Forest Restoration in Missouri

Extensive areas in the Missouri Ozark region, because of the character of the soil and topography, are better suited to forest than to agricultural crops. (Photo by courtesy U. S. Forest Service.)

COLUMBIA, MISSOURI
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FOREWORD

A strong feeling that land is in a very real sense a public utility has arisen in recent years in Missouri and other states. So many problems, in connection with land, cut across the boundaries of tracts owned by individuals and thus become public responsibilities. Control of erosion, of floods, of fires, and of grazing in certain areas are instances of problems that need public attention.

In recognition of both public and private aspects of the land problem, Dean Mumford in 1933 appointed a "Land Use Committee" in the College of Agriculture of the University, both to stimulate new and to correlate existing efforts to improve the efficiency of the use of Missouri's land. The members of the Land Use Committee at present are Professors M. F. Miller (Chairman) and H. H. Krusekopf, Department of Soils; W. C. Etheridge, Department of Field Crops; E. A. Trowbridge, Department of Animal Husbandry; and O. R. Johnson and Conrad H. Hammar, Department of Agricultural Economics.

In late 1936 the Land Use Committee undertook to sponsor a report on Forest Restoration in Missouri and invited the following agencies to act as co-sponsors:

- Missouri State Planning Board
- United States Forest Service, Region Nine and Central States Forest Experiment Station
- Resettlement Administration, Missouri Land Use Planning Section
- American Legion, Department of Missouri

Some eighteen individuals of the administrative and technical personnel of these and other agencies contributed papers to the final report, and these are combined in this publication as a bulletin of the Missouri Agricultural Experiment Station.

Since each of the many contributors attempted to make his section a well rounded statement of the topic he was assigned, a certain amount of repetition will be apparent. This repetition will also emphasize the more pressing aspects of the many problems of forest restoration in Missouri.

The editors are grateful to Mr. E. A. Mayes of the Resettlement Administration for reading and correction of the entire manuscript during its final stages.

Conrad H. Hammar
R. H. Westveld
Editors
INTRODUCTION

By R. H. Westveld and Conrad H. Hammar

University of Missouri

Missouri, with its 15,500,000 acres of forest land, stands high among the states of the Union in the extent of its forest land resource but low in the contribution these lands are making to the social and economic welfare of the State. Table 1 shows that 14 eastern and six western states have more land best suited to forest use than Missouri. Since forest land in public ownership is being used in a way that insures its fullest social and economic contribution now and for all time, the data on forest land acreage in public ownership show in part the progress that each state has made in a constructive forestry program. These data do not show the full extent of constructive forestry efforts because several states with small acreages of state-owned forest land are lending valuable assistance to private land owners in forest fire protection, education, and the production of forest planting stock for public use through their state forestry departments. Furthermore, forestry is practiced on a considerable acreage of privately owned forest land in certain states, thus increasing the scope of the forestry program in those states. Practically the full extent of Missouri's forestry program is represented by the land acreage in public ownership because Missouri has no state forestry department assisting private land owners in forest fire protection, etc., and the area of privately-owned land on which forestry is practiced is negligible. These facts when compared with similar ones for other states (available in part in Table 1) demonstrate that Missouri has not been so progressive in developing a forestry program as most states, many of them with forest land acreages much smaller than Missouri's.

Although earlier attempts had been made to inaugurate a constructive forestry program in the State, it was not until 1933, when the national forest purchase units were established, that a comprehensive program began to take form. As early as 1899 the General Assembly passed a law which provided that the State Geological Survey should investigate the State's forest resources. At the same time, and later, various laws aimed at the prevention of forest fires were passed by the General Assembly. In 1925 provision was made for the creation of a Department of Forestry under the State Board of Agriculture. This department was authorized to practice forestry upon lands owned by
the State, to promote forestry practice throughout the State, to acquire additional lands for forestry purposes, and to sell timber from the state forests. In cooperation with the federal government under the Clarke-McNary Act, the State in 1925 initiated a small program in fire protection, education, and the production of nursery stock. After

### Table 1.—Extent of Forest Lands in Acres\(^1\) and Status of State Forestry, June, 1936.

<table>
<thead>
<tr>
<th>State</th>
<th>Total Acreage</th>
<th>Acreage in Public Ownership</th>
<th>Status of State Forestry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Recommended for Forest Management</td>
<td>National Forests</td>
<td>State Forests</td>
</tr>
<tr>
<td>Alabama</td>
<td>20,360,095</td>
<td>151,668</td>
<td>252,100</td>
</tr>
<tr>
<td>Arizona</td>
<td>6,585,963</td>
<td>6,306,000</td>
<td>29,000</td>
</tr>
<tr>
<td>Arkansas</td>
<td>24,070,533</td>
<td>1,515,074</td>
<td>1,026,793</td>
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<tr>
<td>California</td>
<td>39,895,046</td>
<td>19,202,647</td>
<td>108,613</td>
</tr>
<tr>
<td>Colorado</td>
<td>20,410,020</td>
<td>13,536,000</td>
<td>208,641</td>
</tr>
<tr>
<td>Connecticut</td>
<td>1,184,553</td>
<td>0</td>
<td>57,196</td>
</tr>
<tr>
<td>Delaware</td>
<td>54,200</td>
<td>0</td>
<td>92</td>
</tr>
<tr>
<td>Florida</td>
<td>19,649,748</td>
<td>819,605</td>
<td>132,467</td>
</tr>
<tr>
<td>Georgia</td>
<td>27,614,912</td>
<td>396,426</td>
<td>1,100</td>
</tr>
<tr>
<td>Idaho</td>
<td>22,683,933</td>
<td>19,747,656</td>
<td>1,133,790</td>
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<tr>
<td>Illinois</td>
<td>1,951,795</td>
<td>59,218</td>
<td>4,226</td>
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<tr>
<td>Indiana</td>
<td>2,595,804</td>
<td>2,206</td>
<td>46,205</td>
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<td>Iowa</td>
<td>517,621</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Kansas</td>
<td>10,556,523</td>
<td>125,705</td>
<td>18,624</td>
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<td>Kentucky</td>
<td>15,600,864</td>
<td>413,020</td>
<td>6,580</td>
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<tr>
<td>Louisiana</td>
<td>14,175,409</td>
<td>33,781</td>
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<tr>
<td>Maine</td>
<td>1,506,451</td>
<td>40</td>
<td>115,700</td>
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<tr>
<td>Maryland</td>
<td>14,873,213</td>
<td>1,014,237</td>
<td>2,098,018</td>
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<td>Massachusetts</td>
<td>15,156,001</td>
<td>1,508,061</td>
<td>1,981,708</td>
</tr>
<tr>
<td>Minnesota</td>
<td>15,874,500</td>
<td>668,500</td>
<td>545,000</td>
</tr>
<tr>
<td>Missouri</td>
<td>11,506,451</td>
<td>0</td>
<td>115,700</td>
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<tr>
<td>Montana</td>
<td>17,518,110</td>
<td>13,363,082</td>
<td>553,228</td>
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<tr>
<td>Nebraska</td>
<td>118,655</td>
<td>13,330</td>
<td>0</td>
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<tr>
<td>New Hampshire</td>
<td>8,973,461</td>
<td>4,985,848</td>
<td>0</td>
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<tr>
<td>New Jersey</td>
<td>4,209,118</td>
<td>600,084</td>
<td>34,664</td>
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<tr>
<td>New Mexico</td>
<td>984,900</td>
<td>6,523,000</td>
<td>173,000</td>
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<td>New York</td>
<td>8,973,461</td>
<td>4,985,848</td>
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<tr>
<td>North Carolina</td>
<td>21,863,213</td>
<td>575,771</td>
<td>18,429</td>
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<td>North Dakota</td>
<td>500,000</td>
<td>480</td>
<td>0</td>
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<tr>
<td>Ohio</td>
<td>3,993,577</td>
<td>62,010</td>
<td>0</td>
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<tr>
<td>Oklahoma</td>
<td>6,881,790</td>
<td>195,200</td>
<td>4,000</td>
</tr>
<tr>
<td>Oregon</td>
<td>25,051,200</td>
<td>13,701,814</td>
<td>113,132</td>
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<tr>
<td>Pennsylvania</td>
<td>13,391,306</td>
<td>397,710</td>
<td>1,647,881</td>
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<tr>
<td>Rhode Island</td>
<td>301,376</td>
<td>0</td>
<td>844</td>
</tr>
<tr>
<td>South Carolina</td>
<td>14,548,123</td>
<td>363,764</td>
<td>0</td>
</tr>
<tr>
<td>South Dakota</td>
<td>1,293,278</td>
<td>1,067,745</td>
<td>15,960</td>
</tr>
<tr>
<td>Tennessee</td>
<td>14,843,295</td>
<td>474,914</td>
<td>47,433</td>
</tr>
<tr>
<td>Texas</td>
<td>12,601,477</td>
<td>281,128</td>
<td>7,565</td>
</tr>
<tr>
<td>Utah</td>
<td>22,950,094</td>
<td>7,570,871</td>
<td>898,872</td>
</tr>
<tr>
<td>Vermont</td>
<td>3,590,000</td>
<td>74,132</td>
<td>47,433</td>
</tr>
<tr>
<td>Virginia</td>
<td>14,487,926</td>
<td>701,366</td>
<td>588</td>
</tr>
<tr>
<td>Washington</td>
<td>18,927,825</td>
<td>8,140,547</td>
<td>1,274,349</td>
</tr>
<tr>
<td>West Virginia</td>
<td>7,652,163</td>
<td>688,233</td>
<td>21,600</td>
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<td>Wisconsin</td>
<td>10,381,751</td>
<td>1,038,364</td>
<td>331,326</td>
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<tr>
<td>Wyoming</td>
<td>6,837,800</td>
<td>6,759,858</td>
<td>198,314</td>
</tr>
</tbody>
</table>

