ 34,100 |
| Operating Supplies and Expenses | | 16,200 |
| Indirect and Administrative Costs | | 12,000 |
| UM Research and Development Contract | | 20,000 |
| | Account Total | $ 82,300 |
| Total Capital and Operating Budget | | $2,065,800 |

The result of such a situation is dissatisfied potential customers as well as production and handling costs being incurred for which no revenue is received. After discussions with members of the Attorney General's staff, it appears that this situation can be rectified within the confines of state law by altering certain provisions of the current purchase contracts. The suggested alterations to the contract include:

1. Changing to a policy whereby no cancellations or alterations would be allowed beyond thirty days after the date of the original order, or March 1st, whichever came first.

2. Changing to a policy of charging a service fee, or penalty, for processing alterations and cancellations.

Legally, the key to the success of such changes would be the state's ability to prove that costs equal to the amount of the service fee had actually been incurred. Revision of the DNR's accounting system mandated by Section 12 of the Forest Resource Management Act of 1982, coupled with the planned automation of the nursery accounting system, should allow the state to certify those costs. At the present time indications are that the fee would probably be on the order of $10 or 10 percent of the total dollar amount of the original order, which ever was larger.

A second form of contractual arrangement between the state and purchasers of nursery seedlings must also be established. Each year the nurseries are asked to produce stock of a selected size or species which is not part of the normal nursery output. Growing such stock takes from three to five years and requires a considerable financial investment. In addition, as each type of stock requires its own specific growth regime, it is necessary to grow certain minimum quantities of each type to properly utilize nursery facilities and achieve some economics of scale. These minimums would be:

| | | |
|---|---|---|
| Conifers | - | 50,000 seedlings per species |
| Hardwoods | - | 25,000 seedlings per species |
| Transplants | - | 50,000 seedlings per species |

The state nurseries would be willing to grow special order stock if the purchaser would enter into a binding contract for such production. The proposed contract would stipulate the type of stock to be produced, the quantity to be produced, the delivery date for the stock, and a fixed price for that stock. In exchange for such a contract, the purchaser would be required to provide a non-refundable deposit at the time the contract was accepted by the state. The deposit should be at least 50 percent of the agreed upon total purchase price of the stock being ordered. This deposit would be used to defray the costs of production. The balance due on the contract would be payable on or before January 31st of the year in which delivery is to be made. It is felt that such an arrangement would be equitable to both parties. The purchaser would be assured the stock he wants at a fixed price, while the financial drain on the state would be reduced to an acceptable level.

In conjunction with other contractual agreements, there is a need to revise Minnesota Statute 89.37, which deals with the distribution of planting stock from the state nurseries. A change is needed to allow the Minnesota Department of Natural Resources to sell to, or exchange seedlings with, departments of natural resources in other states. This would enable the nurseries to dispose of stock which is excess to the needs of the planting program in Minnesota, while making advantageous use of excess planting stock which may be available to Minnesota from other states. By limiting the interstate trade to other departments of natural resources, the trees involved would be distributed according to the conservation statutes in the state receiving the trees, and no undue conflict of interest with private nurserymen would result. Opportunities for this type of trade

have occurred in the past, and will certainly occur again in the future. By taking advantage of these opportunities, the state will be able to make more efficient use of its nursery production capacity without incurring non-recoverable costs.

# CHAPTER IV

## THE BENEFITS AND COSTS OF A SELF-SUPPORT POLICY

To better evaluate the benefits and costs of making the nursery and tree improvement program self-supporting, an economic analysis of the proposed self-support policy was undertaken. The objectives of this analysis were to: (1) estimate the surcharges and user fees necessary for program self-support; (2) quantify the most likely direct and indirect effects of those charges; and, (3) evaluate the consequences of those effects over time.

### Analytical Concept and Scope

The analysis was conducted using the "with and without" technique. That is, all effects were identified and measured on the basis of the difference in a given situation with and without the self-support policy existing. In the tradition of economic analysis, the consequences of the policy were evaluated without regard to who benefits and who pays. Rather, all benefits and costs were ascribed to society as a whole, and the efficiency criterion that benefits must equal or exceed costs was employed in evaluating the policy change.

The analysis was based on an anticipated operating statement for the nursery and tree improvement program for fiscal year 1984. All effects were projected through the year 2000 and then discounted to the present. Throughout the analysis all values are expressed in current (1982) dollars. The effects of general price inflation were ignored, as inflation would impact all values equally. The discount rate used in the analysis was 4.4 percent, which is the assumed real cost of capital to society as determined by subtracting the general rate of inflation (5.6%) from the Federal Reserve Board's discount rate (10.0%) at the time the analysis was initiated.

For the sake of analytical simplicity, the issue of public agencies and non-profit entities having to pay for planting stock was considered moot. That policy takes effect on July 1, 1983, regardless of the implementation or non-implementation of a self-support pricing policy. The analysis deals solely with evaluating the effects of changing from the current pricing policy which captures only a portion of the total production and distribution costs, to a policy which would capture all costs including those incurred in the tree improvement program.

