

## DOCUMENT RESUME

05935 - [B1386401]

Need To Concentrate Intensive Timber Management on High Productive Lands. CED-78-105; B-125053. May 11, 1978. 48 pp. + 2 appendices (11 pp.).

Report to the Congress; by Elmer B. Staats, Comptroller General.

Issue Area: Land Use Planning and Control: Management of Federal Lands and Related Resources (2306); Materials: Renewing Resources (1810).

Contact: Community and Economic Development Div.

Budget Function: Natural Resources, Environment, and Energy: Conservation and Land Management (302).

Organization Concerned: Department of Agriculture; Forest Service.

Congressional Relevance: House Committee on Agriculture; Senate Committee on Agriculture, Nutrition, and Forestry; Congress.

Authority: Forest and Rangeland Renewable Resources Planning Act of 1974 (16 U.S.C. 1600). National Forest Management Act of 1976 (16 U.S.C. 1600). 86 Stat. 678.

A 1974 report noted that the Forest Service had a reforestation backlog, including 13.4 million acres needing timber stand improvements (TSIs). The report found that the Service's land inventory data were inadequate because it did not show specifically the location and condition of the lands needing reforestation and TSI. Fund allocation procedures had not insured that appropriated funds were used where reforestation and TSI would result in the best possible timber growth and other multiple-use benefits such as improved recreation, watershed, and wildlife areas.

Findings/Conclusions: Since the report was issued in 1974, annual appropriations for reforestation and timber stand improvement work have increased from about \$33 million to about \$73 million, the Congress has enacted legislation to provide for obtaining the best possible benefits from reforestation and TSI investments, and new timber management plans for national forests have given more attention to reforestation and denuded lands and intensified management. However, many problems still exist. The Service has not: obtained adequate land inventory data, used economic analysis techniques to determine project priorities, stored all land inventory data in a central automated system for easy retrieval, or made or set target dates for using analyses required for investment decisions. Projects were still selected on the basis of individual forest managers' assessments of land condition, land topography, and site accessibility and may not have been cost effective. The basic problem may be the Service's management philosophy for its program. Recommendations: The Secretary of Agriculture should direct the Forest Service to improve land inventory data, determine the benefits expected from intensive management investments, and use improved fund allocation techniques. The

Secretary should monitor these activities and include in annual reports to the Congress information showing the Service's progress. (RRS)

---

BY THE COMPTROLLER GENERAL

# Report To The Congress

OF THE UNITED STATES

---

## Need To Concentrate Intensive Timber Management On High Productive Lands

There is growing pressure on the Department of Agriculture's Forest Service to produce more and better timber in U.S. national forests because of increasing demand, expected shortages, and rising prices. Concentrating intensive forest management on high productive lands can result in substantial gains in timber growth and quality. Despite the efforts of the Forest Service, several management problems persist. This report discusses foreign and domestic timber management techniques and recommends actions the Forest Service could take to overcome problems and manage the forests more productively.



GED-78-105

MAY 11, 1978



COMPTROLLER GENERAL OF THE UNITED STATES

WASHINGTON, D.C. 20546

B-125053

To the President of the Senate and the  
Speaker of the House of Representatives

This report discusses problems the Forest Service, Department of Agriculture, has in increasing the quantity and quality of timber on national forest lands through intensive management.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

Copies of this report are being sent to the Director, Office of Management and Budget, and to the Secretary of Agriculture.

  
Comptroller General  
of the United States

D I G E S T

The Congress has long felt that the national forest lands should produce more and better timber because of growing demand, expected shortages, and rising prices. Concern has been expressed that lands capable of producing timber either are not being reforested or are not being managed to produce timber at its optimal growth rate.

In response to such concerns, the Forest Service has improved its management procedures. But more needs to be done.

Substantial gains in timber growth and quality are possible if reforestation and timber stand improvements, such as thinning and fertilization, are concentrated on the most productive sites. The Service's land inventory data, fund allocation procedures, and standards and guidance provided to its field personnel, however, fall short of what is needed to permit such concentration.

The Secretary of Agriculture should direct the Service to

- improve land inventory data (see p. 21),
- determine the benefits expected from intensive management investments (see p. 31), and
- use improved fund allocation procedures (see p. 45).

The Secretary should also monitor these activities and, in annual reports to the Congress, include information which will show the Service's progress. (See pp. 22 and 46.)

In determining annual funding levels for intensive management, the Congress should insure that the Service is (1) improving its land inventory data and classifying timber lands by their productive capabilities and (2) using fund allocation procedures to make sure that the funds are used to

obtain the best possible timber growth and other multiple-use benefits. The Congress also should insure that the Service has provided improved standards and guidance to its field managers. (See pp. 12 and 48.)

GAO made this review because past Department studies and a 1974 GAO report showed that there were several problems despite the Service's efforts to improve the rate of timber growth. One problem had been the lack of sufficient appropriated funds. Additionally, funds that were appropriated had been allocated without making sure that the projects were sound or had the highest priority.

In its 1974 report, GAO presented for congressional consideration several alternatives for increasing funds. GAO also recommended action to improve the Service's land inventory data and fund allocation procedures which the Secretary of Agriculture promised to implement. (See p. 2.)

Since then

- annual appropriations for reforestation and timber stand improvement work have increased from about \$33 million for fiscal year 1974 to about \$73 million for fiscal year 1978;
- the Congress has enacted legislation to provide for obtaining the best possible benefits from reforestation and timber stand improvement investments; and
- new timber management plans for national forests have given more attention to opportunities for reforestation of denuded lands and for intensified management as a means of increasing timber production, quality, and harvest levels. (See pp. 1 to 4.)

However, many of the problems still persist. The Service has not

- obtained adequate land inventory data (see p. 14);
- used economic analysis techniques to determine project priorities (see p. 33);

- stored all the land inventory data that had been obtained in a central automated system where it could be readily retrieved by all management levels (see p. 19); or
- made, or set target dates for preparing and using, the analyses required for investment decisions. (see p. 33).

Projects were still selected on the basis of individual forest managers' assessments of land condition, land topography, and site accessibility, and may not have been cost effective. (See ch. 5.)

Progress has been slow because the Service has required the managers of each of the 154 national forests to separately obtain the land inventory data necessary to identify the areas needing reforestation and timber stand improvement work and to establish priorities for doing the work. The managers had problems doing this because of other work priorities and because they lacked staff qualified to do the analyses needed to decide on the best investments. As a result, managers' decisions were often inconsistent. (See pp. 10, 18, and 23.)

For example, lands on one forest were reported as needing reforestation and timber stand improvement work, while similar lands on another forest were not. Also, some managers gave priority to applying certain practices on highly productive lands, while others gave priority to applying the same practices on low productive lands.

The basic problem may be the Service's management philosophy for its reforestation and timber stand improvement programs. Management is highly decentralized and extremely dependent on the knowledge, judgment, and experience of individual forest managers. Generally, they are recognized as highly competent foresters but few have the background or training to make economic analyses necessary for investment decisions. Therefore, the managers gave more emphasis to doing the work than to analyzing investment alternatives.

Further, Service headquarters had not given the managers guidance as to (1) where and how often the various practices should be used and (2) the increased yields or benefits that could be expected from their use. (See p. 11.)

State, private and foreign timber managers have not experienced the kinds of problems the Service has. They have staffs of trained specialists, rather than field managers, obtain needed data and make economic analyses which are used at the highest management level to decide on intensive management investments. These other managers said that this was the most effective way to establish work priorities and minimize inconsistencies among field managers in making investments. (See pp. 17, 19, and 20 and app. I.)

GAO recognizes that none of these managers work with as many diverse acres and timber types as the Service. It seems, however, that many of their techniques would be beneficial to the Service in intensifying its management of the national forests to obtain the best possible timber growth and other multiple-use benefits.

The Service agreed with most of GAO's recommendations and described actions taken or planned on these matters. (See pp. 22, 31, and 46.) However, much remains to be done; some of the actions could take as long as 8 years to complete.

The Service said that, because of the size and diversity of the national forests, logistics, and the need to consider multiple-use objectives, it is necessary to have a decentralized organization. It said that, because of this, other timber managers' practices should not be compared with those of the Forest Service. GAO's views on this are discussed on page 12.

# C o n t e n t s

		<u>Page</u>
DIGEST		i
CHAPTER		
1	INTRODUCTION	1
	Legislative requirements for best possible use of funds	3
	Purpose and scope of review	5
2	INTENSIVE MANAGEMENT OF THE NATIONAL FORESTS: A TIME FOR CHANGE	10
	Overall agency comments and our evaluation	12
	Recommendation to the Congress	12
3	ADEQUATE LAND INVENTORY DATA STILL NOT AVAILABLE	14
	Major reductions in needs have not resulted from work accomplishments	14
	Problems in acquiring data to estimate needs	16
	Problems in consistently estimating needs even when better data is available	18
	Problems in data retrieval	19
	Conclusions	21
	Recommendations to the Secretary of Agriculture	21
	Agency comments	22
4	BENEFITS FROM REFORESTATION AND TSI NOT DETERMINED	23
	Economic analyses of planned reforestation work	23
	Need to decide on yields from timber harvests	24
	Need to decide when commercial thinnings should be done	25
	Need to decide on timing of final harvest	27
	Need to decide on yields from other intensive management practices	28
	Other timber managers' practices	30
	Conclusions	31
	Recommendations to the Secretary of Agriculture	31
	Agency comments	31

CHAPTER		<u>Page</u>
5	FUND ALLOCATION PROCEDURES	
	STILL NOT IMPROVED	33
	Efforts to improve fund	
	allocation procedures	33
	Problems in implementing	
	economic analyses procedures	36
	Procedures of other timber managers	43
	Conclusions	44
	Recommendations to the Secretary of	
	Agriculture	45
	Agency comments and our evaluation	46
	Recommendation to the Congress	48
 APPENDIX		
I	Foreign timber management practices	49
II	Letter dated February 10, 1978, from the Chief of the Forest Service	54
III	Principal officials of the Department of Agriculture responsible for admin- istration of activities discussed in this report	60

#### ABBREVIATIONS

GAO	General Accounting Office
IRR	internal rate of return
TSI	timber stand improvements

## CHAPTER 1

### INTRODUCTION

Each year the Department of Agriculture's Forest Service sells billions of board feet of timber from the national forests. In fiscal year 1976 the Service sold 10.3 billion board feet, of which 4.8 billion, or 47 percent, came from the Pacific Northwest Region. Returns to the Treasury from Service timber sales are estimated at \$552 million for fiscal year 1978. Forest land management appropriations totaled about \$534 million for fiscal year 1978.

The national forests of the United States are under increasing pressure to provide more and better products and benefits to more people. This pressure has accelerated the development of procedures for multipurpose management planning to provide a mix of goods and services when and where they are needed. Forest management, in turn, is being directed more toward the establishment and care of forests for a wide combination of uses. Because of this trend, there is an increasing need to intensify forest management.

New timber management plans prepared by national forest managers indicate that substantial gains in timber growth and quality are possible by (1) reforesting denuded lands and (2) doing timber stand improvements (TSI), such as thinning, release, fertilization, and genetic tree improvement, which can increase the quality and quantity of timber growth.

Thinning is cutting a number of trees on overstocked land to increase the growth rate of the remaining trees, improve species composition, make better use of growing space, or otherwise increase timber production. Release is cutting or killing growth-inhibiting vegetation and branches, usually in young stands of timber. Fertilization is the application of nutrients to the soil to enhance timber growth. Genetic tree improvement is the propagation of seedlings from trees that exhibit superior growth characteristics. (See pp. 6 to 9 for photographs illustrating the application of, need for, or results of these practices.)

A suitable system of timber management must provide for harvesting, regenerating, and maintaining desired species of trees in stands of suitable structure. Each timber production treatment must be done on schedule and according to certain standards to attain optimum timber growth.

In September 1972 the Congress enacted legislation (86 Stat. 678) to accelerate the reforestation of national forests. The Congress was concerned about the growing demand for timber and the Service's slow progress in eliminating the backlog of denuded lands needing reforestation. As of July 1, 1973, the backlog was estimated at 4.8 million acres. The 1972 act required the Secretary of Agriculture to report to the Congress on the scope of the total national forest reforestation needs and annually on the progress made in meeting these needs.

In our report to the Congress entitled "More Intensive Reforestation and Timber Stand Improvement Programs Could Help Meet Timber Demand" (B-125053, Feb. 14, 1974), we said that, in addition to the reforestation backlog, the Service estimated that it had a backlog of 13.4 million acres needing TSI. Further, we reported that the Service's land inventory data was inadequate because it did not show specifically the location and condition of the lands needing reforestation and TSI. Also, its fund allocation procedures had not insured that appropriated funds were used where reforestation and TSI would result in the best possible timber growth and other multiple-use benefits, such as improved recreation, watershed, and wildlife areas.