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2. \(\times\)State forestry department has fire protection organization and produces nursery stock for distribution to farmers.

\(\times\)\(\times\)Either a state forestry department or other facilities for producing nursery stock only.

\(\times\)\(\times\)\(\times\)State forestry department has fire protection organization and in most cases does educational work.

3. Increased to 1,000,000 June 1, 1937.
two or three years of development this program was gradually curtailed to the point of ineffectiveness because of insufficient state appropriations, and finally abandoned in 1933 when the law providing for the Board of Agriculture was repealed. Subsequently the State Game and Fish Commissioner served as State Forester ex officio but no funds have been available for strictly forestry work.

Other early contributions to the development of a forestry program for the State included forestry instruction and the management of University-owned forest lands by the University of Missouri from 1911 to 1921, the part-time farm forest extension program of the University from 1925 to 1927, and the educational program of the Missouri Forestry Association from 1921 to 1933. These activities, although initiating forestry work of various kinds on a small scale, failed to develop a sustained program, apparently due to the lack of public support.

Although the state forestry work was abandoned in 1933 interest in forestry soon was revived through a more widespread appreciation of the value of the work brought about by the establishment of the national forest purchase units, the development of state-owned forest areas by the Civilian Conservation Corps, and the attitude of the national administration toward conservation. Subsequently in 1936 a limited field of resident instruction in forestry and extension work in forestry were added to the activities of the University of Missouri. These have been constructive undertakings which appear to be the start of a new and enlarged era of forestry in Missouri.

The purpose of this report is to call attention to the following facts: (1) That the forest lands of the State constitute a major social and economic problem; (2) that these lands can if properly cared for make real contributions that they are not now making to industry and labor, to erosion control, to regulation of streamflow, to flood control, to the restoration of fish and game, and to recreation, and (3) that there now exist opportunities in the form of federal aid from which the State is not benefiting. An attempt is made also to outline a long-time forestry program for Missouri.

Such a presentation now is timely because it appears that the public demands proper use of its forest resources as evidenced by the overwhelming support it gave recently to Amendment 4 of the State Constitution providing for the control of the forests and other natural resources by a Conservation Commission. This report should be helpful to this Commission, and to all state, federal, and local agencies in developing a coordinated program of forest and other land use.
PLATE II.—Many Ozark farms have been "cut out" of the timber and developed in a crude way. Stony soils quickly lose their fertility and farming becomes a losing struggle. Tax delinquency and farm abandonment are high where farms have been developed on soils unsuited to agriculture. (Photos by courtesy U. S. Forest Service.)
I. Area and Location of Lands that Should Be Reforested.

FOREST LAND PRIORITIES AS REVEALED BY THE CENSUS

BY E. A. MAYES

Resettlement Administration

The land area of Missouri is 43,985,280 acres. When in a virgin condition, or prior to the arrival of the first white settlers, about 31,000,000 acres or 70 per cent of the land surface was in forest cover. In general, the virgin forests were located in the Ozark Region, in practically all stream bottoms in the state, on the river hills, and in a narrow strip of land extending north from Boone County to the Iowa line. The virgin prairie covered about 13,000,000 acres or 30 per cent of the land area and was practically all located either north of the Missouri river or in the region directly south and east of the present site of Kansas City.
All of the original prairie is now in farms excepting limited areas of stream bottom prairie in North Missouri and the limited acreage which is used for towns, railroads, highways, and other higher uses.

Of the original area of 31,000,000 acres which was in virgin forests, about 15,500,000 acres, or approximately one-half, is now cleared of trees and is in farms, towns, and other uses. It is unlikely that any great quantity of this cleared land will ever revert to tree cover, as most of it is suited to its present uses. Some areas should be removed from crop production and changed to pasture, and some swamp areas, where artificial drainage is too difficult and too expensive in proportion to the natural fertility of the land, may be best suited to forest cover.

The remaining half of the original forest land, or about 15,500,000 acres, remains in tree or brush cover, practically all of which has been cut over. It is estimated that less than 150,000 acres of this area still possesses its virgin timber, 57% or 8,902,997 acres is in farms, and 43% or 6,692,667 acres is wild land outside of farms. Practically all of the present timber land is in a depleted condition as a result of over-grazing, overcutting, and burning. (Table 2).

### Table 2.—Major Categories of Land Use—Missouri.

<table>
<thead>
<tr>
<th>Category</th>
<th>Acres</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Towns, Highways, etc.</td>
<td>2,238,071</td>
<td>5.1</td>
</tr>
<tr>
<td>2. Crops and Plowable Pasture</td>
<td>27,521,179</td>
<td>51.2</td>
</tr>
<tr>
<td>3. Other Pasture (in Farms, Cleared but not Plowable)</td>
<td>2,242,761</td>
<td>3.1</td>
</tr>
<tr>
<td>4. Other Land in Farms (Mostly Improvements)</td>
<td>1,387,605</td>
<td>2.2</td>
</tr>
<tr>
<td>5. Woodland</td>
<td>15,595,664</td>
<td>24.4</td>
</tr>
<tr>
<td>6. In Farms</td>
<td>8,902,587</td>
<td>15.2</td>
</tr>
<tr>
<td>7. Outside of Farms</td>
<td>6,692,667</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>43,985,280</td>
<td></td>
</tr>
</tbody>
</table>

Data from a joint tabulation of Land Use in Missouri by the Missouri State Planning Board, Department of Agricultural Economics, College of Agriculture, and Land Use Planning Section, Division of Land Utilization, Resettlement Administration, United States Department of Agriculture, based largely on Federal Census of Agriculture for 1935.