### Establishing Surcharges and User Fees

The information contained in Tables 4.1 and 4.2 provides an historical perspective on nursery operations and finances over the past five years. A review of these historical figures would suggest, among other things, that a doubling in nursery production results in a doubling of operating costs. However, much of the increased cost in the past three years has been for replacement and improvement of the nurseries' physical plant and equipment. Capital investment, combined with increased mechanization and the application of new technologies, has begun to pay off in the form of improved pro-

TABLE 4.1

NURSERY SEEDLING PRODUCTION AND SHIPMENTS
FIVE YEAR HISTORY

| YEAR | SEEDLING PRODUCTION | SHIPMENTS | |
|---|---|---|---|
| | | SEEDLINGS | % OF PRODUCTION |
| 1978 | 16,046,800 | 15,183,400 | 94.6 |
| 1979 | 11,123,700 | 11,999,400 | 107.9 * |
| 1980 | 12,247,100 | 12,986,300 | 106.0 * |
| 1981 | 23,077,000 | 21,872,000 | 94.8 |
| 1982 | 25,971,000 | 21,450,000 | 82.6 |

NURSERY SEEDLING SHIPMENTS, DETAIL
FIVE YEAR HISTORY

| YEAR | STATE AGENCIES | SHIPPED TO OTHER PUBLIC ENTITIES | ALL PRIVATE ORDERS |
|---|---|---|---|
| 1978 | 4,323,500 | 2,349,900 | 8,510,000 |
| 1979 | 4,386,700 | 1,976,700 | 5,636,000 |
| 1980 | 4,516,200 | 2,545,000 | 5,925,100 |
| 1981 | 6,808,000 | 2,842,000 | 12,222,000 |
| 1982 | 7,683,000 | 4,136,000 | 9,631,000 |

* Immature (2 yr. old) nursery stock, intended for future shipment, was shipped during these years to meet state land planting needs.

TABLE 4.2

NURSERY STOCK RECEIPTS AND PRICES
FIVE YEAR HISTORY

| YEAR | PRICE PER THOUSAND* | TOTAL RECEIPTS | SALES TAXES | NET RECEIPTS |
|---|---|---|---|---|
| 1978 | $40.13 | $341,488 | $13,134 | $328,354 |
| 1979 | $52.94 | $298,362 | $11,475 | $286,887 |
| 1980 | $64.99 | $385,065 | $14,810 | $370,255 |
| 1981 | $51.13 | $624,917 | $24,035 | $600,882 |
| 1982 | $60.16 | $579,424 | $27,592 | $551,832 |

NURSERY AND TREE IMPROVEMENT PROGRAM FUNDING
FIVE YEAR HISTORY

| YEAR | GENERAL FUNDS 1/ | TRUST FUNDS | FEDERAL FUNDS 2/ | OTHER FUNDS 3/ | TOTAL |
|---|---|---|---|---|---|
| 1978 | $ 832,100 | $40,700 | $ 20,000 | -0- | $ 892,800 |
| 1979 | $ 903,200 | $46,200 | $ 20,000 | -0- | $ 969,400 |
| 1980 | $1,270,100 | $36,800 | $424,800 | $533,000 | $2,264,700 |
| 1981 | $1,424,600 | $38,000 | $377,600 | $409,700 | $2,249,800 |
| 1982 | $1,461,700 | $44,400 | $465,700 | $ 50,200 | $2,022,000 |

* Calculated as an average price including sales tax per 1,000 seedlings actually sold.

1/ Includes appropriate proportions of DNR-Forestry and DNR-Administrative budgets, as well as direct nursery allocations and depreciation on capital purchases.

2/ Includes BWCAW monies beginning in 1980.

3/ 1980 and 1982 amounts are capital budget (bond) funds, while 1981 is an L.A.C. appropriation.

duction efficiency. Next year (FY 1984) the nurseries will produce 32 million seedlings at a cost equal to that of FY 1982, when only 25 million seedlings were produced.

Table 4.3 presents, in summary form, the anticipated budget for fiscal year 1984 for the nursery and tree improvement program. If the self-support policy were enacted, this budget would be the last one supported by general government revenues. Program operations in FY 85 and beyond would be supported by the previous year's receipts having been deposited to and then appropriated from the Forest Management Fund (M.S. 89.04). Table 4.4 illustrates the calculations used to develop the appropriate surcharges and user fees necessary for program self-support. The values shown in Table 4.4 are averages for all stock produced. Actual prices charged would vary by species and type of stock (e.g. transplants) being produced and sold. A new nursery accounting system being developed in conjuction with the Forestry Information System, funded by the Legislative Commission on Minnesota Resources, will provide the means and basis for calculating those detailed prices.

The tree improvement surcharge would only be applied to those species of seedlings which would actually benefit from the tree improvement program. Initially, the surcharge would be the same for all species involved in the program. After the program has been fully initiated, and costs can be accurately determined on a species by species basis, the surcharge would be made species specific. Once improved stock was actually being sold by the nurseries, the surcharge could be collected solely on the sale of that improved stock. However, some portions of the tree improvement program (i.e. seed source control) will benefit all purchasers of seedlings. Also, it may prove administratively difficult to provide separate ordering, packaging and shipping systems for improved and unimproved seedlings of the same species. Ultimately, all of the seedlings produced by the nurseries will be from improved stock. Therefore, the tree improvement surcharge should probably remain in effect on a species specific basis, without being applied on a selected order by order basis, until full production of improved stock is attained. At that time, tree improvement costs would be included in the regular production costs of the nurseries, and the surcharge could be eliminated.