We recommended that the Secretary of Agriculture take action to improve the land inventory data and fund allocation procedures and that the Congress decide among several alternatives for increasing funds to accelerate reforestation and TSI. We recommended further that, in making this decision, the Congress consider the Service's progress in improving its land inventory data and fund allocation procedures.

The Secretary reported to the Congress in October 1974 that action had been started on our recommendations and that the current and subsequent annual reforestation progress reports required by the 1972 act would be expanded to include information on

- the progress of the Service's headquarters and field offices in improving the land inventory data,
- the TSI needs and the Service's plans for and progress toward fulfilling such needs, and
- the Service's progress in improving fund allocation procedures.

Since fiscal year 1974 funds appropriated to the Service for reforestation and TSI have more than doubled--from

about \$33 million in fiscal year 1974 to about \$73 million in fiscal year 1978. The following schedule shows (1) the Service's budget estimates for reforestation and TSI, (2) the amounts allowed by the Department and the Office of Management and Budget, and (3) the amounts appropriated by the Congress.

<u>Fiscal year</u>	<u>Forest Service estimate</u>	<u>Department of Agriculture allowance</u>	<u>Office of Management and Budget allowance</u>	<u>Appropriated by the Congress</u>
------(000 omitted)-----				
1974	\$40,595	\$29,831	\$23,831	\$33,331
1975	41,915	36,739	36,500	51,262
1976	41,933	47,476	47,476	62,686
Transition quarter (note a)	10,372	-	-	14,706
1977	69,130	64,916	64,597	68,233
1978	89,454	79,213	68,804	72,995

a/July 1 to September 30, 1976.

In its report on the Service's fiscal year 1978 appropriations 1/, the Senate Committee on Appropriations stated that timely reports by the Service on the implementation of our 1974 recommendations were important because of the expanded reforestation and TSI program.

LEGISLATIVE REQUIREMENTS FOR BEST POSSIBLE USE OF FUNDS

Since our 1974 report the Congress has enacted legislation to provide for obtaining the best possible benefits from the Service's program investments and to declare its policy that all forested lands in the national forest system be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple-use, sustained-yield management in accordance with land management plans.

1/S. Report No. 95-276, 95th Cong., 1st Sess , 36.

In August 1974 the Congress enacted the Forest and Rangeland Renewable Resources Planning Act of 1974 (16 U.S.C. 1600 et seq.). The act requires the Secretary of Agriculture to prepare a renewable resource program every 5 years and to include in it the costs and benefits of investment opportunities in Service programs and the suggested priorities for the investments.

The first Forest Service renewable resource program, dated February 1976, said that, by concentrating reforestation, TSI, and other such investments on the most productive national forest sites, the potential timber yield would increase from 2.7 billion cubic feet in 1975 to 2.8 to 3 billion cubic feet in 1980 and to 3.3 to 4.1 billion cubic feet annually in the decade 2011-20.

In October 1976 the Congress enacted the National Forest Management Act of 1976 (16 U.S.C. 1600 et seq.), which amended the 1974 act. The act authorized a \$200 million appropriation each year to meet the reforestation and TSI needs in the national forests. Under this act the Secretary is to (1) attempt to identify by September 30, 1985, lands not suitable for timber production because of economic or physical factors and include this information in land management plans and (2) formulate and implement, as soon as practicable, a process for estimating the long-term costs and benefits of reforestation and TSI. The act also requires the Secretary to identify and report to the Congress annually, beginning with submission of the President's budget for fiscal year 1978,

- the amount and location of all national forest lands where land management plans indicate the need for reforestation and TSI;
- an estimate of the funds needed for reforestation and TSI of national forest lands to be cut over during the year, plus the funds needed to eliminate the backlogs by October 1984;
- a summary of data and findings resulting from the estimates of the long-term costs and benefits associated with reforestation and TSI projects; and
- information on timber sales where returns to the Government are less than the estimated long-term costs of reforestation and TSI.

## PURPOSE AND SCOPE OF REVIEW

We made this review to evaluate the Forest Service's progress in obtaining improved land inventory data and fund allocation procedures to insure the best possible timber growth and other multiple-use benefits. The review was made at the Gifford Pinchot National Forest in Washington; the Mt. Hood, Willamette, and Umpqua National Forests in Oregon; the Service's Pacific Northwest Regional Office in Portland, Oregon; and Service headquarters in Washington, D.C.

We discussed Forest Service research on reforestation and TSI with officials of the Pacific Northwest Forest and Range Experiment Station in Portland, Oregon, and headquarters. We also visited the Bienville and Desoto National Forests in Mississippi and discussed the reforestation and TSI programs with the district, forest, and regional officials of the Service's Southern Region. We reviewed the applicable laws; reports issued by the Department's Office of Audit; and the agency's policies, procedures, and practices.

In addition, we observed and discussed the reforestation and TSI programs of other public and private timber managers in the United States, Sweden, Austria, and West Germany. (See app. I.)

We coordinated the review with a study of national forest reforestation and TSI programs being made by a Service study team. The study team made its review in the Service's Southern and Intermountain Regions, as well as in the Pacific Northwest Region.



**Douglas-fir stand in need of commercial thinning.**



**A stand of 50-year-old Douglas-fir in western Washington that was commercially thinned.**

Courtesy of Weyerhaeuser Company



**In some areas brush can be a severe problem. In this southern plantation, brush has over-topped planted seedlings and release is needed.**

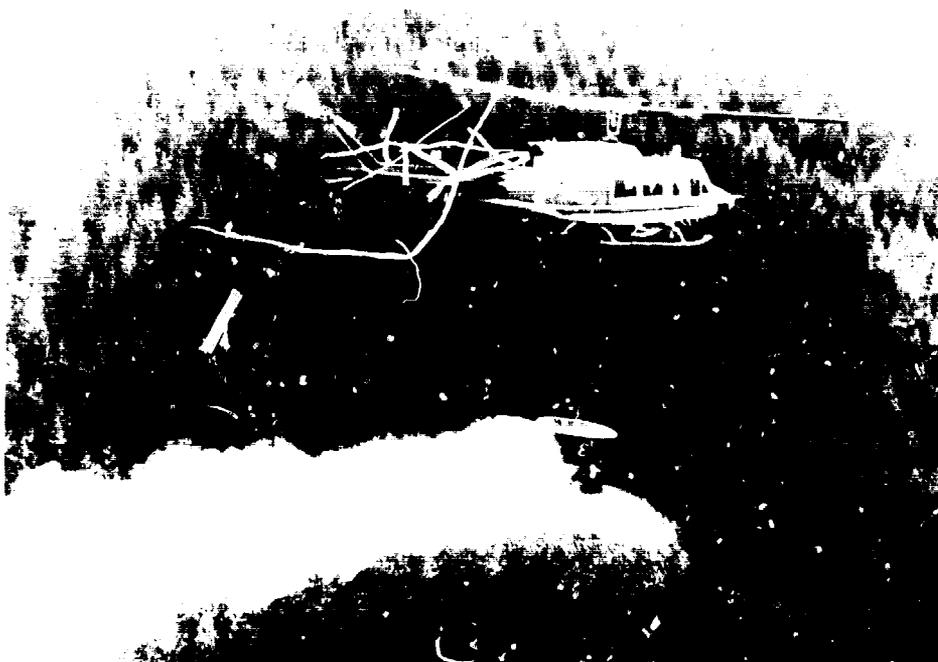


**Suppressed Douglas-fir trees that have been released for greater growth.**

Courtesy of Weyerhaeuser Company

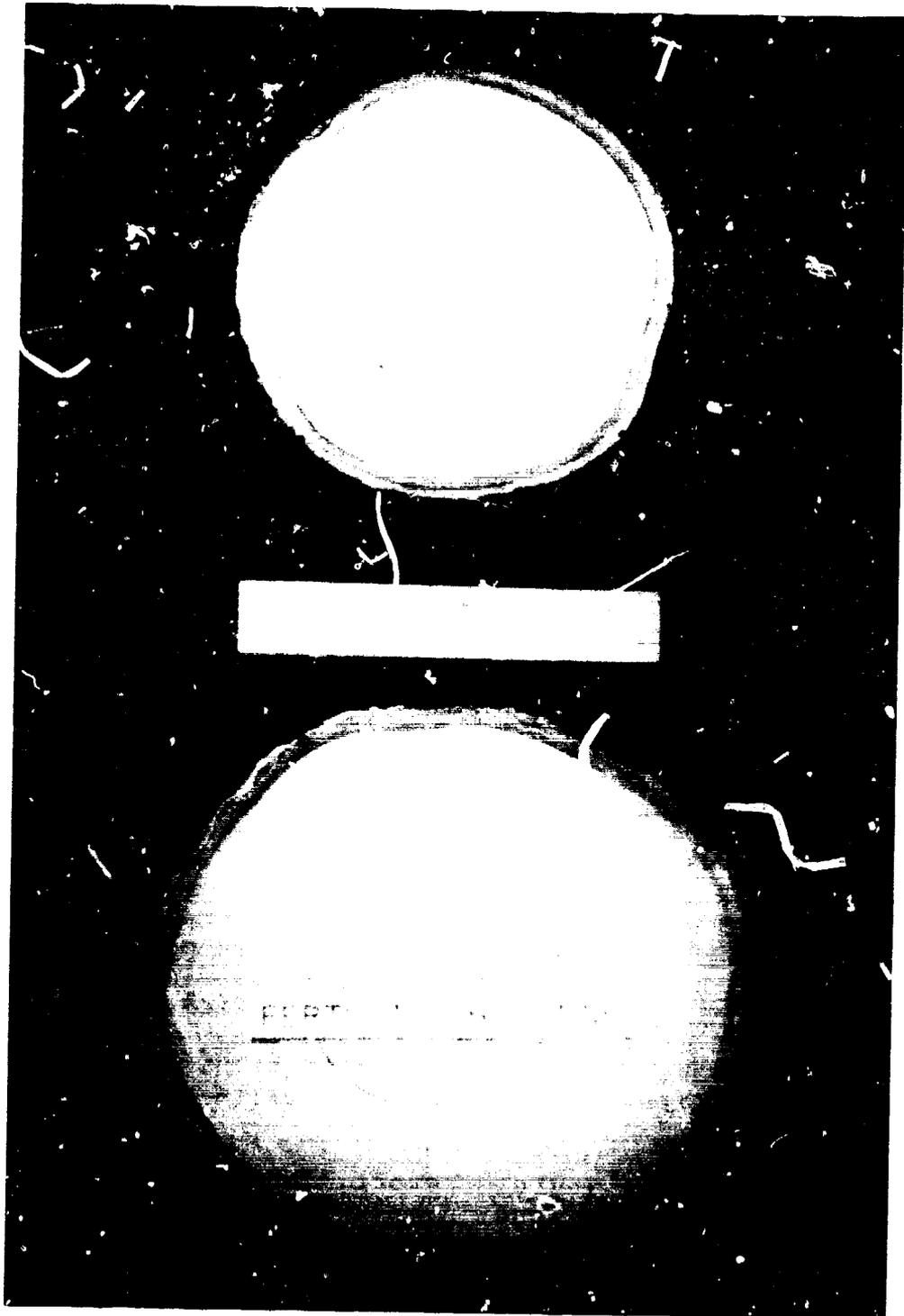


The genetically improved seedlings on the left have outgrown the run-of-the-woods seedlings on the right. The age of both stands is 4-1/2 years.



Aerial application of fertilizer.

Courtesy of Weyerhaeuser Company



**These two fir cross-sections demonstrate the benefits of two silvicultural techniques, fertilization and thinning.**

Courtesy of Weyerhaeuser Company

## CHAPTER 2

### INTENSIVE MANAGEMENT OF THE NATIONAL FORESTS: A TIME FOR CHANGE

The Congress has long been concerned that lands capable of producing timber: either are not being reforested or are not being managed to produce timber at its optimal growth rate.

Various Department of Agriculture studies and our 1974 report showed that there were several problems despite the Forest Service's efforts to improve the rate of timber growth on national forest lands.

One problem was the lack of sufficient appropriated funds for reforestation and TSI work. Additionally, funds that were appropriated for reforestation and TSI were allocated to forests without insuring that they were used to accomplish the most beneficial work. As a result, some young timber stands with high growth potential were not being thinned and other areas with histories of failure and little chance of success were being replanted. These conditions were attributable to an inadequate work priority system and an inadequate inventory of areas needing reforestation and TSI work.