In establishing a priority rating of land to be reforested or placed under organized forest management, it is necessary to eliminate alluvial land, land in cities and towns, and other land which is adapted to uses higher than an intensively managed forest use.

Agriculture is the great competitor of forests for the use of land in Missouri. The most reliable index of lack of suitability of Missouri land for farming is the proportion of rural land which is still unowned by farmers.

An examination of the proportion of land outside of farms in each of the civil townships in Missouri on the basis of 1930 Census of Ag-
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Agriculture Reports facilitates the establishment of priority ratings of the availability of land for forest use. The classification reveals the extreme to be 91.1% of the land area outside of farms in Current Township in Shannon County, and, at the opposite pole, a number of townships in the better land area of the state with less than 1% of their land area outside of farms. There are four townships having more than 90% of the land area outside of farms. Two of these townships are urban and one is lowland, however, and therefore not highly suited to forestry. The single remaining rural township with 91.1% of its land not in farms constituted Class I in Table 3.

Table 3.—Priority of Missouri Land for Forest Uses.

<table>
<thead>
<tr>
<th>Priority Class</th>
<th>Percentage of Land Area not in Farm Ownership</th>
<th>Number of Townships</th>
<th>Cumulative Acres*</th>
<th>Cumulative Average Cumulative Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>90-100</td>
<td>1</td>
<td>23,680</td>
<td>23,680</td>
</tr>
<tr>
<td>II</td>
<td>80-89.9</td>
<td>11</td>
<td>419,840</td>
<td>443,520</td>
</tr>
<tr>
<td>III</td>
<td>70-79.9</td>
<td>24</td>
<td>1,150,080</td>
<td>1,593,600</td>
</tr>
<tr>
<td>IV</td>
<td>60-69.9</td>
<td>35</td>
<td>1,551,360</td>
<td>3,144,960</td>
</tr>
<tr>
<td>V</td>
<td>50-59.9</td>
<td>47</td>
<td>1,823,360</td>
<td>4,668,320</td>
</tr>
<tr>
<td>VI</td>
<td>40-49.9</td>
<td>58</td>
<td>2,279,040</td>
<td>7,279,360</td>
</tr>
<tr>
<td>VII</td>
<td>30-39.9</td>
<td>102</td>
<td>3,227,680</td>
<td>16,175,040</td>
</tr>
<tr>
<td>VIII</td>
<td>20-29.9</td>
<td>159</td>
<td>5,724,160</td>
<td>16,899,200</td>
</tr>
<tr>
<td>IX</td>
<td>10-19.9</td>
<td>338</td>
<td>11,505,920</td>
<td>28,405,120</td>
</tr>
<tr>
<td>X**</td>
<td>0-9.9</td>
<td>529</td>
<td>15,580,160</td>
<td>43,985,280</td>
</tr>
</tbody>
</table>

*Townships areas calculated from planimeter readings of maps. Area in farms from 1930 U. S. census.
**Class I includes all urban and all alluvial townships regardless of proportion of land area outside of farms.

There are eleven rural upland townships with from 80% to 90% of their land area outside of farms; and these eleven townships are placed in Class II of the priority rating. The eleven townships are concentrated in the rugged part of the Ozarks and are 419,840 acres in area.

Twenty-four rural upland townships have from 70% to 80% of their area outside of farms and are placed in Class III. The area of the townships in this class is 1,150,080 acres, and like the two preceding classes, all of these townships are concentrated in the Ozarks.

There are thirty-five upland rural townships with from 60% to 70% of the land area outside of farms, the combined acreage of which is 1,551,360 acres. This group of townships is placed in Class IV of the priority rating and like the preceding classes, all of the townships are concentrated in the rugged parts of the Ozarks. The combined acreage of the first four classes is 3,144,960 acres.

Forty-seven upland rural townships have from 50% to 60% of the land area outside of farms. These forty-seven townships are 1,-
823,360 acres in area, and are also located in the Ozarks. The combined acreage of the first five classes is 4,968,320 acres.

Class VI includes fifty-eight upland rural townships with from 40% to 50% of the area in wild land outside of farms. The total area of this class is 2,279,040 acres and the combined acreage of the first six classes is 7,247,360 acres, all of which is in the Ozarks. The land included in the first six priority classes practically coincides in acreage and location with the land in the Class IV soil class, which includes 7,248,147 acres in the Ozarks, and appears highly suited to large scale public forestry. (See Figures 2 and 3.)

Fig. 2.—Percentage of Total Land Area Outside of Farms. The great area most suitable for development for forestry lies in the southern and southeastern Ozark highland areas.

The seventh priority class is 3,927,680 acres in area. This class includes one hundred and two upland rural townships, all of which have from 30% to 40% of the land area outside of farms. Only four townships in this class are north of the Missouri River and many of them are adjacent to those in the previous classes. The combined acreage of the first seven classes is 11,175,040 acres.

The eighth class includes the one hundred fifty-nine upland rural townships which have from 20% to 30% of the land area outside of farms. One-eighth of the townships in this class are north of the Missouri River, and the remainder in regions of similar quality land in the
Ozarks. The north Missouri townships which are included are typical of the more dissected lands north of the Missouri River and as a class include the larger areas of wild land which are found in the northern part of the state. The total acreage of land of Class VIII priority is 5,724,160 acres and the combined acreage of the first eight classes is 16,899,200 acres. Practically all public forest possibilities of any size are found in the first eight classes.

The ninth class includes 1,505,920 acres of rural upland in three hundred thirty-eight townships, all of which have only 10% to 20% of the land area outside of farms or conversely from 80% to 90% of the land area in farms. The tenth and last priority class includes all alluvial townships, all urban and suburban townships, and all rural townships which have less than 10% of their area outside of farms or conversely more than 90% of the area in farms. It embraces 15,580,160 acres of land. These last two classes include the most highly developed agricultural land in the state. Such lands are the least available for forestry though farm woodlots and occasional areas of park or game refuge forests may be found in them.

Fig. 3.—Most land best suited to forestry and submarginal for crops in Missouri lies south of the Missouri River and in the Ozark highland region of the State.
The apparent conclusion to be drawn from these priority ratings of land for forestry, however, is that there is much land in Missouri not owned by farmers and for the most part unused at present. To put such lands under private or public management for timber production would be to put into constructive use a great acreage of lands in the state now producing little or no income.

PHYSICAL ASPECTS OF LAND IN RELATION TO FOREST USE

By H. H. Krusekopf
University of Missouri

Missouri is one of the leading agricultural states, although approximately one-third of the entire state area is in forests. Its rank in agriculture and also the large forest area are due to soil conditions. It is the purpose of this paper to indicate those soil and physical factors that characterize the forest lands.

It is generally assumed that all land not suited for crop production or for pasture should be used for forestry. On this restricted definition there is not a county in the state that does not have some forest land. In many of the north and west Missouri counties the area of such land is relatively small and occurs in widely distributed and irregular areas. For large portions of the Ozark Region, forest land comprises from 75 to 90% of the total land area. The following paragraphs will therefore relate primarily to the physical aspects of the Ozark forest lands.

The Ozark Region is a distinct geographic area, remarkably uniform in those main physical features of topography, native vegetation, and character of rocks and soils. From the standpoint of location and climate, the region is highly favorable for human occupation. This explains why the Ozark country was settled at an early time, why it is rather completely occupied now, and why it continues to be an attractive area for new settlers. That the majority of the land remains forested in face of the favorable environmental conditions is strong evidence that there are unfavorable physical conditions in the soil.