## Identifying Direct and Indirect Effects

For the analysis, the effects of a change in nursery stock pricing policy were classified as being either a direct or an indirect result of the policy change. Each was then further classified as either a benefit or cost item with respect to the proposed policy change. An effort was made to identify all probable effects of the proposed policy change, with particular emphasis placed on those indirect cost items which might make the policy change unwise in the long run. In the following paragraphs, each of the quantifiable effects of the proposed policy change is briefly identified.

The most obvious direct benefit of a self-supporting nursery and tree improvement program would be an anticipated reduction in government expenditures on the program. A concurrent and indirect benefit of the change in policy would be the elimination of future bonded indebtedness and debt ser-

TABLE 4.3

ANTICIPATED BUDGET FOR SELF-SUPPORT
FISCAL YEAR 1984

| | |
|---|---|
| Nursery Operations: | |
| Personnel Salary and Fringe | $1,354,800 |
| Operating Supplies and Expense | 374,200 |
| Capital Improvements and Equipment | 220,700 |
| Administration and Overhead | 33,800 |
| Total, Nursery Operations | $1,983,500 |
| Tree Improvement Program | |
| Personnel Salary and Fringe | $ 34,100 |
| Operating Supplies and Expense | 16,200 |
| Indirect and Administrative Costs | 12,000 |
| Research and Development | 20,000 |
| Total, Tree Improvement | $ 82,300 |
| Total Anticipated Budget | $2,065,800 |

vice incurred by government in maintaining the capital investment at the nurseries. A second indirect benefit of the policy change would be to assure a stable source of funding for the tree improvement program, thereby reducing the risk of program failure in subsequent years due to unforeseen budget reductions. A final, indirect benefit would be the returns that could be derived from alternative investments made with the savings of public dollars.

The most obvious, direct cost of a self-support policy would be a reduction in seedling sales and a concurrent reduction in receipts due to unwillingness of purchasers to pay higher prices. An indirect cost associated with this reduction in sales would be a loss of reforestation activity in the state and, hence, a potential reduction in the allowable timber harvest. A second indirect cost, arising from the loss of timber harvesting, would be the potential loss of economic activity in the forest products sector of the state's economy. Another indirect cost would be an increase in unemployment claims resulting from the loss of economic activity in the forest products sector. A final indirect cost of a self-support policy would be an increase in the costs of tree planting practices under the state and federal cost-sharing programs.

TABLE 4.4

CALCULATION OF SURCHARGES AND USER FEES
FISCAL YEAR 1984 BASIS

| | | | |
|---|---|---|---|
| 1. | Nursery Operating Budget | | $ 1,983,500 |
| | less miscellaneous revenues | a. Equipment salvage value (10% of depreciation) | (12,400) |
| | | b. Processed seed for State (1100 lbs at $42.50/lb) | (46,700) |
| | | c. Misc. services to State (2600 hrs at $13.25, Salary & Experience) | (34,400) |
| | Revenue Necessary from Seedling Sales | | $ 1,890,000 |
| 2. | Seedlings Available for Shipment | | 32,000,000 |
| | less 15% (10 yr ave.) allowance for order cancellation, production exceeding orders, and damaged stock. | | 4,800,000 |
| | Expected Seedling Shipments | | 27,200,000 |
| 3. | Nursery Charge per 1,000 Seedings: | $1,890,000 - 27,200 = | $69.49 |
| 4. | Tree Improvement Surcharge per 1,000 Seedings: | $82,300 - 27,200 = | $ 3.03 1/ |
| 5. | List Price F.O.B. the Nursery per 1,000 Seedlings: | | $72.52 2/ |
| 6. | Sales Tax at 6% on Sales to Private Sector: | | $ 4.35 |
| 7. | Total Cost to Private Sector per 1,000 Seedlings: | | $76.87 |

1/ Actual Surcharge will be $3.80 per 1,000 seedlings for the species being addressed by the tree improvement program and $0.00 for those species not included in the program.

2/ Transportation costs remain the responsibility of the individual purchaser. However, DNR costs for bulk transport to major distribution centers have been included in calculating the F.O.B. price.

## Valuing Direct and Indirect Effects

In valuing the various benefits and costs associated with a change in pricing policy, it was necessary to estimate the effect that a price change would have on the number of seedlings sold by the nurseries. An increase in price to the full self-support level would reduce nursery shipments by approximately 2,509,000 seedlings per year. Table 4.5 shows the detailed calculations used to reach this conclusion. Assumptions employed at this stage of the analysis include: (1) the various classes of landowners would continue to receive their historical market share of the seedlings shipped from the nurseries; (2) the total reforestation budget of each landowner class is relatively fixed in size, and; (3) the various cost-sharing programs will continue to provide at least 50% financing on six million privately planted seedlings each year.