In 1974 we recommended that the Service improve its land inventory data and establish fund allocation procedures to insure the best possible timber growth and other multiple-use benefits. We also suggested ways in which the Congress could provide increased funding for the necessary work. The Congress has provided increased funding and the Service has taken some actions and has promised to take others. The problems, however, still persist. A 1976 report by the Department of Agriculture's Office of Audit said that projects were still selected on the basis of individual forest managers' assessments of land condition, land topography, and site accessibility, and that some projects may not have been cost-effective.

As discussed later in this report, the Service still has not obtained adequate land inventory data, nor has it used economic analysis techniques to determine work priorities. As a result, it is still unable to determine where and when investments should be made to obtain the best possible timber growth and other multiple-use benefits. Further, it will be some time before it can do so.

Progress has been slow because the Service has required the managers of each of the 154 national forests to separately obtain the land inventory data necessary to identify areas

needing reforestation and TSI and to establish priorities for doing the work. The forest managers are having problems doing this because of other work priorities and because they lack staff qualified to do the analyses needed to decide on the best investments.

As a result, the individual managers' decisions were often inconsistent. For example, lands on one forest were reported as needing reforestation and TSI work, while similar lands on another forest were not reported as needing such work. Also, some managers gave priority to certain practices on highly productive lands, while others gave priority to the same practices on low productive lands.

The basic problem may be the Service's management philosophy for the reforestation and TSI programs. Service management is highly decentralized and extremely dependent on the individual forest manager's knowledge, judgment, and experience. Forest managers are generally recognized as highly competent foresters but very few have the background or training to make economic analyses needed for investment decisions. Therefore, the managers gave more emphasis to doing the work than to analyzing investment alternatives. Further, Service headquarters has not given the managers guidance as to (1) where and how often various intensive management practices should be used and (2) the increased yields or benefits that can be expected from their use. It is apparent that the Service is expecting too much from its forest managers and this may be detracting managers from their primary jobs as foresters.

After reviewing the management practices of other State, private, and foreign timber managers, we believe that the Service needs to change the way it manages its reforestation and TSI programs. Other timber managers have not experienced the kinds of problems the Service has. They have staffs of trained specialists, rather than field managers, obtain the needed data and make the economic analyses which are used at the highest management level to decide on the reforestation and TSI investments that their field managers will make. These timber managers said this is the most effective way to establish work priorities and minimize inconsistencies among field managers in making investments.

We realize that none of these other managers work with as many diverse acres and timber types as the Service. It seems, however, that many of the techniques used by these managers would be beneficial to the Service in managing the national forests. The subsequent chapters of this report describe ways in which the Service could use these management techniques.

## OVERALL AGENCY COMMENTS AND OUR EVALUATION

In commenting on our report (see app. II), the Service agreed that there is a need to obtain improved land inventory data, use economic analyses, improve standards and guidance for the field, and concentrate investments on the most productive sites. It also described actions taken or planned on these matters. (See chs. 3, 4, and 5.) However, much still remains to be done; some of the actions could take as long as 8 years to complete.

The Service said that the centralized analysis and decisionmaking of other timber managers would be inappropriate for the national forests. It said that, because of (1) the size and diversity of the national forests, (2) logistics, and (3) multiple-use objectives, decisions should be made at the field level where the staff knew local conditions and objectives.

We realize that managing the national forests is complex and difficult and often requires local decisionmaking. However, the Service has not provided its forest managers with guidance as to (1) where and how often various intensive management practices should be used or (2) the increased yields or benefits that can be expected from their use.

We believe that the size and diversity of the national forests make it even more important to have Servicewide standards as to where and when investments will be made by forest managers. Otherwise, there can be no assurance that reforestation and TSI investments will result in the best possible benefits throughout the national forest system.

We realize that such standards may sometimes conflict with local conditions and objectives. In such cases, forest managers should be allowed, if justified and approved, to deviate from the centralized standards.

## RECOMMENDATION TO THE CONGRESS

The Forest Service practices and advocates a highly decentralized management system in which reforestation and TSI investment decisions are made by individual managers at the field level. This kind of system works best when the field managers are given specific guidance and standards so that they can make investments consistently to achieve the best possible timber growth and other multiple-use benefits. The Service agreed that there is a need to improve standards and guidance for its field managers.

We recommend that, in determining annual funding levels for intensive management of the national forests, the Congress insure that the Service has provided its managers with improved standards and guidance for making reforestation and TSI investments.

## CHAPTER 3

### ADEQUATE LAND INVENTORY DATA STILL NOT AVAILABLE

Following our 1974 report, the Secretary of Agriculture reported to the Congress that the Forest Service had developed an automated system for storage and retrieval of land inventory data. In February 1977, however, the Secretary reported to the Congress that the Service still did not have land inventory data adequate to accurately assess reforestation and TSI needs. He said that such data would not be available for some time. The Service has changed its estimates of the acres needing reforestation and TSI work and has annually reported the revised estimates to the Congress. It has not clearly presented its progress in fulfilling these needs, however, nor has it adequately explained why the estimates changed.

The National Forest Management Act of 1976 established new reporting requirements. It required the Secretary to

--identify all national forest lands needing reforestation and not growing trees at their best potential rate of growth and

--report this information to the Congress each year at the time of the President's budget submission, beginning with the submission for fiscal year 1978.

The Forest Service, which carries out these responsibilities, has been unable to comply and it will be some time before it can do so. The Service has problems (1) acquiring the land inventory data necessary to estimate reforestation and TSI needs, (2) estimating needs consistently even when better data is available, and (3) retrieving the improved land inventory data after it has been acquired.

### MAJOR REDUCTIONS IN NEEDS HAVE NOT RESULTED FROM WORK ACCOMPLISHMENTS

The Service has made major changes in its estimates of reforestation and TSI needs since July 1, 1973. The estimates at that time were that 4.8 million acres needed reforestation and 13.4 million acres needed TSI--a total of 18.2 million acres. As of October 1, 1976, the estimated needs totaled only 6.5 million acres--2.5 million for reforestation and 4 million for TSI. Because the needed work had been accomplished on a total of only 3.4 million acres, we asked the Service for its analysis of the factors accounting for the other changes. Its records were not sufficient, particularly for the early years of the period, to show the number of acres attributable to each factor. However, it provided the following information.

	<u>Reforest-</u> <u>ation</u>	Timber stand <u>improve-</u> <u>ments</u>	<u>Total</u>
	----- (million acres) -----		
Estimated needs July 1, 1973	4.8	13.4	18.2
Adjustment (note a)	<u>1.5</u>	<u>-</u>	<u>1.5</u>
Revised estimate	3.3	13.4	16.7
Additional denuded lands due to such factors as fire, insects, storms, timber harvesting, and reforestation failures (July 1, 1973, to October 1, 1976)	<u>1.2</u>	<u>-</u>	<u>1.2</u>
Subtotal	4.5	13.4	17.9
Reduction in estimated needs (acres no longer reported as being in need of reforestation or TSI)	<u>.8</u>	<u>7.8</u>	<u>8.6</u>
Adjusted needs	3.7	5.6	9.3
Acres accomplished to October 1, 1976	<u>1.2</u>	<u>1.6</u>	<u>2.8</u>
Estimated needs October 1, 1976	<u>2.5</u>	<u>4.0</u>	<u>6.5</u>

a/Adjustment for factors, such as areas reforested before July 1, 1973, which were not taken into account in preparing the 1973 estimate.

As shown, only 1.2 million acres of the reduction in reforestation needs (which was sufficient only to keep pace with the additional denuded acreage) and 1.6 million acres of the reduction in TSI needs resulted from such work. The most significant reduction--0.8 million acres of reforestation needs and 7.8 million acres of TSI needs--resulted from removing lands which Service officials said

- were diverted to nontimber uses, such as wilderness areas, power lines, and roads, and were not scheduled for reforestation or TSI;
- no longer offered opportunities for increasing timber volume through thinning because the trees had grown too large;
- had been reforested through natural means; and
- could not feasibly be reforested for some time because of inaccessibility or lack of proper technology, or because prospective costs appeared greater than prospective returns.

Service officials could not identify the number of acres in each of the above categories.

#### PROBLEMS IN ACQUIRING DATA TO ESTIMATE NEEDS

In March 1976 the Deputy Chief of the National Forest System expressed concern that the data used to estimate needs was not reliable and told the regional foresters that the needs reported to the Congress were expected to be accurate. He said that he had observed that the needs reported by the regional foresters were not reliable because actual on-the-ground conditions differed from those reported and some reported needs were difficult to locate by specific site.

He said that reforestation and TSI needs could only be accurately assessed through on-the-ground examinations and instructed the regional foresters to complete examinations by October 1, 1978, on all stands or areas requiring reforestation or TSI work. It is doubtful, however, that such examinations can be completed by the deadline or that on-the-ground examinations are needed to acquire land inventory data. Other timber managers acquired adequate data more expeditiously by using aerial photographs and records available from previous land activities.

In December 1976 the Deputy Chief asked the regional foresters to report on the progress as of October 1, 1976, in completing the examinations. The regional foresters' reports showed the following.

<u>Region</u>	<u>Acres in need of reforestation and timber stand improvements</u>	<u>Acres in need of on-the-ground examinations</u>
Northern	1,225,000	1,205,000
Rocky Mountain	699,000	657,000
Southwestern	899,000	828,000
Intermountain	403,000	295,000
California	672,000	406,000
Pacific Northwest	1,012,000	541,000
Southern	486,000	200,000
Eastern	684,000	516,000
Alaska	<u>31,000</u>	<u>31,000</u>
Total	<u><u>6,111,000</u></u>	<u><u>4,679,000</u></u>

a/The reports did not include about 500,000 acres of reforestation needs created since July 1, 1975, by such factors as timber harvesting, insect damage, and reforestation failures.

As shown above, about 4.7 million acres still needed to be examined to meet the October 1, 1978, target date. Forest managers have stated that they are uncertain whether they will be able to meet the deadline. They explained that they do not have the staff resources needed to both make the examinations, and carry out their other responsibilities, such as planning reforestation and TSI projects and administering the work.

Other timber managers had obtained land inventory data for all their lands, not just those judged by field managers to need reforestation and TSI at some specific time. These managers did not obtain their initial land inventory data base from on-the-ground examinations because they believed this would take too long. Instead, the data was obtained from available records, such as aerial photographs, soil surveys, and information obtained during previous timber harvest, reforestation, and TSI activities. Full-time specialists trained in photo interpretation were assigned to analyze the records and record the land inventory data in automated data storage and retrieval systems. The data obtained included such characteristics as land productivity, species, age, and stocking levels.

These managers said that they used the land inventory data to identify reforestation and TSI needs and to schedule the field managers' work. For each scheduled project, the field managers were given the applicable land inventory data record and required to make on-the-ground examinations to design the specific work to be done. When an examination showed that the land inventory data was so erroneous that it eliminated the need for a project, it was not done and the corrected land inventory data was entered into the automated storage and retrieval system. The managers acknowledged that greater accuracy can be achieved through on-the-ground examinations. One told us, however, that in its operations the data obtained from photo interpretations and analyses of other records had been about 95 percent accurate.

#### PROBLEMS IN CONSISTENTLY ESTIMATING NEEDS EVEN WHEN BETTER DATA IS AVAILABLE

The Service's forest managers were also inconsistent in estimating their needs. Their opinions differed greatly on (1) the effect of the land's productive capability on the optimum timber stocking level and (2) how close an area should be to the optimum stocking level to be considered in need of reforestation or TSI. As a result, lands on one forest would be reported as needing reforestation or TSI work, while similar lands on another forest would not. Other timber managers estimated their needs at the highest management level thereby minimizing such inconsistencies among their field managers.

The Service's Pacific Northwest Region had developed stocking level tables to be used for comparing the existing stocking level of a timber stand in an area with the optimum stocking level of the land. These tables, implemented in September 1974, were developed from Service studies and observations of timber growth in stands of various densities. The forest managers were instructed to use the stocking level tables as guides, but were permitted to deviate from them if sound facts and professional judgment indicated deviation was warranted.

A regional official said that the region's optimum stocking level for newly planted Douglas-fir was about 435 trees an acre. However, managers at one forest considered the forest's more productive lands to be optimally stocked if at least 280 trees an acre survived a reforestation planting effort. The forest's less productive lands were considered optimally stocked if 150 trees an acre survived. At another forest the managers did not report a need for

reforestation if there were at least 315 trees an acre. They used this number for both highly productive and less productive lands.

The field managers at both forests told us that they did not strive to reach the optimum stocking levels shown in the regional tables because they thought it would be uneconomical to do so.