The dominantly hilly topography of the Ozark Region consists of ridges, narrow valleys and broad intervening hill areas. The rolling surface on the divides changes to steep slopes near the larger streams. It is estimated that approximately 50% of the hill land consists of such steep slopes (20 to 45°) as to preclude cultivation. Much of the
rolling land would be destroyed by erosion if the forest cover were removed.

The relatively low fertility of the soils is the most important factor in determining the forest use of the land. The low fertility of the soils is evident by almost any standard that may be applied. This is due to the fact that the soils are old and rather thoroughly leached. The agricultural utilization of the land is limited, and successful farming is largely confined to the valleys and better uplands.

The light colored Ozark soils are low in nitrogen and organic matter. The content of phosphorus averages less than one-half that in the soils of northern Missouri. A soil feature that is difficult to evaluate or define, but which nevertheless is an important fertility factor, is that of structure or tilth. Many Ozarks soils have a tendency to crust, or bake, or “run-together.” This condition favors rapid erosion and also rapid drying. The low resistance to dry weather is characteristic of the Ozark soils.

Another physical aspect of the Ozark soils is the almost universal presence of stones or chert. In much of the stony land from 50 to 70% of the soil mass consists of angular chert fragments varying in size from small chips to pieces 4 to 6 inches in diameter. In general, the stone content is highest on slopes. Also, the eastern half of the Ozark region averages more stony than the western portion. For much of the hill land where slope in itself is not a limiting factor, the presence of stones makes cultivation impossible. The stones tend to retard erosion but, on the other hand, cause the soils to be droughty.

It is characteristic for soils in limestone regions to be relatively dry, because of the porous and cavernous structure of the lower substrata. The Ozark Region is noted for a cavernous structure, as evidenced by the number and size of the springs. A large percentage of the rainfall readily percolates through the stony top soil, and passes to depths beyond the reach of plants. Another factor that contributes to the dryness of the soils is the hilly surface which favors rapid run-off of much of the rainfall. For some drainage basins the run-off is approximately 38% of the total rainfall. This percentage is almost twice as high as for most of north Missouri. The destruction of the forest litter by frequent burning is in part responsible for the loss of much rainfall by run-off.

Soil erosion as a physical factor in land use is of minor importance in the Ozark Region. Practically all of the upland is subject to erosion but it is only in the border counties along the Missouri and Mississippi rivers that soil destruction has occurred that is comparable to the deterioration in northern Missouri. The forest cover and the stone
content in the soils have been the protecting agencies from more serious erosion. The utilization of the hill land for either cultivated crops or pasture would quickly result in the hopeless destruction of the land. The nature of the soil is such that, once it is eroded, reclamation is practically impossible.

The various physical aspects then of topography, low fertility, stone content, dryness, erosion, etc., separately or in combination, impose insurmountable limitations on the use of much of the Ozark land for agriculture, but gives forestry prior claim. More than 50% of the land is now in forests. There can be no marked reduction in this area. Such clearings as may develop, in all probability will be more than offset by reversion to forest of fields now cleared.

In regard to the relation of forestry to the physical properties of land in other parts of the state, little need be said. In all the counties bordering the Mississippi River between Hannibal and St. Charles, there are extensive areas of steep hill land where cultivation is impossible, and where a forest cover only will prevent destruction of the land by erosion. Similar conditions prevail in the counties bordering the north side of the Missouri River between St. Charles and Glasgow. Some of the steepest hill land in the state occurs in this section. Throughout the north central part of the state there is much eroded land where reclamation or protection from further deterioration can be attained by forestry only. In the lowlands of southeastern Missouri the physical features that affect land use are unlike those in other parts of the state. Soils composed of light sand or heavy clay, poor drainage and frequent flooding are the factors that effectively limit the use of the land. That forestry has a definite place in this complex soil region is becoming increasingly apparent.

It is a conservative estimate that the soil on more than 10,000,000 acres has such unfavorable physical properties as to limit the use of the land to forestry.
This subject can be approached most effectively by dividing the State into three regions, each reasonably uniform in topography, climate, soil, character of forest, and relative importance of various forest uses. These regions, shown in Figure 4, are: north Missouri glacial and loessial and southwest Missouri prairie regions (discussed as a single region), Ozark region, and southeast Missouri lowland region.¹

Fig. 4.—Physiographic regions of Missouri.

Ozark Region

The Ozark region with its dissected topography, stony soils, copious precipitation, long growing season, varied scenery and extensive forests is admirably suited to forests of varied use. Furthermore the forest lands are a major factor in the economy of the region.

Timber Production.—The Ozark soils with the exception of the Lebanon silt loam are well suited to satisfactory forest growth. In

general trees become established with ease where fire is controlled. Growth rate of trees varies greatly with the character of the site but the majority of sites will yield timber of merchantable value in a reasonably short rotation. Potential growth capacity per acre in this region is probably somewhat higher than the average of 200 board feet per acre per year for well-managed forests estimated for the State as a whole. Use of the forests for timber production should therefore be a primary consideration in this region.

Protective Values.—The rolling to rough topography, the stoniness of the soils, and the deficiency of organic matter in the soils accentuate the runoff and erosion when the land is not covered with vegetation. Streams irregular in flow and with stream beds becoming filled with gravel are evidence of the need for better control of runoff and erosion. All timbered areas are valuable for this purpose. It is a coincidence that some of the most critical areas are poor quality sites incapable of yielding commercial timber products. However since these areas are so important in the protection of watersheds they must be given primary consideration.

Wildlife and Domestic Livestock.—The broken topography, the numerous streams, and the varied cover make this region potentially ideal for a great variety of wild animals, birds, and fish. The extent to which the wildlife population might be restored through proper land management and other measures is described in detail elsewhere.² Obviously this resource would be a great asset to this region.

All timberlands (except small farm woodlands) have some value for grazing domestic livestock. Due to past overgrazing, palatable nutritious forage plants are scarce, consequently the carrying capacity of these lands is low. Even with the reestablishment of valuable forage species the stocking by domestic livestock apparently will have to be kept low if timber production is not to be impaired.

Inasmuch as the use of forest lands for wildlife and domestic livestock is incidental to other uses and the return from such use is generally considerably less than from timber production, seldom need this type of use be given primary consideration in the location of forest areas.

Recreation.—The varied topography, numerous beautiful streams and springs, potentialities for wildlife, and varied scenery give the Ozark region high value for recreation. The forests contribute materially to this value by making the scenery more attractive. Large

². Bennitt, Rudolf and Nagel, Werner O. A survey of the resident game and furbearers of Missouri. The Univ. of Mo. Studies, Vol. XII, Number 2, April, 1937.
sums of money are now spent by recreationists each year in this region but the income from this source could be augmented greatly by expanded and improved facilities for the recreationist. Therefore sites of special value for recreation should be given primary consideration in a program for forest development.

Settlement and the Cost of Public Services.—In a real, though less direct manner, settlement and the cost of maintaining public services are related to this consideration of the use of land for forests. As later paragraphs will show (see sections under head of "The Problem of Local Government Maintenance During the Transition Period") public finance in the Ozark uplands is in a strained not to say critical condition. Despite a low level of governmental expenditure per capita as compared to more wealthy agricultural counties in the State, Ozark counties are suffering from a scourge of outstanding and protested warrants and, particularly, of delinquent taxes.

The Ozarks labor under two grave difficulties from the viewpoint of cost of maintaining local government; first, settlement is sparse and, second, per capita taxable wealth is low. The sparse settlement makes the per capita cost of maintaining a given quality of public service high. The per child cost of operating schools in districts where attendance is low is, for instance, high and for this reason schools in communities of sparse settlement are high-cost schools.