Table 4.7 illustrates the calculations used to establish the current value of the beneficial effects of a self-support policy. In these calculations, the reduction in nursery program expenditures by government was equated to the anticipated net increase in seedling revenues. The average annual bonded indebtedness over the past five years was assumed to have a coupon rate of 8%, and a real cost of 2.4% per year. Calculations of the tree improvement program's value (see Chapter II of this plan) indicate that returns are in excess of 4.4% per year. However, for purposes of this analysis, the returns were held at the minimum required rate of return of 4.4% so as not to over-rate their importance. Finally, it was assumed that savings by government could be invested in instruments which would earn at least a 4.4% real rate of return.

Table C6b illustrates the calculation of the current value of the cost effects of a self-support policy. The potential loss of receipts was calculated by landowner class, based on the number of seedlings that would have been used on the acreage that would not be planted under the new pricing policy. It was assumed that this unplanted acreage would regenerate itself to some lower-valued form of timber, such as aspen. The difference in future stumpage values between the planted species and aspen was calculated, and discounted to the present. This difference, times the acreage involved, provides an estimate of potential timber revenues forgone due to a change in nursery price policy.

Each dollar in stumpage sales leads to an average of $77.10 in wholesale product value produced in the state. Discounting this multiplier and then applying it to the loss in stumpage sales provides an estimate of potential economic activity forgone. Unemployment impacts were based on the assumption that there may be as much as a 20 cord per acre difference in productivity between planted and unplanted stands. This cordage times the acreage not planted yields a potential reduction in harvest of 71,700 cords. Dividing this cordage by 492, the average number of cords per wood products employee, suggests that 146 jobs would be affected by a reduction in the harvest. For the latest year of record (1981), the Department of Economic Security shows an average weekly rate of pay of $300 for wood products employees. Applying the state's unemployment compensation formula and discounting to the present, because the unemployment will occur in future years, yields a present estimate of the potential unemployment compensation load which might result from a change in nursery stock pricing

TABLE 4.5

PRICE CHANGE IMPACT ON REFORESTATION AND NURSERY SHIPMENTS

| | | | | |
|---|---|---|---|---|
| 1. | 27,200,000 Seedlings Shipped: | 50% to Private Parties | = | 13,600,000 |
| | | 17% to Other Public Agencies | = | 4,624,000 |
| | | 33% to State of Minnesota | = | 8,976,000 |
| 2. | Acres of Planting Anticipated: | Private = 13,600,000 - 700/a. | = | 19,429 a. |
| | | Other Public = 4,624,000 - 700/a. | = | 6,606 a. |
| | | State = 8,976,000 - 700/a. | = | 12,823 a. |
| 3. | Expected Reforestation Budget: | Private = 19,429 x $135/a. | = | $2,622,915 1/ |
| | | Other Public = 6,606 x 132/a. | = | 871,992 |
| | | State = 12,823 x 132/a. | = | 1,692,636 |
| 4. | Acres of Planting after Price Change: | Private = $2,673,045 - $152 | = | 17,586 a. 2/ |
| | | Other Public = 871,992 - 145 | = | 6014 a. |
| | | State = 1,692,636 - 145 | = | 11,673 a. |
| 5. | Net Change in Reforestation Acres: | Private = 19,429 - 17,586 | = | 1,843 a. |
| | | Other Public = 6,606 - 6,014 | = | 592 a. |
| | | State = 12,823 - 11,673 | = | 1,150 a. |
| | | | | 3,585 a. |
| 6. | Revised Seedling Shipments: | Private = 17,586 x 700 tpa | = | 12,310,000 |
| | | Other Public = 6,014 x 700 tpa | = | 4,210,000 |
| | | State = 11,673 x 700 tpa | = | 8,171,000 |
| | | | | 24,691,000 |
| 7. | Net Loss in Shipments: | 27,200,000 - 24,691,000 | = | 2,509,000 |

1/ Anticipated budgets are based on average costs per acre for site preparation and planting, including planting stock and tax where appropriate.

2/ Budget revised upwards to reflect increased cost share payments covering 50% of the cost increase on 6,000,000 seedlings for private planting.

TABLE 4.6

CURRENT VALUE OF BENEFICIAL EFFECTS

| | | |
|---|---|---|
| Reduction in Nursery Program Expenditures: | | |
| Increased Revenue, private sales = 12,310 x ($76.87-60.16) | = | $205,703 |
| Increased Revenue, public sales = 12,381 x ($72.52-57.30) | = | 188,437 |
| | | $394,140 |
| Reduction in Bonded Debt Service: | | |
| 2.4% (APR) on 5 yr ave. debt = 583,200 - 5 x .024 | = | $ 2,799 |
| Maintain Rate of Return on Tree Improvement: | | |
| $82,300/yr x .044 (4.4% APR) | = | $ 3,621 |
| Return on Invested Program Savings: | | |
| $394,140/yr x .044 (4.4% APR) | = | $ 17,352 |

policy. Finally, the increase in cost sharing payments was calculated on the basis of 50% of the cost increase on an assumed six million seedlings covered by the program.