Other timber managers stocked their highly productive lands more heavily than these Service forest managers. For example, the Douglas-fir stands of a timber manager's highly productive lands in the Pacific Northwest were required to have at least 690 trees an acre when the seedlings in a newly planted stand had grown to a height of about 5 feet. The timber manager told us that its studies showed that a heavy stocking level on its highly productive lands made greater gains in timber growth and quality possible from subsequent thinnings and timber harvests because more of the higher quality trees could be left to grow until final harvest. Foreign timber managers also stocked their highly productive lands heavily to assure the best possible timber growth and quality.

Other timber managers told us that they did not require their field managers to determine reforestation and TSI needs. They said that these needs were determined at the highest management level using (1) land inventory data showing land conditions and (2) criteria developed from studies of timber growth. They said that determinations at the highest management level removed personal bias and judgment by field managers and contributed to consistency in identifying investment needs. These managers said that they were able to identify their needs quickly and with a high degree of reliability because they had obtained land inventory data on all of their lands and had recorded the pertinent characteristics in an automated system from which the highest management level could readily retrieve the information.

#### PROBLEMS IN DATA RETRIEVAL

The Service has developed an automated data storage and retrieval system, called INFORM, which, if properly used, could provide land inventory information on the condition of all national forest lands capable of growing timber. However, the land inventory data obtained by forest managers on the national forest lands reported as needing reforestation and TSI is not all stored in INFORM. Three of the Forest Service's four highest potential timber production regions had each previously developed its own land inventory data and had stored the data in its own automated

system, rather than in INFORM. As a result, specific information on the existing conditions of national forest lands is not readily retrievable by all management levels.

In March 1976 the Deputy Chief of the National Forest System told the regional foresters to store in INFORM, by October 1, 1976, information on the reforestation and TSI needs reported at June 30, 1975. The information was to include the specific location of the land; the source of the land inventory data; tree species; land productivity classification; and factors, such as inaccessibility, affecting accomplishment. Also, the regional foresters were to update the information as they completed on-the-ground examinations. The Deputy Chief told us that he wanted the information stored in INFORM so that it would be available to all Service management levels.

The managers in the Pacific Northwest Region did not follow these instructions. They had developed and were using a regional land inventory data storage and retrieval system rather than INFORM. According to the managers, the regional system was being used because it had been developed before INFORM and considerable time and effort had been spent developing and implementing it. They said that it would require an extensive effort to manipulate the land data stored in the regional system so that it could be transferred into the INFORM system. Further, they said that the INFORM system would not be as useful to their forest managers.

The Service team studying national forest reforestation and TSI programs told us that the California and Southern Regions had also developed their own land inventory data storage and retrieval systems and were using them rather than INFORM. The study team said that the remaining Forest Service regions were in various stages of storing their data in INFORM. The study team said that, in its opinion, the inventory data systems were not providing the information needed for administering the reforestation and TSI programs because there was a lack of uniformity among regions.

Other timber managers had obtained land inventory data for all of their lands, not just those judged by field managers to need reforestation and TSI at some specific time. Each had stored the data in one automated storage and retrieval system so that it could be readily retrieved by all management levels. These systems included data by specific location on (1) land productivity, (2) land operability (mainly slope of the ground and accessibility by mechanized equipment), (3) species, numbers, and ages of trees, (4) volumes of timber, and (5) limitations

on timber harvesting, such as watershed and esthetic protection and enhancement.

These managers told us that, by using various computer programs to manipulate the land inventory data file, they could identify at the highest management level the reforestation and TSI needs on all of their lands and rank them for accomplishment. According to these managers, a single data system and use of the information at the highest management level minimized personal bias and differences in professional judgment at the field level and enabled them to monitor and evaluate their field managers' performance.

### CONCLUSIONS

The Forest Service does not yet have land inventory data adequate to accurately determine reforestation and TSI needs, and it will be some time before it does. Data on land conditions is essential to determine needs and to decide on the best reforestation and TSI investments.

The land inventory data could be obtained more quickly by assigning full-time specialists to do the work and requiring them to use the data available from photographs and previous Service activities on the land. Further, the data needs to be stored so that it can be readily retrieved and analyzed by Service headquarters staff to identify reforestation and TSI needs throughout the national forest system and to decide where and when investments will be made. Individual forest managers should not make these decisions.

### RECOMMENDATIONS TO THE SECRETARY OF AGRICULTURE

We recommend that, to accurately identify reforestation and TSI needs and provide for analyses to decide how the needs can most effectively be met, the Secretary of Agriculture direct the Forest Service to:

- Assign a full-time staff of specialists to analyze data from photographs and previous Service activities to obtain improved land inventory data on all national forest lands capable of growing timber.
- Decide on one Servicewide land inventory data storage and retrieval system and require that land inventory data be stored in the one system so that it can be readily retrieved by all management levels.

--Monitor the progress of the assigned staff and include in the annual reports to the Congress information that clearly shows the progress made in obtaining the land inventory data.

#### AGENCY COMMENTS

The Service said that its land inventory data had improved since 1974 and that it will continue to improve. The Service also said that land management planning regulations were to be published this year--the law requires them by October 1978--and that its objective was to implement the regulations after they are published and respond to the concerns expressed in this report. The Service said it believed that it would be premature to establish dates and numbers for assigning full-time specialists until the regulations are completed.

The Service agreed that there should be a uniform land inventory data storage and retrieval system and said that the data systems would be evaluated and a uniform system established by the end of 1980.

The Service said that its annual reports to the Congress will indicate its progress in developing improved land inventory data.

## CHAPTER 4

### BENEFITS FROM REFORESTATION AND TSI NOT DETERMINED

The Forest Service does extensive research on managing trees and timber, but it has not analyzed the research results to determine the expected benefits of reforestation and timber stand improvement work or the information gaps that need to be addressed in future research studies. Other timber managers have (1) analyzed the results of research and field studies done by their own organizations and by other domestic and foreign organizations, including the Forest Service, and (2) decided, at the highest management level, the timber yields--by timber types and land productivity class--that would be used in their economic analyses of alternative reforestation and TSI management levels.

The need for the Service to determine the expected benefits from reforestation and TSI work was evident from economic analyses made by national forest managers in preparing the fiscal year 1979 budget for reforestation work. The analyses showed that the forest managers did not have the data needed to estimate the increase in timber yields that could be achieved from reforestation and TSI work. They each used professional judgment in making such estimates. As a result, there were wide differences in their decisions.

### ECONOMIC ANALYSES OF PLANNED REFORESTATION WORK

In November 1976 the Forest Service asked its forest managers to prepare economic analyses for budgeting the reforestation work they proposed to do in fiscal year 1979. Analyses for TSI were not requested. The analyses, which were being done for the first time, were to enable the Service to respond to possible questions of the Department of Agriculture and the Office of Management and Budget during development of the budget. A headquarters official told us that the Service was not going to use the results of these analyses as a basis for allocating appropriated funds to the forests on a project-by-project basis for reforestation in fiscal year 1979. They could not be used for this because they were made on a forestwide basis and did not consider differences, such as land productivity, within a forest.

In making the economic analyses, the forest managers were to forecast all the management practices that would most likely be done on the lands to be reforested and when they would be done. They had a wide choice of possible practices, including preparing the land for reforestation, planting with normal growing seedlings or genetically improved seedlings,

release, fertilization, thinning, and final harvest. They also had wide choices as to the intensity of some of these practices, such as the planting density of seedlings and the number of thinnings that would be done before final harvest.

In making the economic analyses, the forest managers had to estimate the increase in timber yields or benefits from each of the management practices. Federal, State, and private forest managers told us that the data for making such estimates was usually available through field studies and analyses done by national forest personnel and research studies done by the Service or other forest researchers, such as other timber managers and State universities. The Service's research program was initiated about 50 years ago under the McSweeney-McNary Forestry Research Act of 1928 (16 U.S.C. 581) and has resulted in considerable data on reforestation, growing, and managing timber. For fiscal year 1978 about \$101 million was appropriated for this forest research program. In fiscal year 1977 about 1,500 studies were being done on managing trees and timber.

The Service had not analyzed the field and research studies to determine the yield increases the forest managers should use in their analyses. The individual managers of each of the 154 national forests had to search out the data and make his own judgment on the benefits of each practice. The following sections discuss the differences in these judgments.

#### NEED TO DECIDE ON YIELDS AND TIMBER HARVESTS

Each of the four national forests we reviewed had developed yield tables using a specifically designed regional computer program. These tables provided the forest managers with estimated harvest yields that could be expected from growing timber of a given species on a given land productivity classification under managed conditions. In making their analyses, forest personnel at three of the four forests made adjustments to the yield tables. They said that the tables did not accurately reflect the timber yield volumes that could be expected from on-the-ground conditions. These adjustments were made, however, with little or no analyses and were based primarily on professional judgment.

For example, the forest managers of one forest said that the yield tables reflected yields under ideal conditions and depicted timber stands completely stocked and periodically thinned. They said that actual conditions usually differed.

Therefore, they reduced the tables' volumes by about 15 percent to more closely approximate reality. A forest manager said that the amount of the reduction was based on professional judgment, and that no analyses of research or field studies had been made to document its reasonableness.

The forest managers of two other forests also assumed that the tables' yield volumes were not realistic and reduced the yield estimates by 10 percent and 21 percent, respectively. As with the first forest, the reductions were based primarily on professional judgment.

At the fourth forest the yield table volumes had not been adjusted. The forest manager said that a reduction should probably have been made but that the data needed for a realistic adjustment had not been developed.

A regional official told us that he was not aware that there were major differences in the use of yield tables among forests. He said that the region had let forest managers make adjustments as they saw fit. He agreed that more reliable yield tables were needed. He said that this could best be done by allowing forest managers from each forest to make field studies of managed stands on their forests. He also said that the regional office should coordinate the field studies so that they are made on a consistent basis. He said that researchers from the Service's research organization should be consulted to determine if they could provide information on making the field studies.

#### NEED TO DECIDE WHEN COMMERCIAL THINNINGS SHOULD BE DONE

Commercial thinning is the harvesting of excess merchantable trees from a timber stand. According to forest managers, its primary benefits are that trees that would normally die before the final harvest are harvested while alive and the remaining trees have less competition for nutrients and grow faster. The timing and frequency of commercial thinnings can greatly affect the expected returns from reforestation. Generally, the earlier the commercial thinnings are made, the greater are the expected returns.

The stand ages at which commercial thinnings were to be done and their frequency varied considerably among the four forests. This was due to different assumptions as to when a stand should be commercially thinned.

For example, the managers of one forest assumed that four commercial thinnings would be made before the final

harvest with the first being done when a stand reached an age of 35 years and the others at ages 45, 55, and 65. Another forest manager with comparable lands and tree species planned only two commercial thinnings, the first at age 45 and the second at age 65. The managers of another forest with comparable lands and tree species planned three commercial thinnings at 10-year intervals starting at age 44. The managers of the fourth forest planned five commercial thinnings at ages 40, 50, 60, 70, and 90.

The forest managers said that the number and timing of commercial thinnings was based on when they thought the estimated value of the timber from a thinning operation would exceed harvesting costs. They said that considerable judgment was used because of the lack of reliable data on when this would happen. They said that better data was needed on future timber values and expected costs incurred in thinning timber under different types of logging systems and topographic conditions.

A regional official agreed that better economic data was needed for determining when commercial thinnings should be done. He said that this was particularly true for trees grown under managed conditions because the region's experience had been primarily with large, old-growth timber not grown under managed conditions. According to the official, timber grown under managed conditions is considerably smaller when harvested than old-growth timber, making the value of the timber and the cost of selling and harvesting it considerably different.

The official said that research was being done on such things as logging systems for commercial thinning operations. He said that, because the region had not made economic analyses of reforestation projects in the past, it had not systematically reviewed available research to determine if data was available that could be used to better predict when commercial thinnings should be done. He agreed that such a study should be made and that it could serve as a basis for coordinating future research efforts with the needs of field personnel. At the time of our review, such a study had not been initiated.

Other timber managers had analyzed the yields and costs of commercial thinning and decided that they should be done differently than those planned by some national forest managers. For example, a timber manager of one company told us that, on the basis of its analyses of timber yields and costs and revenues of commercial thinnings, it had decided that commercial thinning would only be done on highly productive lands that did not have steep slopes.

It also decided that the first commercial thinning would be done when the timber stand was 25 years old and would be followed by four others at 5-year intervals. He said that the company would lose money on the first commercial thinning, but the loss would be more than offset by additional yields from the other commercial thinnings and the final harvest.