Because of these facts of high costs and delinquency, the struggle to maintain local government in the Ozarks on a plane similar to that upheld in richer agricultural and urban areas has been a losing one. A restoration of a forest use of land in these Ozark counties could be made to contribute materially toward a solution of the problems thus created. Forest communities need fewer roads than farm communities. Their school needs are likewise less. In fact, a great reduction in the need for public services can be effected if land now sparsely settled for agriculture is returned to forest uses.

Other states, notably Minnesota and Wisconsin have in recent years resorted to zoning in order to concentrate settlement and reduce the need for and cost of public services in cutover areas not dissimilar to the Ozark highland counties. Because of the highly intermingled agricultural and forest soils in the Ozarks, formal zoning may be less desirable as a means of controlling settlement than in Minnesota and Wisconsin.

4. Ibid. pp. 72-76.
Wisconsin. A more feasible method of accomplishing somewhat the same objective is to block up lands suited to forestry only, into strong forest ownership and thus to bar settlement to agriculture.

For these reasons forest use of land now in weak farm ownership and a desultory use for agriculture will serve additional and important objectives.

Because it is only in the Ozarks that problems of this nature rise to a genuinely critical point, no discussion of this aspect of forestry use considerations will be given for the remaining physiographic regions considered in this section.

Because the forests exhibit such varied utility and are such a vital link in the economic structure of the region, it is obvious that extensive well-managed forests must be developed as quickly as possible in the Ozark region.

**Southeast Missouri Lowland Region**

The southeast Missouri lowland region with its generally fertile soil, flat surface, high water table and long growing season originally presented unusually favorable conditions for forest growth, but after drainage of the land was instituted, the land became so valuable for agriculture that most of the forest has been taken from the land. To this statement there are only two exceptions of note. First, there are above 300,000 acres of flat gray land (Waverly silt loam) in eastern Butler and western Stoddard counties not so valuable for farming which may in time prove best suited to forest development. Second, an indeterminate but smaller acreage of lowlands is found between the outer levee and the beds of the Mississippi and Black rivers which will always be available for forest and wildlife development.

**Timber Production.**—The favorable conditions, already noted, make this region ideal for the production of high quality timber on a relatively short rotation. The rate of growth of trees is considerably above the average for the State. Even the sandier phases of the Lintonia soils, of questionable value for agricultural crops, appear capable of producing profitable yields of certain types of tree crops, particularly black locust.

**Protective Values.**—Because of the relatively flat land surface and the permeability of the soil, runoff and soil erosion by water are negligible. The coarser textured soils, notably the sandier phases of the Lintonia soils, are very susceptible to wind erosion after a few years of cultivation. In recognition of this fact the Scott County Agricultural Planning Committee has recommended that 20,000 acres of this “blow sand” be withdrawn from agricultural use and devoted to
forest use. Undetermined amounts of this class of land are known to exist in Mississippi county also.

Windbreaks may have a place in providing protection to agricultural crops where cleared fields occupy extensive areas.

Wildlife and Domestic Livestock.—Although conditions are not so favorable to as great a variety of wildlife in the southeast Missouri lowland region as in some other sections, nevertheless it supports some forms not found elsewhere. There are real opportunities in the extensively developed agricultural areas to increase the wildlife population by increasing the permanent cover such as might be developed as a part of, or in conjunction with, windbreaks and woodlands.

The woodlands have little value for grazing livestock because of the general lack of palatable forage plants. Furthermore small tracts of woodland as a unit of a farm could not be used for grazing without injury to timber production even though palatable vegetation were introduced.

Recreation.—Except for hunting and fishing as a form of recreation, the lowlands offer limited recreational attraction because of the absence of interesting or unusual scenery and the inconvenience caused by the wetness of the site and the abundance of insects.

The excellent timber growing capacity of the soil and the strong local demand for timber products make these forests valuable chiefly for timber production although they can incidentally contribute to wildlife restoration.

North Missouri Glacial and Loessial and Southwest Missouri Prairie Regions

Differences in these two regions are not great enough to affect noticeably the use of forest lands in each region. These regions with their level to rolling surface (less of the rolling topography in the southwest Missouri prairie region), generally deep fertile soils, moderate precipitation, and scattered small tracts of woodland are essentially valuable for their agriculture. Nevertheless certain conditions and factors discussed below indicate the vital importance of forests even here.

Timber Production.—Although it might appear that yields of native timber would be high in these regions, certain factors do not favor high yields. The prairie type of climate and the fact that only the inferior soils are used for timber production are limiting factors in timber yields. Yet facts indicate that timber production may be the most profitable use to which such lands can be put.
Protective Value.—Later sections (Forests in relation to erosion control and (Forests in relation to stream flow and flood control) call attention to the critical nature of the erosion, stream flow, and flood problems in northern Missouri (the southwest Missouri prairie region does not have such critical condition). Since woodlands can make such vital contributions to the solution of these problems it is pertinent that critical lands be devoted to forest.

In view of the high value of the agricultural crops and the ever-present danger of partial losses of them by the damage from hot dry summer winds or cold winter winds, it appears that windbreaks could fill an important place in certain parts of these regions.

Wildlife and Domestic Livestock.—It is a well known fact that cover and food are insufficient for a large wildlife population. Yet with improved and expanded food and cover the land is capable of supporting a large and varied wildlife crop which, under proper regulation and use, could be a real asset to the land owner. Forests and windbreaks would be a tremendous aid in restoring the wildlife resources.

It is such a well established fact in regions of small woodlands like the north Missouri glacial and loessial and the southwest Missouri prairie regions that grazing of woodlands by domestic livestock is incompatible with timber growing that grazing use of forest land must be banned.

Recreation.—The natural features that make for extensive recreation use of land exist here only in a small degree, usually localized. Furthermore, the form of land ownership and use are not conducive to extensive recreational development. There are a few extensive areas of land (in the north Missouri glacial and loessial region) which, if properly developed, would undoubtedly stimulate the recreational trade.

In consideration of the general scarcity of timber, the large local demand for wood products and the high protective value of forests in the north Missouri glacial and loessial and southwest Missouri prairie regions, full use of all forest lands is of tremendous importance here.
II. Purposes to be Served by Reforestation.

TIMBER PRODUCTION

By R. H. Westveld
University of Missouri

The major proportion of Missouri's forest land is an asset primarily for timber production since the maximum monetary return will be realized by the owner from such land use. This does not mean that other contributions that forest land can make are eliminated. On the contrary, forest properly managed for wood products have favorable effects on soil and water conservation, on wildlife population, and upon recreational use (as described in the sections which follow). Certain adjustments in forest management practices may have to be made locally on limited areas to enhance these supplemental values, but these compromises will rarely have a material effect on the yield of timber.

Limited areas of forest land, in the aggregate approximately 3% of the total or 413,229 acres\(^1\) have physical characteristics that make the yield of forest products so low and the quality so poor that the land will have greater primary value for uses other than timber production. Eliminating also 1,000,000 acres for exclusive use for recreation and wildlife, there remain approximately 12,500,000 acres of land suitable for the production of timber products.

Present Condition of Timberland

Not more than 150,000 acres of the original 31 million acres of valuable forests of mixed hardwoods, shortleaf pine, and cypress remain. New forests have taken the place of the old which have been removed chiefly by cutting. The second-growth forests vary in age and composition with the elapsed time since cutting, their history with respect to fire and grazing by domestic livestock, and soil differences. In general, the proportion of inferior trees has increased materially because of mismanagement and a large proportion of all classes of trees is unsound due to injury by almost annual fires which have wounded the trees, thereby making it possible for rot-producing fungi to enter the wood.