Measurement of Economic Effects

Each of the costs and benefits would increase in real value and recur on a fixed schedule during the 17 year course of the analysis. The assumed schedule and rates of real value change used in the analysis are displayed in Table 4.8. All of the values associated with timber were assumed to increase at a real rate of 2.1% per year, which is the real rate at which Minnesota stumpage prices have increased over the past ten years. All of the values associated with nursery stock prices were assumed to increase at a real rate of 5.1% per year, which is the real rate at which state nursery stock prices have increased over the past five years. The 2.4% rate used with unemployment compensation is a calculated real rate of salary increase for wood products workers over the past five years.

For purposes of the analysis, it was assumed that any effect associated with a reduction in planted acreage would not become apparent for five years. This assumption is based on the idea that harvests are determined by inventories that are recalculated once every ten years, and 1984 is approximately halfway through one of those ten year periods. Given our initial assumptions regarding FY 1984 nursery financing, savings can not begin to accrue until FY 1985, and investment returns from those sav-

TABLE 4.7

CURRENT VALUE OF COST EFFECTS

Loss of Receipts, including Sales Tax:

| | | |
|---|---|---|
| Private = 1,843 a. x 700 tpa x 76.87/1000 trees | = | $ 99,170 |
| Other Public = 592 a. x 700 tpa x 72.52/1000 trees | = | 30,052 |
| State = 1,150 a. x 700 tpa x 72.52/1000 trees | | 58,379 |
| | | $187,601 |

Present Worth of Timber on Unplanted Acres:

| | | |
|---|---|---|
| 3,585 a. x ($9.00-5.60) = 3,585 x $3.40 | = | $ 12,189 |

Present Worth of Lost Economic Activity:

| | | |
|---|---|---|
| $12,189 x (77.1 x .061) 12,189 = $12,189 x 4.69 - 12,189 1/ | = | $ 45,137 |

Potential Unemployment Compensation Load:

| | | |
|---|---|---|
| 3,585 a. x 20 cds/a. = 71,700 cds<br>71,700 cds - 492 cds/job = 146 jobs<br>146 jobs x $150/wk x 26 wks x .061 1/ | = | $ 34,733 |

Increased Cost Share Program Payments:

| | | |
|---|---|---|
| ($76.87-60.16) x .5 x 6,000 | = | $ 50,130 |

1/ Discounted for 65 years, which is the estimated average rotation age for all species concerned.

ings would not appear until one year later (FY 1986). Having finally established all of this information, it was then possible to utilize DNR Forestry's cash flow analysis computer program to complete the required economic investigation. The cash flow table generated by the program is displayed as Table 4.9 in this report.

The results of the economic analysis suggest that the change to a self-support pricing policy is economically efficient. At the 4.4% discount rate specified in the analysis, the Net Present Worth (i.e. benefits minus costs, expressed in 1982 dollars) of such a policy change through the year 2000 would be $528,000, while total benefits received would exceed $8,400,000. The Internal Rate of Return (i.e. the discount rate at which benefits just equal costs) for the policy change is 36.26%, while the overall Benefit to Cost Ratio is 1.10 to one. For every one dollar of costs incurred by society in making the policy change, one dollar and ten cents

TABLE 4.8

AMOUNT AND TIMING OF COSTS AND BENEFITS
THROUGH FY 2000

| ITEM | CURRENT VALUE | YEARS FROM | YEARS TO | REAL RATE OF CHANGE 1/ |
|---|---|---|---|---|
| Lost Receipts | $187,601/yr | 1984 | 2000 | + 5.1% |
| Lost Timber | 12,189/yr | 1989 | 2000 | + 2.1% |
| Economic Loss | 44,977/yr | 1989 | 2000 | + 2.1% |
| Unemploy. Comp. | 34,733/yr | 1989 | 2000 | + 2.4% |
| Cost Share Increase | 50,130/yr | 1984 | 2000 | + 5.1% |
| Reduced Expenses | 394,140/yr | 1985 | 2000 | + 5.1% |
| Reduced Debt Service | 2,799/yr | 1984 | 2000 | 0.0 2/ |
| Return on Tree Imp. | 3,621/yr | 1984 | 2000 | + 2.1% |
| Return on Savings | 17,352/yr | 1986 | 2000 | + 5.1% |

1/ Annual compound rate of change in value, net of inflation, as based on historical averages calculated for Minnesota.

2/ No real increase assumed as debt service was fixed at the 1978 - 1982 average price level.

worth of benefits will be received, on the average, between 1984 and the year 2000. However, it should be noted that the cumulative discounted net benefits remain negative until 1987. This would suggest that it will take at least four years before the policy change would begin to pay off.