#### NEED TO DECIDE ON TIMING OF FINAL HARVEST

The National Forest Management Act of 1976 states that the final harvest of timber stands should generally not be made before a stand reaches the age at which the mean annual increment of wood growth culminates. This is when the rate of timber growth starts to decline. According to a regional official, if two separate land areas of the same productivity class have the same timber species growing on them and there is agreement as to when a tree first becomes merchantable, then the age at which culmination of the mean annual increment of timber growth occurs should be about the same for both areas.

The managers of two of the national forests used yield tables for the same species and land productivity class to determine when final harvests of areas to be planted in 1979 would be made. The yield tables, however, were based on different assumptions as to the minimum sized tree that would be merchantable. This resulted in the culmination of the mean annual increment of growth on one forest to be considerably later than on the other.

One manager determined that the timber stand age for final harvest should be 85 years; the other determined that it should be 110 years. This difference could result in a substantial difference in the two forests' financial returns for the areas planted in 1979.

A regional official said that it would be reasonable to assume that both forests should use the same tree merchantability standards. He said that the region had not helped the forests decide on the optimum time to harvest a stand at each forest. The official said that better data was needed to predict merchantability, and that this could be obtained through a study by Forest Service researchers experienced in such fields as economics and wood utilization.

Other timber managers had analyzed the technological advances in logging and wood product manufacturing processes and had decided, at the highest management level, what size trees could be economically removed from their lands in the future. Such decisions were not made individually by their field managers.

## NEED TO DECIDE ON YIELDS FROM OTHER INTENSIVE MANAGEMENT PRACTICES

Certain intensive management practices were being used or were expected to be used in the immediate future. These practices included release, precommercial thinning, fertilization, and genetic improvements. Adequate data was not available to the forest managers, however, on the increased timber yields that could be expected from these practices.

### Release

In making economic analyses of their reforestation programs, the managers of two forests included release as a management practice that would be used during the early life of the timber stand; the managers of the other two forests did not. One of the managers who omitted this practice said that release work could be done on that forest, but there was uncertainty as to whether the cost of the work was equal to or exceeded its benefits.

The manager said that, although the growth of timber stands may be slowed by competing vegetation, the trees eventually dominate and growth returns to normal. He said that, before he could make reliable decisions on doing release work, better data was needed on its benefits.

According to a regional official, some action has been taken to develop improved data on release work. On March 14, 1977, regional officials, two forest managers, researchers from the Pacific Northwest Forest and Range Experiment Station, and professors from a State university met to start trying to develop standards for identifying timber stands needing release work. The regional official said that it was too early to assess how useful this would be and that he believed future research would be needed to better determine the growth responses from release work under various forest conditions.

### Precommercial thinning

Forest managers' opinions also differed on whether there would be a greater increase in timber growth from precommercial thinning of a stand on high or low productive land. Managers of two forests were giving priority to the more productive lands. The other two forest managers were emphasizing low productive lands. The latter officials' rationale was that, on higher productive lands, stands would eventually outgrow the need for precommercial thinning, whereas on poorer lands stagnation is common and the trees never grow to commercial size unless thinned.

Both the forest managers and a regional official agreed that data was needed to help them make better decisions on scheduling precommercial thinning projects. A regional official said that, although research had been done on expected growth responses from precommercial thinning, the results have not yet been specific enough to show whether precommercial thinning should be done first on high or low productive lands or on heavily or moderately overstocked stands. According to the regional official, a Forest Service researcher had told him that reliable data was not yet available for publication.

### Fertilization

Using fertilizer to stimulate tree growth is an intensive management practice that was being started at one forest we visited. At this forest a fertilization program was scheduled for fiscal year 1977 on a very limited scale--about 3,000 acres. This was the first stage in what was expected to be a continuing fertilization program. Regional and forest officials said that adequate data was not available for determining the effect of fertilization on timber yields.

A regional official said that some forest-level field studies had been made to determine, under controlled conditions, which types of soil result in increased timber growth after fertilization. The official said that these studies could help identify which areas to fertilize, but they could not serve as a reliable basis for estimating timber yields from fertilization.

The regional official said that Service studies to date had involved on-the-ground applications of fertilizer although, from an operational standpoint, fertilizer would be applied from aircraft. He said that there had been no Service studies to determine the effect of aerially applied fertilizer on growth. He said that the growth response could be considerably less because it is not possible to evenly distribute fertilizer over a large area from the air.

According to this official, the Service needs to do more research on the growth that could be achieved through an operational fertilization program. He said that the region was trying to develop a systematic method for measuring timber growth in areas that have been aerially fertilized and that, once implemented, evaluations would be necessary over many years before reliable estimates of timber yields could be developed.

## Genetic improvements

The managers of the four national forests also planned to use genetically improved seedlings to reforest inadequately stocked areas. These seedlings were to be produced through the Pacific Northwest Region's genetic tree improvement program.

The managers said they were unsure about the amount of increased timber yields that could be expected from planting genetically improved seedlings. They said that Service and private industry data indicated that a variety of yields could be expected. The managers said that, because they lacked reliable information, their estimates of yields expected from genetically improved seedlings were conservative.

A regional official said that, due mainly to an inadequate seed supply, the region had not yet started field studies that would provide reliable data on expected yields from genetically improved seedlings. He said that trees with superior growth characteristics had been identified, but that not enough seed had been collected because these trees had not had a good cone crop since 1971.

The official said that, once an adequate seed supply is available, it will take many years to establish field studies and to collect data for projecting expected timber yields. He said that, because so many factors affect yields, field testing would have to be done at about 100 different locations throughout the region.

## OTHER TIMBER MANAGERS' PRACTICES

Other timber managers had analyzed research and field studies made by their own organizations and by other domestic and foreign timber managers, including the Service, and had identified expected yield increases from release, pre-commercial thinning, fertilization, and genetics. These managers said that enough data was available to make reasonably reliable estimates of the timber yields from these practices.

For example, one manager had decided to implement an extensive tree fertilization program and had determined where, when, and in what quantities fertilizer would be applied. The decision was based on a review of available data and economic analyses of the data developed from field studies made by the manager's research organization. In 1977, 300,000 acres were fertilized. The timber manager said that its field studies showed no significant difference in timber growth response between ground and aerial fertilizer

applications, provided the fertilizer was applied shortly after a timber stand was thinned and large pellets were used. Swedish forestry officials told us that they had found fertilization to be the most beneficial TSI practice. In 1977 Sweden's Forest Service fertilized 185,000 acres.

Other timber managers' analyses showed that there was not enough data available yet to precisely predict the increase in timber yields from planting genetically improved seedlings. They said, however, that enough data was available to make reasonably reliable estimates for deciding on investments in genetically improved trees.

### CONCLUSIONS

To decide which lands will produce the greatest benefits from reforestation and TSI work, the best available data must be used to predict future timber yields. Some usable information is available from the Service's research program and from the research and studies of other domestic and foreign timber managers. The Service should fully review these resources to identify the best available data and use it to predict future timber yields from reforestation and TSI work. When better data is needed, appropriate research projects and studies should be established.

### RECOMMENDATIONS TO THE SECRETARY OF AGRICULTURE

We recommend that, to help identify reforestation and TSI needs and make economic analyses to decide how the needs will be met, the Secretary of Agriculture direct the Forest Service to:

- Decide, on the basis of a review of research and field studies made by the Service and other timber managers, what estimates of timber yields to use.
- Establish research projects and field studies, when needed, to more accurately estimate timber yields and use their results to update the economic analyses.

### AGENCY COMMENTS

The Service agreed that not enough guidance had been given to forest managers on consistent and uniform use of timber yield information. It said that information was still lacking for a few important species and areas, but that it was working to determine the best information available. The Service said that it planned to provide yield tables to its managers by the end of 1979 with instructions to keep adjustments to a minimum.

The Service said that it was establishing additional research projects and field studies to more accurately estimate timber yields, and that it probably had not kept its managers as informed as it should. The Service said that it would determine where improvement was needed to provide timely information to the field and establish improved procedures by the end of 1978.

## CHAPTER 5

### FUND ALLOCATION PROCEDURES STILL NOT IMPROVED

The Forest Service requires that funds appropriated for reforestation and timber stand improvements be used in areas where the best possible timber growth and other multiple-use benefits can be expected. Although the Secretary promised the Congress in October 1974 that procedures would be established to insure that funds are used in such a manner, Service officials have not made, nor set target dates for preparing and using, the analyses required to determine the best reforestation and TSI investments. As a result, there is no assurance that funds appropriated for reforestation and TSI work have been or will be used on those areas which provide the greatest benefits.

Although forest managers made economic analyses for the fiscal year 1979 reforestation budget, they did not have the cost data, guidance, and training to properly make such analyses. Therefore, it is doubtful that they could and should be the ones to implement fund allocation procedures.

Other timber managers did not have such problems because their analyses were made by economists and other such specialists for the highest management level rather than by individual field managers. The highest management level used the results of the analyses to decide on the nature and extent of reforestation and TSI investments to be made by their field managers. They also established control procedures to monitor and evaluate their field managers' performance.

### EFFORTS TO IMPROVE FUND ALLOCATION PROCEDURES

In February 1974 we reported to the Congress that:

--The Service did not have procedures to insure that funds appropriated for reforestation and TSI were allocated and used in areas where such work would result in optimum timber growth and other benefits.

--As of June 1973 standard instructions for making economic analyses of reforestation and TSI opportunities had not been issued and a new target date for doing so had not been set, but issuance of such instructions was planned.

--In June 1973 the Service's manual was revised to require field offices to establish guidelines for assigning reforestation and TSI priorities, but no target dates were set for implementing the guidelines.

The revised manual established a Service policy that areas to be reforested or subjected to TSI treatments with appropriated funds should be programmed for performance on a cost-benefit priority basis. The manual directed regional foresters to issue guidelines establishing general reforestation and TSI priorities within each region. Forest supervisors were to issue specific guidelines establishing the priorities by timber types, stand condition classes, and land productivity classes. Within these guidelines, forest managers were to establish and maintain priority lists of reforestation and TSI projects for all project areas which had been examined and for which work had been planned.

In view of this action, we recommended in our 1974 report that

- the Service set target dates for completing the planned improvements in fund allocation procedures and
- the Secretary report to the Congress annually on the Service's progress in implementing the procedures.

In response to our recommendations, the Secretary advised the Congress in October 1974 that action had been initiated to improve fund allocation procedures. The Secretary also promised that subsequent annual reports to the Congress would include information on the Service's progress in improving fund allocation procedures.

In the annual reforestation and TSI needs reports to the Congress at the ends of fiscal years 1974 and 1975, the Secretary stated that the Service was developing and testing computerized systems to identify those areas where work would result in optimum timber growth and other benefits. In November 1976, however, the Department's Office of Audit reported that its reviews of four regional offices' reforestation and TSI programs showed that economic analyses were not being used to select work projects. Instead, projects were selected on the basis of individual forest managers' assessments of land condition, land topography, and site accessibility. The Office of Audit concluded, therefore, that some selected projects may not be cost effective.

The Office of Audit recommended to each of the four regional foresters that they develop cost-benefit analyses of reforestation and TSI projects and that they use the analyses to insure that funds are allocated to the most beneficial projects. Three of the regional foresters stated that they would develop procedures for making the cost-benefit analyses and for training their staffs in using such techniques. Only one, however, set a specific target date for using the analyses in allocating funds to projects. At the time of our review, the fourth regional forester had not responded to the Office of Audit's recommendation.

In the fiscal year 1976 progress report sent to the Congress in February 1977, the Secretary said that adequate information on cost-benefit relationships still was not available to set priorities, but that in another year major progress would be made.

In April 1977 the Deputy Chief of the National Forest System told all regional foresters that computerized systems were available to analyze and set priorities for reforestation and TSI projects. He reminded them that "cost-benefit analyses are required now in your reforestation and timber stand improvement program planning and evaluation." Making these analyses has been Forest Service policy since June 1973.

The Deputy Chief told us in April 1977, however, that there were no specific target dates for implementing the policy requiring the use of cost-benefit analyses for funding reforestation and TSI work. He said that the National Forest Management Act of 1976 required a number of changes in Service procedures and regulations, including more emphasis on cost-benefit analyses. He said, however, that other requirements of the act had been given higher priority and no schedule for using cost-benefit analyses had been established.

Service field officials at district, forest, and region levels told us that they were uncertain of the need to use economic analyses to help them decide on funding reforestation projects. They said that the 1976 act's provisions, which require the Service to reforest all denuded lands even if they have been determined to be unsuitable for timber production, may require them to reforest areas with unfavorable cost-benefit ratios.