In the upland forests of oak, hickory and pine (these make up a major portion of the forest land of the State) neglect has caused a decided increase in such tree species as post oak, blackjack oak, dog-

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wood, and sassafras, the woods of which have very limited commercial value. These inferior tree species have taken almost complete possession of some sites while in the better timber stands as much as 30 to 50% of the timber stand is composed of these species. Few of the forests contain trees over 10 inches in diameter, and in many, the majority of the trees are under 5 inches in diameter, excellent indications of the deficiency of marketable timber in Missouri's forests. A sample area in one of the better second-growth stands had only 31 trees per acre over 10 inches in diameter.

A recent study by the U. S. Forest Service on the Clark National Forest revealed that 31.6% of the total board foot volume in trees over 9.6 inches in diameter, and from 8.2 to 9.6% of the total merchantable cubic foot volume of trees under 9.6 inches in diameter are lost because of defect.2 This study shows also that 60% of the trees analyzed were injured by fires, and of these 68% were defective. The other major causative factor in defect is branch stubs, as shown by the fact that 68% of the trees having branch stubs over 2 inches in diameter were defective. Branch stub formation is directly attributable to understocking (trees too widely spaced) of the stands resulting from improper management. Although the data referred to did not sample an extensive area, observations over a wider area led to the conclusion that they are representative of Missouri forests. Some areas will have less defect, others more.

Understocking of timber stands, the condition previously referred to, is characteristic of Missouri forests. Particularly is this true of the farm woodlands where frequent close cutting combined with the use of the woods for pasture has resulted in so much exposure and damage that regeneration has not occurred. These timber lands become progressively worse when continually subjected to such treatment, and as the mature trees are removed from time to time and not replaced by seedlings, the forest is doomed to extinction. Such depleted forests do not utilize the potential soil productivity and are therefore unprofitable.

Because of understocking and a preponderance of defective and commercially worthless species, Missouri's forests are producing only a small amount of commercially valuable wood. It is estimated that the existing timber stands on the average do not produce a net growth of more than 25 board feet of sound commercially valuable wood per acre annually, or 312.5 million board feet for the entire State. Less

PLATE III.—Forest restoration will provide extensive employment in permanent timber industries. At present the small portable sawmill is the chief means of utilizing the small quantities of logs available. The cooperage industry also is rapidly approaching the fate of other wood-using industries because of the depletion of supplies.
than 5% of this growth, or 18.75 million board feet is being put on trees of saw log size. Yet in 1936 there was removed from Missouri’s forests approximately 100 million board feet of lumber in addition to an amount, probably as large or larger, for numerous other products. In other words, sawtimber is being cut about 10 times as fast as it is being grown. Even the current growth on small and large trees, estimated at 312.5 million board feet is only approximately equal to the lumber consumption for the State in 1934 and equal to only 38% of the 1928 lumber consumption.

Potential Timber Growing Capacity of the Forest Land

The forest lands of Missouri are producing only a small proportion of the commercially valuable wood volume that they are capable of growing. Exclusion of fire and the control of grazing by domestic livestock are essential if further deterioration is to stop. The application of stand improvement measures in the second-growth stands, judicious cutting of the few remaining old growth stands, and reforestation of denuded lands and understocked timber stands, in addition to fire and grazing control, are essential if the production of valuable wood in proportion to the productive capacity of the land is to be realized. Through proper forest land management, which would imply all of the practices just outlined, the forests would be capable of yielding a maximum quantity of the more valuable species, as black walnut, black cherry, red oak, black oak, white oak, red gum, sugar maple, yellow poplar, basswood, white ash, hickories, cypress, shortleaf pine, eastern red cedar, American elm, black locust, and catalpa. Included in this list are some of the most valuable woods of the United States. The more important products that can be derived from these species are sawlogs, cooperage stock, pulpwood, mine timbers and props, piling, railroad ties, and fence posts. All of these are in active demand.

The actual volume growth that can be expected following restoration of the valuable tree growth on the forest lands depends on the intensity of the measures that are applied. Intensive management seems justified on much of the forest land acreage in Missouri for reasons that will be outlined later.

Actual growth data for Missouri forests are not available. Based on observations and estimates by foresters familiar with forest conditions, the prediction is made that growth under intensive management should be not less than 200 board feet per acre per year, and under crude management 100 board feet per acre annually. Assuming that 75% of Missouri’s 12,500,000 acres of commercial forest are eventually inten-
sively managed and the remaining 25% extensively managed and assuming the rate of growth for each condition just referred to, the total annual growth would approximate 2,187,500,000 board feet. Probably not more than 60% of this amount or 1,312,500,000 board feet, would be marketed as lumber, the remainder going into cross ties, fuelwood, piling, pulpwood, stave bolts, etc.

Estimated annual growth under forestry practice.
2,187.5 million board feet.

Annual normal wood consumption (all products)
1,377 million board feet.

Present annual growth on all trees.
312.5 million board feet.

Present annual cut of lumber
100 million board feet.

Intensive Forest Management is Justified

The strategic location of Missouri's forests in relation to lumber consuming centers is ample justification for intensive forestry practice in Missouri. The center of lumber consumption of the United States is in Illinois, only 200 miles distant from the center of Missouri. Significant also is the fact that the State is bounded by five states; namely, Oklahoma, Kansas, Nebraska, Iowa, and Illinois that have so little acreage of forest land that they are not capable of supplying their own needs for timber products.

The lumber production of these five states was 131,521,000 board feet and their lumber consumption was 1,327,147,000 board feet in 1934. These figures do not represent potential production and consumption since building activities were at low ebb at this time. In 1928, a year of great activity in building, these states produced 237-
324,000 board feet and consumed 4,218,948,000 board feet of lumber. Although greater industrial activity increased lumber production, it increased lumber consumption in greater proportion. Yet these states were using nearly 18 times as much lumber as they were producing. In addition they were using other wood products beyond their ability to produce. The estimated total forest land area of these five states is approximately nine and one-half million acres, more than 70% of which is in one state, Oklahoma. Missouri alone has more than 15 million acres of forest land.

These data demonstrate that there is a large potential market for timber products readily accessible to Missouri. Furthermore, this State is in a position more advantageously to supply this demand than the majority of other states. Inasmuch as transportation increases lumber prices, Missouri, with its short distance to market, has a distinct marketing advantage. With this advantage, the land owner can better afford to invest in intensive management practices which will not only increase timber yields but timber quality as well.

**Measures Needed to Increase Timber Production**

Of profound importance to a successful program of forest conservation is stabilized land ownership. As long as land is owned by absentee owners whose chief interest is speculation, no progress can be made in a forest restoration program. Little can be accomplished even in the first requisite of such a program—fire prevention and control. Inasmuch as a large proportion of the land in the Ozark section is in this type of ownership, it is prerequisite that the federal and state governments acquire a major portion of this area as quickly as possible. Until this is done little can be accomplished toward a comprehensive program for increasing timber production.

Next in importance is a satisfactory system of fire prevention and control. Fire control will aid in improving the soil, thereby restoring productivity, it will prevent an increase in the number of defective trees from this cause, it will prevent added deterioration of trees already defective, and it will allow natural regeneration to take place. Fire control is, therefore, paramount.

Control of grazing by domestic livestock is essential to a successful program of timber growing. In farm woodlands, control of grazing implies exclusion of livestock because it is impossible to control the concentration of animals in an area as small as the average farm
woodland. Experience has demonstrated and the evidence on the ground shows that grazing of any kind in the farm woodland is ruinous.

The grazing situation in the more extensive timber tracts of the Ozarks is somewhat different because of the less intensive character of the grazing. In spite of the lower concentration of animals, much of the wooded area has been overgrazed with the resultant damage to tree reproduction. Grazing must be reduced to the carrying capacity of the range if the full timber producing capacity of the land is to be realized.