A sensitivity analysis was conducted in conjunction with the economic analysis. The value of a sensitivity analysis is that it illustrates how "sensitive" the results of the economic analysis are to changes, or uncertainty, in the assumed values of costs and benefits. The results of the sensitivity analysis are presented in Table 4.10. Based on these results, the most critical factors with regard to the economic validity of a self-support pricing policy are: (1) actual reductions in government nursery program expenditures, and; (2) actual losses in nursery sales and receipts caused by purchaser aversion to price increases. As both of these factors are interrelated, it appears likely that if government savings were more

TABLE 4.9

ECONOMIC VALUE FLOW PROJECTIONS
($1.00 = $1,000.00)

| ITEM | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|
| Lost Receipts | 188.00 | 197.59 | 207.66 | 218.26 | 229.39 | 241.09 |
| Lost Timber | 0 | 0 | 0 | 0 | 0 | 13.31 |
| Economic Loss | 0 | 0 | 0 | 0 | 0 | 49.93 |
| Unemployment | 0 | 0 | 0 | 0 | 0 | 39.41 |
| Cost Shares | 50.00 | 52.55 | 55.23 | 58.05 | 61.01 | 64.12 |
| Total Costs | 238.00 | 250.14 | 262.90 | 276.30 | 290.39 | 407.85 |
| Reduce Exp | 0 | 330.01 | 346.84 | 364.53 | 383.13 | 402.66 |
| Reduce Debt | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Tree Imp Rtn | 4.00 | 4.08 | 4.17 | 4.26 | 4.35 | 4.44 |
| Invest Save | 0 | 0 | 18.78 | 19.74 | 20.74 | 21.80 |
| Total Benefits | 7.00 | 337.10 | 372.79 | 391.53 | 411.21 | 431.90 |
| CUM DIS NET BEN | -231.00 | -147.70 | - 46.88 | 54.39 | 156.09 | 175.46 |

| ITEM | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|
| Lost Receipts | 253.38 | 266.30 | 279.88 | 294.16 | 309.16 | 324.93 |
| Lost Timber | 13.59 | 13.88 | 14.17 | 14.47 | 14.77 | 15.08 |
| Economic Loss | 50.98 | 52.05 | 53.14 | 54.26 | 55.39 | 56.56 |
| Unemployment | 40.35 | 41.32 | 42.31 | 43.33 | 44.37 | 45.43 |
| Cost Shares | 67.39 | 70.83 | 74.44 | 78.23 | 82.22 | 86.42 |
| Total Costs | 425.69 | 444.38 | 463.95 | 484.44 | 505.92 | 528.42 |
| Reduce Exp | 423.20 | 444.78 | 467.47 | 491.31 | 516.37 | 542.70 |
| Reduce Debt | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Tree Imp Rtn | 4.53 | 4.63 | 4.72 | 4.82 | 4.92 | 5.03 |
| Invest Save | 22.91 | 24.08 | 25.31 | 26.60 | 27.96 | 29.38 |
| Total Benefits | 453.64 | 476.49 | 500.50 | 525.73 | 552.25 | 580.11 |
| CUM DIS NET BEN | 197.07 | 220.83 | 246.73 | 274.75 | 304.87 | 337.06 |

TABLE 4.9 Continued

| ITEM | 1996 | 1997 | 1998 | 1999 | 2000 | TOTALS |
|---|---|---|---|---|---|---|
| Lost Receipts | 341.50 | 358.92 | 377.22 | 396.46 | 416.68 | 4,900.57 |
| Lost Timber | 15.40 | 15.72 | 16.05 | 16.39 | 16.73 | 179.58 |
| Economic Loss | 57.75 | 58.96 | 60.20 | 61.46 | 62.75 | 673.41 |
| Unemployment | 46.52 | 47.64 | 48.78 | 49.95 | 51.15 | 540.57 |
| Cost Shares | 90.82 | 95.46 | 100.32 | 105.44 | 110.82 | 1,303.34 |
| Total Costs | 551.99 | 576.69 | 602.58 | 629.70 | 658.14 | 7,597.48 |
| Reduce Exp | 570.38 | 599.47 | 630.04 | 662.17 | 695.94 | 7,871.00 |
| Reduce Debt | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 51.00 |
| Tree Imp Rtn | 5.13 | 5.24 | 5.35 | 5.46 | 5.58 | 80.72 |
| Invest Save | 30.88 | 32.46 | 34.11 | 35.85 | 37.68 | 408.27 |
| Total Benefits | 609.39 | 640.16 | 672.50 | 706.48 | 742.20 | 8,410.99 |
| CUM DIS NET BEN | 371.29 | 407.56 | 445.82 | 486.07 | 528.28 | 528.28 |

than five percent below original estimates, while lost receipts were more than five percent above original estimates, the change in pricing policy would not be economically justified. The outcome of the economic analysis is much less sensitive to uncertainty or variability in any of the other cost or benefit assumptions. Any one of these assumptions could vary by as much as 50% and the economic consequences of changing pricing policies would not be effected.

Other Considerations and Consequences

Two considerations, other than economic efficiency may enter into the decision regarding whether or not to implement a self-support pricing policy. These other considerations are: (1) equity, or income redistribution issues, and; (2) the change in the balance of payments between state government accounts which result from implementing a self-support policy.