The field managers also said that economic analyses of some reforestation and TSI projects would not be useful because those projects would have to be done regardless of the outcome of such analyses. They said that, if these projects

were not done, the timber harvest levels in specific areas would have to be reduced and such reductions may force wood product manufacturing facilities in those areas out of business, causing hardships to nearby communities. For the reasons discussed in subsequent sections of this chapter, we continue to believe that the analyses should be done.

#### PROBLEMS IN IMPLEMENTING ECONOMIC ANALYSES PROCEDURES

The forest managers analyzed the economics of reforestation work planned to be done with appropriated funds in fiscal year 1979 by calculating the internal rate of return (IRR) on investments. The IRR is a measure for evaluating the economic desirability of proposed investments. It measures the rate of value growth--how much an investment in reforestation, thinning, release, fertilization, and genetic improvements adds to the value of the timber stand in relation to costs and the length of time until the stand is harvested. The higher the IRR, the more economically desirable the work.

The IRR is one of several economic criteria which could be used to evaluate the economic desirability of reforestation work. We reviewed the IRR calculations at four national forests in the Pacific Northwest Region to identify actual and potential problems which field offices had in making the economic analyses called for in the 1976 act and the Service manual. We found that problems had occurred or could be expected because (1) there were no minimum economic criteria for reforestation and TSI investments, (2) economic analyses were not specific enough to take into account differences in site productivity, (3) training in economic analysis was not provided to the proper employees, and (4) reviews were not made to correct errors and omissions.

#### Minimum economic criteria needed for reforestation and TSI work

The Forest and Rangeland Renewable Resources Planning Act of 1974 stated that Service budget requests could be adjusted to eliminate proposed reforestation and TSI work whose costs exceeded related economic and environmental benefits. The Service's renewable resource program, submitted to the Congress in February 1976, said that investments in reforestation and TSI work should provide a minimum return of 5 percent. This 5-percent minimum return, however, was not included in the guidelines to field officials.

The National Forest Management Act of 1976 amended the 1974 act to require that lands identified as unsuitable for timber production because of economic or physical factors continue to be treated for reforestation purposes, particularly in regard to protecting multiple-use values.

The lack of minimum economic criteria could result in substantial reforestation and TSI investments being made by field managers in areas where timber returns will be marginal. For example, each of the four forests had denuded lands with soil, topography, or climatic conditions which the field managers knew would cause reforestation difficulties. Some of the areas had been planted several times, but the young trees had not survived. Such areas may be more suitable for other uses, such as wildlife and range, than for timber production, and may not need extensive reforestation to protect these other values.

At one district some reforestation projects were planned for lands that had been deforested as early as 1951 and unsuccessfully replanted as many as eight times. A field manager said that to successfully reforest some areas he may have to shade each young tree from the sun and irrigate the young trees individually by hand. Other field managers said that they would probably have to plant some areas several more times before there were enough trees to consider the areas adequately reforested for timber production. A photograph showing one method the Forest Service used in reforesting a difficult area is shown on page 38.

District and forest officials told us that, unless they received instructions to the contrary, they would continue to try to reforest these difficult areas--regardless of the costs and the unlikelihood of success. The officials said they believed they were required by the 1976 act to reforest all denuded lands without regard to cost. Forest Service headquarters officials did not agree with this interpretation of the act.

Field managers also said that economic analyses would not be useful to them in decisionmaking. They pointed out that the success of wood product manufacturers in nearby communities depended on maintaining certain timber harvest levels. If certain projects which did not meet an established minimum rate of return were not done, then the timber harvest levels in these areas would probably have to be reduced.

The field managers' rationale does not take into account the Service's noncommercial timber objectives. To meet these objectives, it may not be necessary to do reforestation work



**A difficult area to reforest. Seedlings planted on a 40-percent south slope. Rocks placed around seedlings to prevent damage from debris and to help conserve moisture.**

Forest Service Photo

with the same intensity as for commercial timber production. Further, the provisions of the act do not preclude the preparation and use of economic analyses to predict the outcome of reforestation decisions. Such analyses would be useful to the field managers in making better decisions on the reasons for reforestation and the nature and extent of the work needed to meet multiple-use objectives.

On the need to sustain dependent wood product manufacturers and surrounding communities, we disagree that economic analyses would not be useful to forest managers. We view such analyses as a tool in the decisionmaking process to be considered in choosing between alternative courses of actions, particularly in choosing projects that would be most beneficial to the dependent manufacturers and communities.

#### Need to take into account differences in site productivity

None of the four national forests analyzed the economic desirability of individual projects or individual classes of projects. Instead, each forest evaluated the total acreage on which it planned work for fiscal year 1979. Analyses of entire forest programs can aid in identifying those forests which offer the better investment opportunities. They do not, however, provide a basis for allocating funds to individual projects within a forest which provide the greatest benefits.

Selecting the most beneficial projects in a particular forest requires evaluating individual projects or groups of projects with similar characteristics. Characteristics which affect site productivity are pertinent in such evaluations because they influence project cost or yield. Various forest managers said that site productivity is determined by such characteristics as soil type, climate, elevation, land slope, and exposure to adverse weather conditions. The managers said that site productivity, in turn, affects the size, density, and species of timber and the age at which it can be harvested. If projects are unique as to these factors, they should be evaluated individually. If several projects have like characteristics, they could be evaluated as a group for comparison with other projects or groups of projects.

On the four forests, however, projects were not segregated individually or into groups with similar productivity characteristics, with their costs and benefits being compared with other projects or groups of projects. Instead, the total acreage on which work was planned was multiplied by the forest-wide average cost per acre for each proposed treatment. Returns were calculated by multiplying the estimated average volume of timber yield to be created by each type of treatment by

the regionwide average sales prices for the dominant species of trees in the forest. These prices were calculated and furnished to the field offices by Service headquarters. The total costs and benefits were then compared.

The projects included in the total acreage computations were not all alike as to their productivity. Some had characteristics which indicated that they would be more or less productive than others. For example, in examining eight reforestation projects totaling 235 acres, which were scheduled by a forest manager for fiscal year 1979, we noted the following characteristics that would most likely result in differences in the IRR among projects:

- Five projects contained soils of average to low productivity for the district, two projects contained soils ranging from high to low productivity, and one project contained soils of high productivity.
- Three projects contained soils classified as being difficult to reforest and the remaining five projects contained soils classified as ranging from moderately difficult to easy to reforest.
- One project was at an elevation greater than 4,000 feet where reforestation is generally more difficult to attain, four projects were at elevations in the range of 3,000 to 3,999 feet, and the remaining three projects were at elevations less than 2,000 feet.
- Four projects were on south-facing slopes where reforestation is generally more difficult to attain; the other four were on north- or east-facing slopes.

Forest managers said that the different conditions among and within forests also greatly affected timber prices. They said that, as a result, they did not believe that using regionwide average timber sale prices for computing the returns from reforestation projects accurately reflected the returns individual projects could be expected to provide.

Timber sale prices during the last half of fiscal year 1976 for two of the forests we visited showed large variances for the same timber species between forests. For example, the average timber sale price for Douglas-fir on one forest was \$151 a thousand board feet; on the other, it was \$236.

The timber sale prices for Douglas-fir also varied considerably within each forest. On one forest the prices ranged from a low of \$9 to a high of \$264 a thousand board feet. On the other forest, the prices ranged from \$18 to \$348 a thousand board feet.

Variances in timber sale prices are caused by such factors as the quality and accessibility of the timber and the intensity of competition among timber buyers.

Personnel who prepared economic analyses were not given needed training

As previously stated, Service policy is that reforestation and TSI projects be subjected to economic analyses and be programmed to be done on a cost-benefit priority basis. Field office employees responsible for preparing project plans were to make the analyses. They said, however, that they were foresters rather than economists and therefore had limited experience in preparing economic analyses. They said that they had needed training. The Service provided some training, but it had low priority and was not always directed at the right employees.

The Pacific Northwest regional forester told the Chief of the Forest Service in September 1976 that, although the region had not developed procedures for preparing economic analyses and no date had been set to provide the field planners with instructions, it planned to provide training sessions by May 15, 1977, which would enable personnel who prepare project plans to make at least simple cost-benefit analyses of planned projects.

According to a regional official, three regional training sessions were held, one in December 1976 and the other two in April 1977, but most of those attending were not the field employees who prepared the project plans.

The December 1976 session was held to assist field offices in preparing economic analyses of the reforestation work budgeted for fiscal year 1979. However, few participants had anything to do with preparing the analyses. None of the field office employees responsible for preparing project plans attended this session. The April 1977 sessions were attended by 46 employees. However, they included only 8 of about 100 field office employees responsible for preparing reforestation and TSI project plans.

The regional official who provided the training said that he now realized that the December 1976 training was not provided to the right employees. Another regional official, who was in charge of the region's reforestation and TSI program, said that the districts were responsible for selecting staff to participate in the April training sessions and that there was not much emphasis on making sure that those employees who prepared reforestation and TSI project plans attended. The official also said that the region did not have immediate

plans for further economic analysis training because it was costly and other activities had higher priority.

Review procedures needed to insure accuracy and completeness

The economic analyses of the fiscal year 1979 reforestation work prepared by the managers of the four forests did not always include accurate and realistic estimates of expected costs and benefits. These faulty estimates resulted from omissions of major costs and benefits, incorrect assumptions, and simple mathematical errors. Because errors and omissions can be expected, particularly when employees have limited or no experience or training in making economic analyses, review procedures were needed to insure that the analyses were accurate and complete. Such procedures, however, were not in place.

One forest omitted from the IRR calculation the costs of (1) preparing the sites for planting, (2) replanting failures, (3) release treatment, (4) fertilizer, (5) stand examinations, and (6) preparing and administering subsequent timber harvests. Another forest omitted the cost of stand examinations, animal control, and release treatments. A third forest omitted the cost of stand examinations and fertilization.

The forest official who omitted the cost of preparing the site for planting said that he was following headquarters instructions to include only projects for which initial funding was proposed in fiscal year 1979. Because site preparation expenses were to be incurred in fiscal year 1978, he assumed that they should be excluded from the calculation. The calculations of the other three forests included costs incurred before fiscal year 1979. According to forest officials, all of the other major costs were omitted because they had been overlooked.

In preparing the analysis for one forest, the benefits from commercial thinning were overstated by about \$4 million because

- the expected timber volume was erroneously calculated;
- a decimal point was misplaced, overstating returns from a commercial thinning by \$50 million; and
- returns were understated by \$56 million because the volume of timber to be realized from the final harvest was not included in the computation.

Officials of two forests said they did not increase the sales value of future timber harvests to reflect anticipated timber price increases because they misunderstood headquarters instructions.

Officials at the four forests said that most of the errors resulted from rushing to complete the calculations. They said they believed that, if the calculations had been reviewed, the mistakes would have been corrected.

#### PROCEDURES OF OTHER TIMBER MANAGERS

Other timber managers said that, in many areas, they were required by local laws to reforest all areas from which timber had been harvested. They used economic analyses to decide on the amounts that would be invested in reforesting such lands.

The managers said that, to decide on the amounts to invest, they classified their lands on the basis of their productivity, using such characteristics as soil quality, land slope, and exposure to adverse weather conditions. The timber species to be grown were also considered. For each land productivity class and timber species, analyses were made to estimate the returns from alternative levels of reforestation investments in such practices as site preparation and planting seedlings. The analyses were used at the highest management level to decide on the extent of reforestation work that field managers would do on each land productivity class.

On highly productive lands the field managers were to do extensive work to prepare sites for planting, obtain genetically improved seedlings, densely plant the seedlings, and replant failures. On low productive lands they were to let the lands reforest naturally and only plant seedlings to the extent needed to augment the natural reforestation to meet minimum stocking levels. One manager said that the lands left for natural reforestation were often more useful for wildlife or recreation purposes than for timber production.

These managers also used the land productivity classes for each timber species to decide on the extent of TSI work to be done. They said that, for each species and land productivity class, analyses were made to estimate the returns from alternative levels of investments in TSI practices. The analyses were used at the highest management level to decide on the nature and extent of TSI that field managers would do on each land productivity class.

On highly productive lands the field managers were to follow intensive TSI management practices specifying when and under what conditions release work was to be done and when fertilization and thinning were to be done. On less productive lands these practices were to be done less frequently or, in some cases, such as on steep slopes, no TSI work was to be done.

These managers also said that they had established control procedures to continuously monitor and evaluate their field managers' performance and insure that the prescribed reforestation and TSI management practices were followed.