Given protection from fire and grazing, many timber stands will improve greatly under Nature's guidance. Nearly all stands will have to be given some silvicultural treatment to accelerate Nature's work. In the more badly deteriorated stands, considerable silvicultural treatment involving the destruction of the inferior and badly defective trees, and the planting of desirable trees to increase the stocking or to improve the quality of the timber stand will be necessary.

In the limited areas of fully-stocked stands of desirable composition, thinning should be applied to provide greater space for the trees in order that they may make more rapid growth.

Forest lands which were cleared for agriculture and later withdrawn from such use because of low fertility or soil erosion or which were denuded of tree growth by recurring fires or other destructive forces should be planted to trees to prevent further soil deterioration and to avoid delay in the utilization of these lands. Placing dependence on natural regeneration of these areas is a slow and uncertain process.

Much of the restoration work referred to in the foregoing paragraphs will not need to be applied to remaining areas of virgin timber if the merchantable trees in them are removed according to good conservation principles. This implies that only the fully mature trees of all species be removed, leaving, however, enough of the larger trees of seed-bearing size to provide for regeneration, and logging with sufficient care to avoid unnecessary damage to the trees left standing. Protected from fire and grazing, such areas would remain fully productive.

Disposal of a portion of the slash resulting from cutting may be necessary to prevent the creation of an abnormal fire hazard. The need for the disposal of this debris will be greatest where shortleaf pine constitutes an appreciable part of the stand because of the greater inflammability of shortleaf pine slash than hardwood slash. Complete
disposal of the slash will seldom be necessary. Disposal can generally take the form of partial disposal in the more strategic locations.

The applications of the foregoing measures on all forest lands is essential if Missouri is to become an important timber producing state again.
STREAM FLOW AND FLOOD CONTROL—A FORESTER'S VIEWPOINT

BY R. H. PECK
University of Missouri

Effect of Forests on Stream Flow and Flood Control

That run-off, the key to erosion control, is vastly less from well-managed forest land than from cultivated land or grass land is strikingly set forth in the next section and in other reports.\(^1\) In the southern parts of Missouri, where the forests are most extensive, forest covered land is likely to be more effective in reducing run-off during winter than in more northerly regions, due to the mild winter climate which decreases the length of time during which, and the depth to which, the soil will freeze. Unfortunately actual data on the effect that reduced run-off from forested land has on stream flow in Missouri are lacking. However data from other parts of the country reported elsewhere,\(^1,2\) a few of which will be reproduced below, show substantial effects of forests on stream flow. During the Yazoo River Flood of 1931-32 in Mississippi when 27 inches of rain fell in a few weeks time, 62% of the precipitation on cultivated fields was converted into run-off while only 0.5% of the precipitation from forest land was converted into run-off. Munns in a recent report\(^2\) calls attention to the 2½-day storm in southern California in January 1934 which yielded a 12-inch rain, causing a destructive flood in a stream from a denuded watershed while streams originating in heavily forested watersheds subjected to the same or greater precipitation yielded clear water and were not flooded. In southern Ohio pits dug just at the close of the January 1937 rains revealed a much drier soil at 2 to 3 feet below the surface than in the surface soil of cultivated fields, whereas forest soils at depths of from 3 to 5 feet contained as much or more water than the surface soils, suggesting strongly that the forest soils had contributed less to the flood waters than the cultivated soils.

These data as well as those in the next section demonstrate that forests materially reduce runoff and thereby produce beneficial effects in flood control. As suggested in the next section, the condition of the forest determines its effectiveness in controlling runoff and erosion. Furthermore, forests are not always equally effective; a deeply frozen surface soil, high water content of the soil, impervious
subsoils, etc. may minimize or to a large extent nullify the effect of forest cover.

Forests make an equally important contribution to flood control by reducing erosion to a minimum. Stream beds and reservoirs become smaller each year when large quantities of soil from eroding lands are dumped into them. Smaller stream beds will carry, and smaller reservoirs will hold, less water. Each year of erosion makes the situation more acute. Consequently stream beds must be either frequently dredged or levees must be built higher if the flood waters are to be kept from covering more land. Likewise, reservoirs must be cleared out or reconstructed if they are to hold back the amount of water that their builders intended they should. Since forests are so effective in controlling erosion, forests indirectly will lower the cost of maintaining engineering works.

By reducing run-offs forests greatly reduce water losses. They conserve water also by reducing evaporation of moisture from the soil. However forests remove large quantities of water from the soil through transpiration, the amount varying greatly with different tree species. The net effect of tree cover on water conservation on sloping land (such as characterizes much of Missouri) is beneficial because the water loss by transpiration would generally be less than the water loss by runoff from a similar piece of barren land. Of greater significance is the fact that the water from a forested watershed reaches the stream over a long period of time, thus making stream flow more uniform throughout the year than from a barren watershed.

Major Drainage Basins

Since forest land constitutes such a large percentage of the area of the State, an effective forestry program could be very helpful in solving the flood problem. Parts of four drainage basins, the Lower Missouri River, the Upper Mississippi River, the Arkansas and Red Rivers, and the Lower Mississippi River occur within the boundaries of the State.3

The Lower Missouri River basin is the largest, covering approximately 40% of the land area of the State. Because of difference in soil and vegetative cover, this basin logically falls into three regions, the northern region, the western prairie region, and the Ozark region. The northern region is characterized by glacial and loessal soils with a rolling to undulating surface, which are subject to considerable erosion when cultivated. Forests are confined chiefly to the stream bottoms and

ridges. The streams carry much silt; the Grand River, for example, with a drainage area 1.2% of the entire Missouri River is responsible for 5% of its silt load. 4

The prairie region south of the Missouri River is the smoothest portion of the State. This area is of minor influence on watershed protection.

![Map of Missouri showing major drainage basins](image)

**Fig. 6.—Major drainage basins of Missouri.**

The Ozark region is mostly covered with forest but its continuity is broken by cultivated land on the broad ridges, gentler slopes and in the bottoms. Records of the Mississippi River Flood Commission show that Ozark streams contribute heavily to the flood waters of the Mississippi River, the Missouri contributing 11 and 20% of the flood waters in 1915 and 1927, respectively. The Osage River, a major Ozark tributary of the Missouri River has at various times contributed from 20 to 73% of the Missouri River flood waters reaching Cairo, Illinois.

The part of the Upper Mississippi River drainage basin in Missouri is a region of rolling and broken topography. As noted elsewhere

some of the worst erosion in the State is in this section. This area must therefore contribute much silt to the Mississippi River.

The Lower Mississippi River basin, the smallest drainage in Missouri, occupies the southeast lowlands and a small part of the Ozark region. The hilly sections of the latter previously referred to, are of major watershed influence.

All of the area within the Arkansas and Red River drainages in Missouri is a part of the Ozark region. The White River, a tributary of the Arkansas that drains southern Missouri and northern Arkansas, although constituting only 2% of the total land area of the Mississippi Basin contributed 7.3% of the flood waters of the Lower Mississippi in the period 1911-27 inclusive. In 1927 estimates placed the silt load of this river at nearly 3 million tons or 11% of the total silt load of the Arkansas River. 5

Essentials of a Forestry Program As An Aid to Better Regulated Stream Flow and Flood Control

Reduction of the run-off from Missouri’s lands and the silt load of her streams is essential to a satisfactory solution of Missouri’s stream flow and flood control problem. This depends on correct management of all lands. This implies control of fire and grazing, restoration to full stocking, and conservative cutting on all timbered lands. It implies the transfer from agricultural to forest use of lands severely gullied by erosion or too steep to be held in place by other types of vegetation. Only by these means can forests make their maximum contribution to regulating stream flow and controlling floods.