Under current policy, the taxpayers of Minnesota are providing a subsidy to private purchasers of state nursery stock. This subsidy is increased whenever the private purchaser also elects to plant those seedlings under a government sponsored cost sharing program. In essence, the result of the current pricing policy with respect to private purchasers has been to redistribute income from taxpayers in general to specific, tree planting individuals who may or may not need the income thus received. Under the proposed self-support policy, the income redistribution associated with

TABLE 4.10

SENSITIVITY ANALYSIS
SELF-SUPPORT PRICING POLICY

(4.40 Percent Discount Rate)

| Change in NPW | Due to a 10% change in: |
|---|---|
| $337,330 | Lost Receipts |
| 11,430 | Lost Timber Values |
| 42,860 | Lost Economic Activity |
| 34,360 | Increased Unemployment |
| 89,720 | Increased Cost Shares |
| $532,020 | Reduced Gov't Expenses |
| 3,690 | Reduced Debt Service |
| 5,720 | Tree Improvement Returns |
| 27,090 | Return on Invested Savings |

subsidized nursery stock would not occur. A self-support policy would improve equity because those who benefit from the trees will be those who are paying for the trees. At the same time, Minnesota's public policy of encouraging private reforestation would not be unduly hampered. Seedlings would still be made available, but at their true cost, and those who wished could then receive reforestation aid through cost sharing programs.

The balance of payments between state government accounts would not be affected as significantly as one might expect when changing to a self-support pricing policy. As shown in Table 4.1, the State of Minnesota is the single biggest user of nursery products. Under the current pricing policy the state is spending approximately one and one-half million dollars in state funds per year on the nurseries. These expenditures are made mainly from the General Fund, with some expenditures from the State Forest Development Fund and other sources. Under a self-support policy, these expenditures would be reduced to about $979,000, which is the estimated value of the nursery products and services that the State would be "purchasing" from the nurseries.

The estimated savings of $520,000 per year, or $1,040,000 per biennium would accrue, basically to the State General Fund, beginning in FY 1985 under the plan envisioned here. This savings would be accomplished through a reduction in the General Fund appropriations of the Department of Natural Resources, Division of Forestry. However, to cover the costs of nursery operations and capital improvement purchases, it will be necessary to increase the Division's appropriations from the Forest Management Fund. This increased appropriation would be funded by the additional nursery receipts that would be deposited to that fund. The net effect of these actions may be an increase in the Division of Forestry's overall budget, but the increase will come from dedicated funds generated by the sale of the nursery stock itself. On balance, cash flow within state government will probably be enhanced under the self-support policy, as General Fund obligations for the forest nurseries would be reduced, thus freeing funds for other public purposes.

Discussion

Based on the results of the economic analysis it appears likely that changing to a full, self-support, but non-profit pricing policy would be in the state's best interest. However, making that policy change in FY 1984 may entail a high degree of risk and uncertainty. The economic analysis and its conclusions are valid only so long as the ceterus parabus assumption upon which the analysis was based is not violated. Therefore, it was necessary to evaluate the consequences of other changes in state law and policy and their relationship to a change in nursery stock pricing policy.

In fiscal year 1984 many public and non-profit agencies will be obligated to pay for seedlings which they formerly received free of charge. This change in nursery practices, mandated by law, will most likely have a significant, adverse effect on nursery stock shipments in FY 1984, if not for several years thereafter. The magnitude and longevity of this effect are totally unknown, and can not be readily quantified at this time. Logic suggests that there may be a fairly large (2 - 4 million seedling) reduction in nursery orders occasioned by this change in policy. The change in demand and, hence, receipts introduces enough uncertainty into the current analysis to warrant suspending the implementation of what otherwise would be an economically efficient and equitable self-support policy.

Economics would dictate that timeliness and caution be used in implementing a self-support pricing policy at the state nurseries. Structural changes in demand for state nursery stock will occur over the next several years as a result of recent changes in state law. Until these changes in demand stabilize, and a new demand function can be estimated for state nursery stock, it will be difficult to regulate production and costs at the nurseries. Unbalanced demand and production could easily lead to nursery stock surpluses, under-pricing of stock being sold, and the loss of the self-support capability. It may be in the long-term best interests of the state to implement the total self-support policy in two stages.

From an economic perspective, there would be a net gain in FY 1984 through the implementation of a tree improvement surcharge. This action would place the tree improvement program on a self-supporting basis by FY 1985, and would provide some financial relief for the State General

Fund. At the same time, financial risks associated with unknown changes in demand could be minimized by delaying full implementation of the nursery self-support policy until FY 1986, when demand and production schedules should have stabilized. The cost of delaying this part of the overall policy will be approximately $520,000 in continued General Fund obligations during the 1983 to 1985 biennium. This cost would offset a potential deficit of up to $600,000 in the Forest Management Fund during the same time period. On balance, the suggested delay would be cost effective, and could help assure the ultimate implementation of a successful self-support policy which would generate an estimated $8,000,000 in General Fund savings by the turn of the century.

Finally, some beneficial externalities may result from the implementation of the recommendations in this report, and from the 1984 policy of charging all tree seedling users for their stock. In Chapter III it is suggested that Black Spruce, Larch and White Cedar be considered as principal species for a containerized planting stock program. Because of the high capital investment requirements for the startup of such a program, it is further suggested that these containers be grown by private nurserymen under contract to the state. In this way, the state would not incur the initial startup costs, while private nurserymen who have established, or are developing a container program, would have a financial incentive for their program. In addition, it is possible that a full self-support price policy at the state nurseries, coupled with the new policy of charging all tree users, may eliminate any economic disparities between the public and private nursery sectors. Private nurserymen may benefit because the state nurseries will no longer be subsidized and will, therefore, be more price competitive. The end result may well be a shift in demand from the public to the private nurseries, with no loss in reforestation effort, but with a net economic gain for society as a whole.