## CONCLUSIONS

The Service still has a great deal to accomplish before fund allocation procedures can be implemented to insure that reforestation and TSI funds are used most effectively. If economic analyses and setting of reforestation and TSI work priorities are to be done by the managers of each national forest, the managers would need cost and benefit data, guidance, and personnel trained in economic analysis techniques. The Service has been passive in meeting these needs, and it is questionable whether they can be met expeditiously because of the number of forest managers and the priorities being given to other activities. In our opinion, it would be more expedient to make economic analyses and set work priorities at a higher management level.

Other timber managers with similar differences in their forest lands, although not managing as many acres as the Service, have been more aggressive in implementing economic analysis techniques to intensively manage their reforestation and TSI investments. Instead of having individual field managers make analyses and set priorities, these are done at the highest management level. As a result, the data, guidance, and training problems associated with the Service's decentralized procedures are minimized, and reforestation and TSI work priorities are established more timely.

We realize that the other managers' land productivity classifications and economic analyses may not always adequately take into account all nontimber multiple-use objectives. However, the Service could take nontimber objectives into account by specifically providing for them in the land productivity classifications and the analyses made of each of the classifications.

We also realize that the costs of reforestation and TSI may exceed the benefits of some projects in some national forests. In such cases, the Service will have to decide whether uneconomical reforestation and TSI work is needed to maintain timber harvest levels and sustain dependent wood product manufacturing facilities and nearby communities. In making these decisions, the results of the economic analyses would enable the Service to measure the returns lost from doing reforestation and TSI work in such areas and to evaluate alternatives that could meet the local need for timber, such as increasing the volumes of timber that could be harvested from other public and private lands in the area or that could be made available through more efficient timber utilization practices.

RECOMMENDATIONS TO THE  
SECRETARY OF AGRICULTURE

We recommend that, to insure that funds appropriated for reforestation and TSI are used most effectively, the Secretary of Agriculture direct the Forest Service to:

- In classifying all national forest lands capable of growing timber by their timber production capabilities, include classifications for each timber species to be grown.
- Assign personnel professionally trained in analytical techniques to make economic analyses of the reforestation and TSI practices that can be applied to each land productivity classification for each timber species.
- Decide on the minimum economic criteria for reforestation and TSI investments.
- Require that the economic analyses be used at the headquarters level to identify the reforestation and TSI needs and prescribe standards as to where and when reforestation and TSI investments will be made by forest managers.
- Implement fund allocation procedures to provide the forest managers with the appropriated funds that are needed for the most beneficial work.
- Implement controls to insure that the most beneficial work is done by the forest managers and that deviations are not made unless justified and approved.

- Require that economic analyses and investment decisions be updated, as needed, to take into account changes in land inventory data, benefits, costs, and technology.
- Include in the annual report to the Congress information which will clearly show the progress in implementing improved procedures to insure that funds appropriated for reforestation and TSI are used in areas where such work will result in the best possible timber growth and other benefits.

#### AGENCY COMMENTS AND OUR EVALUATION

The Service pointed out that the law provided for classifying lands capable of growing timber by their timber production capabilities taking into account other resource needs and management practices. It did not comment on including classifications for each timber species. It said that, although land classification will be a continuing process, it may not be completed until 1985. The law requires the land classification process to be completed by September 30, 1985.

The Service agreed that there was an increasing need for personnel with talents in analytical techniques. It said that it was currently recruiting and obtaining additional economists and training forest managers in such techniques. The Service said that it would develop analytical procedures to be used by forest managers and provide training to analysts assigned to its regional offices. The procedures and training should be underway within 2 years.

The Service agreed that minimum economic criteria should be applied to reforestation and TSI and said that a major effort was already underway to develop sound economic criteria that can be used in reforestation and TSI investments. The Service said that it plans to have an approved procedure for analyzing investment opportunities in roads, reforestation, recreation facilities, and buildings, including a training package, and guidelines for their use completed by August 1, 1978.

The Service agreed that fund allocation decisions should be based on economic analyses that are comparable in coverage and procedure and that reflect the relative advantage of programs in various geographic areas. It did not agree, however, that individual projects should be ranked at the headquarters level. It said that the appropriate role of the headquarters office was to establish procedures and

standards for analyses, continually refine them, and monitor the field units' application of the procedures.

As previously stated, we believe that the Service needs to classify national forest lands on the basis of their productivity and, for each land productivity class and timber species, make analyses to estimate the returns from alternative levels of reforestation and TSI investments. The classifications and analyses can be done by field personnel and researchers with intimate knowledge of local conditions. As the Service pointed out, the headquarters role should be to establish procedures and standards to insure comparability. The headquarters role, however, should be more than this. The analyses developed at the field level should be used at the headquarters level to decide on the extent of reforestation and TSI work that would be done by the field managers on each land productivity class to insure that the most beneficial work is done. In the absence of such a determination, there is not an adequate basis to insure that appropriated funds are allocated and used for the most beneficial work.

In regard to its fund allocation procedures, the Service said that the objectives of eliminating the reforestation backlog by 1985 and investing in TSI (with returns greater than 5 percent) on sites capable of producing more than 50 cubic feet of wood a year were contained in the annual instructions to the field for budget preparation. Local managers have the opportunity to propose funding to accomplish their programs. The proposals are then considered along with the needs of other programs and the national financial situation in developing the President's budget. The Service, however, did not address our recommendation to implement fund allocation procedures to provide forest managers with the appropriated funds needed to do the most beneficial work.

The Service said that controls have been initiated to insure that prescribed work is done and that deviations are not made without justification and approval. None of the controls mentioned by the Service would insure that the most beneficial work is done. The controls track the number of acres on which work has been done but do not provide information on whether these acres provided the best opportunities for doing the work.

The Service said that all planning and budgeting efforts will take into account changes in land inventory data, benefits, costs, and technology as they occur. It also said that information on its progress in implementing improved fund allocation procedures would be included in its annual report to the Congress.

## RECOMMENDATION TO THE CONGRESS

We recommend that, in determining annual funding levels for intensive timber management of the national forests, the Congress insure that the Forest Service is (1) improving the land inventory data and classifying the lands capable of growing timber by their timber production capabilities and (2) implementing fund allocation procedures and controls to insure that funds appropriated for reforestation and TSI are used to obtain the best possible timber growth and other multiple-use benefits.

FOREIGN TIMBER MANAGEMENT PRACTICES

Several European countries have been practicing intensive timber management for years and, in some cases, centuries. We visited three of these countries--Sweden, West Germany, and Austria--to discuss and observe their intensive timber management practices.

All three countries managed their forests under sustained-yield and multiple-use principles. They have maintained land inventory data for many years and developed historical data on the quality and quantity of timber growth on their lands. The intensive timber management practices were essentially the same as those being used in the United States. None of these countries manage as many acres and timber types as the Forest Service. A discussion of the timber management practices used by each of these countries follows.

SWEDEN

Timber is an important resource in Sweden. It supplies industries which employ directly or indirectly about 12 percent of the Swedish labor force. It is also important to Sweden's international trade.

Nearly 60 percent of the land area of Sweden, about 58 million acres, is productive forest area. About 50 percent of the forest land is owned by 250,000 individuals; timber companies own about 25 percent; and the remainder is publicly owned. Most of the public forest land, more than 10 million acres, is owned by the Swedish Government and managed by the Swedish Forest Service. The Swedish Forest Service consists of a central headquarters office, six regions, and 65 forest districts.

Swedish Forest Service headquarters officials said that the Service operates on an economic basis much like a large private timber company. It not only grows the trees, but harvests and sells them as well. Much of the timber is sold to the Government-owned State Forest Industries (Assi) for conversion into end products, such as lumber, pulp, and paper. The Swedish Forest Service competes directly with private timber companies and has a long-range objective of achieving the best possible economic profit from its operations. These profits are used for further development of the Government-owned forests through such practices as reforestation and timber stand improvement (TSI).

According to Swedish officials, the Service has an automated land inventory storage and retrieval system. Data is

obtained from aerial photographs, records of previous treatments, and on-the-ground examinations made on a sample basis at 10-to-15-year intervals. Trained technicians detailed from the headquarters office interpret aerial photographs and collect data from sample plots. The officials said this is done to reduce the effect of personal biases and differences in professional judgment, thus maximizing the consistency of the data. The automated inventory is updated each year to reflect harvests, reforestation and TSI accomplishments, and refined data obtained through on-the-ground examinations. Investment opportunities for TSI work are identified by computer from the automated inventory storage and retrieval system.

Swedish Forest Service headquarters officials told us that each year they identify the better investment opportunities available to each field office. They said the better opportunities are in those areas with high-value tree species growing on highly productive land which have reached an age and condition where an intensive management practice will significantly increase timber yields. Research done by the Royal College of Forestry and a research institute was used to develop the criteria for identifying the better investment opportunities and the returns which could be realized.

The officials said that, after they had identified the better opportunities, the field personnel evaluated them individually to select those that would provide the best possible timber benefits. For example, there could be a number of TSI opportunities available for a specific timber species and land productivity class, but some of the opportunities would be affected by other factors, such as watershed protection and aesthetics. In such cases the field personnel could give priority to the opportunities that were unaffected by such other factors.

Swedish Forest Service officials said that the extent of investment for reforestation and TSI varies greatly depending on land productivity. They said that their largest investments are made on their highly productive lands. For example:

- Highly productive lands are reforested by planting seedlings, while low productivity lands are reforested through natural regeneration from seed trees.
- One commercial thinning is made on low productivity lands and two or three are made on highly productive lands.

--All medium and highly productive lands are fertilized; low productivity lands are not.

The Swedish Forest Service officials said, however, that they have problems with field personnel deviating from the prescribed practices. They said that they needed more control over field personnel and that they were developing stronger control procedures to monitor their activities.

### AUSTRIA

About 44 percent of Austria is classified as forest land and, according to Austrian officials, timber production is important to the country's economy. The Government owns about 1.4 million acres, or 15 percent, of the forest land. The remainder is privately owned with much of the land in small holdings. The Government's forestry program is managed by a national headquarters office in Vienna. The forest management practices are carried out by a forestry staff in each of Austria's nine provinces.

Austrian national headquarters officials said that they prescribe different levels of management for their forest lands. They said that greater investments in intensive management practices are made on highly productive lands growing high-value tree species which have no harvest restrictions. The officials said their prescriptions were developed at the headquarters level and were based on the findings of trained specialists who had analyzed the benefits which could be attained from alternative management practices.

The headquarters officials said that planning specialists from the headquarters office together with forestry officials in each province review the condition of each timber stand and select the appropriate level of management to be exercised during the next 10 years. The condition of each stand is determined from an automated land inventory data storage and retrieval system which may be updated and verified through on-the-ground examinations. According to the officials, the joint preparation of the management plans by headquarters and local field office staff is the most expedient way of establishing work priorities and it minimizes the inconsistencies among field managers as to which management practices are to be used and where and when the practices are to be done.

In addition to the 10-year plan, the local field manager is required to prepare annual plans showing when the agreed-upon management actions will be done. When the management actions are taken, the local field manager reports his accomplishments by individual stand to the national headquarters

office where this information is stored in the land inventory data storage and retrieval system. Headquarters staff monitors the reported accomplishments to assess the field managers' progress in complying with the 10-year program. The headquarters staff makes periodic inspections to verify the reported accomplishments.

### WEST GERMANY

A substantial part of West Germany--nearly 18 million acres--is comprised of forest land. This acreage represents 29 percent of the total land area in West Germany.

According to West German forest officials, there is almost no forest land under Federal ownership. Instead, ownership is held by small, private landowners; corporate forest owners; communities; and West Germany's 11 States. Of the forest land, the small, private landowners own about 44 percent; the corporate and community forest owners, about 25 percent; and the 11 States, about 30 percent.

In West Germany, the Federal Government does not play an active role in managing the country's forest resources. Instead, each of the 11 States has its own forestry program and each is autonomous as to how its forests will be managed. We visited one State with substantial forest resources in the Black Forest area to observe and discuss its intensive timber management practices.

The State manages about 2.2 million acres of forest land. It has a Forest Service headquarters office, four regional offices, and 190 district offices. Each district office is responsible for about 10,000 to 15,000 acres.

The State's Forest Service headquarters controls the management of the forest lands under the State's jurisdiction. State officials said that teams of specialists at the headquarters and regional office levels are responsible for reviewing and analyzing available data on timber growth, costs, and benefits to establish reforestation and TSI investment levels for the different types of timber stands and forest conditions, taking into account the nontimber uses of the land.

For example, different investment levels have been established for lands that have different levels of recreation use. In limited-recreation areas large-scale clearcuts were used to harvest the timber, pure coniferous timber stands were planted by machine, and the stands were subjected to frequent thinnings and early harvests. In the forest areas

having extensive recreation use, natural regeneration techniques, rather than more costly machine planting, were employed with emphasis on obtaining mixed timber stands of coniferous and hardwood trees. Also, the timber was grown for longer periods than in the limited-recreation areas.

State forest officials said that decisions on investments for each individual timber stand were made jointly by a regional office specialist and the local field manager and included in a management plan which was updated every 10 years. The regional office specialists had received special training in applying the results of the State's economic analysis of alternative levels of reforestation and TSI practices.

In developing the plan, each stand is visited by the specialist and field manager to determine if the condition of the stand has changed since the last plan was prepared. If conditions have changed materially, an inventory would be made to update the data stored in an automated storage and retrieval system. The inventory data in storage has been developed through years of experience in managing the forest lands. For example, in one district we visited, records had been maintained since 1836 on stand conditions and completed management practices.

The management specialist and field manager evaluate the stored data and reach agreement on how the timber stand is to be managed and what management actions are to be taken in the next 10 years. At the time the plan is prepared, a review is made of the previous plan to evaluate how well agreed-upon actions have been carried out by the local field manager. According to State officials, this review process encourages the district field manager to carry out the agreed-upon plan.

UNITED STATES DEPARTMENT OF AGRICULTURE  
FOREST SERVICE  
P.O. Box 2417  
Washington, D.C. 20013

Feb. 10, 1978



Mr. Henry Eschwege  
Director  
United States General Accounting Office  
Washington, D.C. 20548

Dear Mr. Eschwege:

In response to your letter of December 16, 1977, here are our comments on the draft of your proposed report to the Congress, Intensive Timber Management: Much Remains to be Accomplished by the Forest Service.

Continued and increased timber production has long been and remains one of the objectives of National Forest management. Our concerns about the need for increased and improved use of appropriations have been expressed in a number of reports and in testimony before congressional committees. Congressional response has been positive with the enactment of the National Forest and Rangeland Renewable Resources Planning Act of 1974 and the National Forest Management Act of 1976.

We appreciate the views of the auditors as represented by the recommendations in the report and the dialogue with our people during the period of the review.

The draft report has several central themes with related recommendations. It indicates a continued need for improved land inventory data, the use of economic analysis for improved fund allocation procedures, concentrating investments on the most productive sites, and providing improved standards and guidance to the field. We concur in all these objectives.

There is a second theme in the report which is inappropriate for the management of the National Forests. This theme is a comparison of the timber management procedures and objectives of National Forests with private industrial timber landowners and with several foreign and State Governments. There must be recognition that these other timber landowners probably have made a decision on primary use of their lands for timber production and can manage the land accordingly while the National Forests must be managed for multiple use resources benefits. European and Scandinavian forests are essentially all manmade and have been intensively managed for many years. Nearly all these forests cover

a limited region, and thus analysis and decisionmaking can be centralized. The Forest Service has a diversity of area from Alaska to Florida and everything in between. Because of size and diversity of area to manage, logistics, and multiple use objectives, we believe it is necessary to have a decentralized organization. Decisions should be made at the field level where an intimate knowledge of local conditions and objectives are known.

#### Recommendation 1

Over the past 10 or more years the Forest Service has been employing more and more specialists in all phases of resource management, a practice we intend to continue in the future. In some instances personnel ceilings and funding have limited our ability to place specialists below regional levels. However, where the timber workload is heavy we are placing specialists at the National Forest and some district levels. In lighter timber workload areas, specialists are assigned on a zone basis covering several forests. Our objective is to place such specialists as close to the ground level as possible in order to have an intimate knowledge of local conditions.

Our timberland inventory data has improved since the 1974 GAO report and it will continue to improve and evolve until it will be at the quality level desired. The timberland data is only one component of the overall land management data base. After land management planning regulations are published this year, our objective is to implement the regulations and likewise respond to the concerns expressed in the report. Land inventory specialists will be trained not only to recognize timber growing capabilities but to recognize all resource capabilities. We believe it premature to establish dates and numbers for assignment of full-time specialists until the regulations are completed and needs are known on a national basis.

#### Recommendation 2

We agree that there should be a uniform land inventory data storage and retrieval system for the Forest Service. This will probably not be completed for 8 to 10 years because of the evolving land management planning process, the cost of converting existing systems into a uniform system, and the collection of data. After the regulations are completed and data needs are established, there will be a number of new plans started. An evaluation will be made of data bases used. By the end of 1980 the Forest Service should have established a uniform system.

Recommendation 3

We agree that there has not been enough guidance provided the field on consistent and uniform use of timber yield information. For some species and for some geographic areas there are adequate managed yield tables, but information is still lacking for a few important species and areas. Where weaknesses currently exist, National Forest System and Research are working together to determine the best information available. When evidence indicates that adjustments are necessary, the "best information available" will be modified. The tables will be provided the field by the end of 1979 with Manual instructions to keep adjustments to a minimum. By the end of 1979 National Forest System and Research will review on a regional basis the yield tables we now have, how useful they are, or where changes are needed. Where a lack of useful information is confirmed, short-term and long-term needs will be established. Priorities for yield data development will be established jointly by National Forest System and Research. Projects will be initiated within financial and personnel limitations.

Recommendation 4

We are currently establishing additional research projects and field studies to more accurately estimate timber yields, but we probably have not kept the field people as informed as we should. We will assess our present efforts and determine where improvement is needed to provide timely information to the field. The Washington Office will be responsible for disseminating new information. Procedures will be established by the end of 1978.

Recommendation 5

The National Forest Management Act provides for classifying lands capable of growing timber by their timber production capabilities taking into account other resource needs and management practices. Such classification will be on a forest-by-forest basis as land management planning is in progress. Planning procedures will be developed by the end of 1978. After the land management plans are completed, growth adjustments will be reflected in the timber portion of the plan to reflect other resource constraints. For example, on one unit of the forest the yield capability may be 150 cubic feet per acre a year. But because of a wildlife constraint to provide forage we may reduce the number of stems periodically so that the yield is only 125 cubic feet per acre a year. The Act requires that land management planning be completed by September 30, 1985. Therefore, although land classification will be a continuing process it may not be completed until 1985.

Recommendation 6

We are currently recruiting and placing additional economists within the National Forest System. We are training other personnel at regional, forest, and district levels in analytical techniques to make economic analysis. Again, priorities on use of ceilings must be a consideration in all Forest Service placement. Placement will be commensurate with need and potential benefits to the Forest Service. We agree there is an ever increasing need for people with this talent at the field organization level. The Timber Management Staff unit in the Washington Office plans to assign an economist by mid-1978 whose duties will include the development of analytical procedures to be used by the field. Training will be provided to analysts assigned to the Regions. Procedures and training should be underway within 2 years.

Recommendation 7

We agree that minimum economic criteria should be applied to reforestation and TSI, as well as all long-term Forest Service program investments. Analysis procedures being developed in the Forest Service in response to the National Forest Management Act consider economic, social, and environmental criteria, and are to include all significant multiple use and environmental impacts that can be quantified and credibly valued. A major analytical study and action plan on reforestation and TSI underway for 18 months will be completed during 1978. Economic criteria have been considered by the team in the study. Another major study of transportation investment decision policies and analysis and action plan was recently completed. The action plan calls for an approved operational procedure for analyzing opportunities for capital investments in roads, reforestation, recreation facilities, and buildings. This will include methods to determine nonmarket and special values. It will also include nationally uniform procedures of capital budgeting, multiyear investments in RPA and other long-term plans. A revised procedure, complete training aid package, and published program development and budget guidelines for use in the fiscal year 1981 budget are to be completed by August 1, 1978. Therefore, there already is underway a significant effort to develop sound economic criteria that can be used in reforestation and TSI investments.

Recommendation 8

We agree with the basic purpose of the recommendation that fund allocation decisions at the Washington Office and field levels use as one criteria economic analyses that are comparable in coverage and procedure, and that reflect the relative advantage of programs in various geographic areas. We strongly disagree that the basic inventory and analysis work be done in the Washington Office or that individual

projects be ranked at that level. First, the size of the Washington Office staffs concerned would have to be increased many-fold. This is contrary to the direction of the present and previous Administrations that regional work be done in regional locations and contrary to the often expressed intent of Congressmen, collectively and individually, that Government functions be conducted as close to the affected public as possible. Second, much of the technical knowledge of where, when, and how timber management practices should be conducted is gained from close contact with field personnel and researchers with intimate knowledge of local conditions.

The appropriate role of the Washington Office technical staff is to establish procedures and standards for such inventories and analyses, continually refine them according to experience in field use, facilitate the exchange of technical improvements and scientific research, and monitor and audit the application of the procedures and techniques in field units. As stated previously, standards and procedures resulting from the FR&T Study Action Plan should be available by the end of 1978.

#### Recommendation 9

Our fund allocation procedures must consider national priorities of the President and the Congress and the needs of the forest manager in all of the programs he administers. The recommended Resources Planning Act Program provides the basis for our budget estimates. The local manager has the opportunity in this process to propose funding to accomplish his programs. This is then considered along with the needs of other programs, and the national financial situation in the development of the President's budget. The objective for the recommended RPA Program is to eliminate the reforestation backlog by 1984 and invest in timber stand improvement (with rates of return greater than 5 percent) on sites capable of producing more than 50 cubic feet of wood per acre per year. These objectives are contained in the annual instructions to the field or budget preparation.

#### Recommendation 10

Controls to insure that the prescribed work is accomplished and that deviations are not made without justification and approval have been initiated. (1) Targets are established annually in the program planning and budgeting process. An attainment reporting process has been implemented to check accomplishment against targets quarterly. This report is summarized at each level from the ranger district to the Washington Office and is available within 4 weeks after the end of each quarter. (2) Tighter fund adjustment constraints have been directed by the Congress. The congressional appropriations subcommittees must approve all reallocation of funds from one budget activity to another

that exceeds \$250,000. (3) Adjustments are authorized on a project-by-project basis within the same activity. This is necessary since a planned project may not be available. For example, a planned planting project may depend upon fall burning for site preparation. Inability to burn may delay the planting project for a year. Therefore, another high priority project "on the shelf" may have to be substituted. Such project substitution should be approved at the next higher administrative level. As high cost/benefit areas are located and examined on each forest, they are placed in the proper order in work priority areas. As new priorities are established, they are also placed in proper order.

#### Recommendation 11

The National Forest Management Act (NFMA) requires that economic analysis and investment decisions be updated to take into account changes in land conditions and status, benefits, costs, and technology. Regulations being formulated to implement this provision of the NFMA provide a planning process that include a system of analysis. The Resources Program and Assessment effort requires economic analysis and provides direction for investments in Reforestation and TSI.

Short-term analysis is also required on the fiscal year 1980 program development. Cost/benefit analysis and rate of return on investment are a part of the analytical effort in the RPA update. All planning and budgeting efforts including RPA, Land Management Planning, and the annual program development will take into account changes in land inventory data, benefits, costs, and technology as they occur.

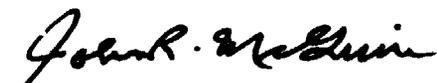
#### Recommendation 12

The required annual report to Congress will indicate the progress in developing improved land inventory data and in implementing fund allocation procedures along with other requirements of the Resources Program and Assessment and the NFMA.

In summary, we are in agreement with the intent of the report. The productive capacity of the National Forest for timber growth could be more nearly realized through intensive management. We believe progress has been made since the 1974 report but much still remains to be accomplished.

Thank you for the opportunity to review and comment on the draft report.

Sincerely,



JOHN R. MCGUIRE  
Chief

PRINCIPAL OFFICIALS OF  
THE DEPARTMENT OF AGRICULTURE  
RESPONSIBLE FOR ADMINISTRATION OF  
ACTIVITIES DISCUSSED IN THIS REPORT

	<u>Tenure of office</u>	
	<u>From</u>	<u>To</u>
<b>SECRETARY OF AGRICULTURE:</b>		
Bob Bergland	Jan. 1977	Present
John A. Knebel	Oct. 1976	Jan. 1977
Earl L. Butz	Dec. 1971	Oct. 1976
Clifford M. Hardin	Jan. 1969	Dec. 1971
<b>ASSISTANT SECRETARY, CONSERVATION, RESEARCH, AND EDUCATION (note a):</b>		
M. Rupert Cutler	Apr. 1977	Present
Paul A. Vander Myde (acting)	Jan. 1977	Apr. 1977
Robert W. Long	Mar. 1973	Jan. 1977
Thomas K. Cowden	May 1969	Mar. 1973
<b>CHIEF, FOREST SERVICE:</b>		
John R. McGuire	Apr. 1972	Present
Edward P. Cliff	Mar. 1962	Apr. 1972

a/ Title changed from Assistant Secretary, Rural Development and Conservation, in January 1973.

(02171)