# CHAPTER V

## CONCLUSIONS AND RECOMMENDATIONS

### Conclusions

After a thorough review of the state nursery operations and tree improvement programs of the Minnesota Department of Natural Resources, the university scientists and forestry professionals involved have concluded that:

1. The Department of Natural Resources has a viable genetic tree improvement program for nine of the most important commercial tree species in Minnesota. With the addition of one tree improvement specialist, as proposed in Section 34(c) of the Forest Resource Management Act of 1982, the DNR, working in conjunction with the University of Minnesota, will have sufficient scientific and technical expertise to fully implement that tree improvement program. If fully implemented, such a program will provide public and private benefits far in excess of its costs.

2. Adoption of a seed certification system for forest reproductive materials is not practical or warranted in Minnesota at this time. Benefits from such a system accrue most favorably when commerce in forest tree seed between multiple producers reaches a high level of development. Such a situation is not evident in Minnesota at this time, but is expected to develop by the early 1990's. At that time a seed certification system should be developed and implemented in accordance with guidelines developed by the Organization for Economic Cooperation and Development (OECD) in 1974.

3. The DNR nurseries, thanks to a large infusion of financial resources in recent years, have begun to implement modern nursery management techniques. The full and successful implementation of such techniques will be dependent upon the development of computerized information systems for nursery management during the 1983 - 1985 biennium. Once fully implemented, the modern nursery techniques will greatly improve the quality of stock being produced, as well as the productivity and efficiency of the nurseries.

4. Contractual arrangements between the state nurseries and the users of tree seedlings can be improved and expanded upon to increase the cost effectiveness of the nursery program. In addition, a statutory change is possible which would increase the flexibility and profitability of the nursery program. Such changes would not create an undue conflict of interest with private nursery operations, while they would prove beneficial to all affected parties.

5. It would be both practical and beneficial for the DNR to place the nursery operations and tree improvement programs on a self-supporting financial basis. Implementation of appropriate surcharges to make the tree improvement program self-supporting should take place as soon as possible.

However, full self-support of the nursery program should be delayed until the 1985 - 1987 biennium, when the full effects of recent revisions in Minnesota Statutes 89.32, Subdivisions 2, 3 and 3a are more fully known and understood.

Recommendations

In conjunction with the above conclusions, it is recommended that the following actions be implemented:

1. Tree Improvement Program

   (a) DNR-Forestry should implement a seed source control system for all species of trees covered in Catagories I and II of the tree improvement plan by July 1, 1985.

   (b) UM-College of Forestry should revise the current "Tree Improvement Plan for Minnesota" to incorporate those changes in the program which are summarized in Chapter II of this report.

   (c) DNR-Forestry and UM-College of Forestry personnel should fully implement all genetic improvement activities for Category I and II species during the 1983 - 1985 biennium.

2. Modern Nursery Operations

   (a) DNR-Forestry should fully develop and implement a complete, computerized Management Imformation System for nursery operations and financial records by July 1, 1985.

   (b) DNR-Forestry, in conjunction with (a) above, should develop a comprehensive manual documenting and governing the implementation and use of modern nursery management techniques at each state nursery.

   (c) DNR-Forestry, with the assistance of UM-College of Forestry scientists, should develop a containerized tree reproduction program with emphasis directed toward the lowland (swamp) conifer species, and the use of private sector contract nurserymen during the next two bienniums.

3. Financial Actions

   (a) DNR-Forestry should implement a system of appropriate and reasonable surcharges to place the tree improvement program on a fully self-supporting basis, beginning with tree orders received in FY 1984.

   (b) DNR-Forestry should implement a system of nursery tree seedling charges which would provide for the full self-support of all nursery operations beginning with tree orders received in FY 1986.

(c) Department of Natural Resources, with the assistance of the Department of Finance should develop and implement a complete cost and revenue accounting system for the nursery and tree improvement programs by July 1, 1984.

(d) DNR-Forestry, through the Commissioner of Natural Resources, should report to the legislature the specific amounts for reduction in General Fund appropriations and increases in Forest Management Fund appropriations which are consistent with a full self-support policy for the state nurseries. These amounts should be included in the departmental budget for the 1985 - 1987 biennium.

4. Legal Actions

(a) DNR-Forestry, with the assistance of the Attorney General's office, should revise all nursery tree order forms and contracts to reflect the current provisions of Minnesota Statutes 89.37, Subd. 2, 3, and 3a. Included in these revisions should be provisions for a change in order cancellation and alteration policies as suggested in Chapter III of this report. Such revisions should be made prior to September 1, 1983.

(b) DNR-Forestry, with the assistance of the Attorney General's office, should develop new tree sales contracts and procedures which are consistant with current state statutes, and which provide for long term, special order contracting by the state nurseries as suggested in Chapter III of this report.

(c) Department of Natural Resources should present to the legislature an appropriately worded revision or amendment to Minnesota Statutes 89.37, Subd. 1, which would allow for the interstate trade of nursery stock with departments of natural resources in other states, as suggested in Chapter III of this report. Such presentation should be made no later than January 31, 1984.