STREAM FLOW AND FLOOD CONTROL—
AN ENGINEER’S VIEWPOINT

By H. C. Beckman

United States Geological Survey

The effect which forests have upon stream flow and in reducing or preventing floods is subject to rather wide differences of opinion. In general, it may be said that hydrologists and hydraulic engineers do not believe that forests are as effective in reducing flood run-off as is argued by some strong advocates of forests. These differences in opinion are due to the deficiency in basic information upon this subject, as it is difficult to find forested and unforested areas which are sufficiently similar in size, shape, topography, soil, temperature and rainfall to make a fair comparison.

The roots of trees penetrate deeply into the soil and make it more porous, thus increasing its capacity to absorb water from rains or melting snows. The accumulation of fallen leaves and branches upon the ground makes a bed of humus which can absorb a certain amount of water and which affords a mechanical check to soil erosion and the velocity of run-off. These conditions probably reduce the rate of run-off from ordinary rains, and they also reduce the erosion of soil and thus help keep the streams more clear.

Most hydraulic engineers believe, however, that in heavy rains of long duration both the soil and the forest litter upon the ground become so thoroughly saturated that absorption is decreased and any superiority of forest cover in retarding or reducing the surface run-off becomes comparatively immaterial. If this is true, it seems quite improbable that forests have any substantial effect in preventing or reducing floods from the major storms.

Forests also have little effect in reducing run-off from rains falling upon frozen ground, into which the water cannot percolate, and to the extent that they hold snow until thawing rains occur, their presence may increase flood run-off.

In the devastating floods in New England and the Middle Atlantic States in March 1936 and those in the Ohio River Basin in January, 1937, high rates of run-off occurred without apparent difference from both forested and unforested areas.

The highest known flood on the Mississippi River at St. Louis occurred in June, 1844, when practically the entire river basin was forested. Since the clearing of the forests that accompanied the settlement and development of the Mississippi River Basin, no flood equal to that of 1844 has occurred—in spite of the fact that since 1844 long stretches of the river in Illinois, Iowa, and Missouri have been leveed, thus preventing the storage of flood waters in the lowland areas and tending to increase the magnitude of the floods at St. Louis.

These examples do not show definitely that the forests may not have reduced somewhat the maximum rate of run-off from these areas, but they at least indicate that if any reduction was effected it was not sufficient to prevent floods of disastrous proportions.

All plants draw water from the soil and pass it into the air through their leaves, by the process known as transpiration. The roots of trees penetrate more deeply into the soil and ground water than those of smaller plants, and the surface area of the vast number of leaves on trees is much greater than that of smaller plants. It is therefore reasonable to assume that forests draw more heavily upon ground-water
supplies than do grass or farm crops, and that in doing so they reduce both the total flow of streams and the minimum flow during low-water periods, which is derived almost wholly from ground water. This assumption appears to be borne out by the moderate information available upon this subject.

From these facts, the following conclusions may be drawn in regard to the effect of forests upon stream flow and flood control:

1. Forests have a beneficial effect in preventing minor floods from ordinary rains and also in helping to keep the streams clear as a result of the reduction in soil erosion which they effect.

2. Forests probably have little effect in reducing run-off from rains falling upon frozen ground or in preventing or reducing floods from major storms—at least, any material reduction in these respects is not established through our present knowledge of the subject.

3. Forests probably reduce somewhat the total flow of streams and also the minimum flow during periods of low water.

CONTROL OF EROSION

By L. D. BAVER AND R. H. WESTVELD

University of Missouri

From the point of view of the present status of the erosion of Missouri soils in areas where the original as well as the existing vegetation was primarily forest, two distinct regions should be differentiated. The most important is the Ozark and border Ozark region where most of the existing timber occurs. The other is the rolling lands of north-eastern Missouri which originally were timbered but now are cultivated or covered by a mixed vegetation of scattered mediocre timber and poor grasses. The latter area includes primarily the Lindley loam and associated soil types.

Present Status of Erosion

Ozark and Border Ozark Region.—With the exception of the flat ridge tops in this area, all of the land was originally in forest. Most of the region is strongly rolling to hilly, with large tracts of very steep land occurring adjacent to the major streams. The extent of erosion is primarily related to the degree to which the land has been farmed, the method of handling the woodland areas, and the slope of the land. Erosion has been serious to severe on practically all soils that have been cultivated. Moderate erosion has taken place where the timber has not been completely removed.
Burning over the woodlands and pasturing the rather steep slopes with livestock have destroyed the protective surface covering and caused losses of surface soil within the timber. These bad management practices have been responsible more than any other causes for the present unproductiveness of these soils. Where the land has been cultivated about two-thirds of the original surface soil has been lost. Gullying has been moderate because of the stony nature of the soil. Probably slightly more than one-fourth of the surface soil has been lost where the amount of timber is over 40 to 50%. In other areas where the timber is more sparse, at least one-half of the surface has been eroded.

The Northeastern Missouri Region.—Some of the most severe erosion in the state occurs on Shelby and Lindley. Most of the 2,000,000 acres of land in the state that have lost over three-fourths of their original surface soil are located on these two soils in this region. The subsoil is exposed over large acreages. Originally the Lindley loam was timbered with white and other oaks. After the timber was cleared the land was planted to ordinary farm crops. The strongly rolling to hilly topography of the Lindley, together with its only slightly pervious subsoil favored rapid runoff and intensive erosion. At present, there are only a few townships where more than one-fifth of the farm land is in timber of any kind. Land which was depleted by cropping has been allowed to return to mediocre grass and white oak sprouts.

The large areas of Putnam soils in the eastern part of the area have a rather smooth topography and erosion, while severe, has not yet reached the critical stages found on the Lindley and Shelby areas.

The Effects of Forest Cover on the Physical Properties of Soils Affecting Erosion

The leaf litter on the forest floor has a pronounced effect upon the properties of the soil in two ways:

1. It maintains an open and sponge-like structure which permits rapid percolation of water through the soil.
2. It maintains a granular, crumb-like structure which holds the soil together against the cutting action of runoff water.

When a good leaf litter is maintained in a forest, the soil is made up of a network of numerous air passages of rather large size which permit the rapid entrance of water. These air passages are caused by the burrowing of worms and insects as well as the roots of the smaller underbrush. The rapid absorption and percolation of rainfall in such forests reduces run-off to a minimum. In addition to its effect on the preservation of large air channels, litter also acts as a shield to the descending rain drops and prevents the beating of the surface soil
into a soupy mass. If the surface soil becomes muddy or turbid, the water drainage pores are clogged by this fine mud and percolation is reduced. This does not happen under a good leaf litter.

A heavy leaf litter also prevents the freezing of the soil to great depths during cold weather. Since the soil is not frozen, percolation of water during the winter and early spring rains is made possible. All of these effects add up to a control of run-off. If run-off is controlled, erosion of the soil is not a problem.

If the leaf litter in a forest is destroyed by burning or over-grazing, there is a break down of soil structure which leads to decreased absorption of rainfall, increased run-off and soil losses.

There are considerable data showing the effect of forest cover on water absorption and run-off. Only a few of the more pertinent facts will be presented here. For example, J. T. Auten of the Central States Forest Experiment Station has studied the effect of burning and pasturing oak woods on the rate of water absorption in the Missouri and Arkansas Ozarks. He found that water soaked into virgin, oak woods 6.2 times faster than in the same type of oak woods that had been burned. The virgin woods absorbed water 6.7 times faster than open pasture land. W. C. Lowdermilk of the Soil Conservation Service studied the effect of burning forest plots on run-off and found that the burned woods lost about 41 1/2% of the annual rainfall as run-off, whereas, the undisturbed woods lost only a fraction of 1%. H. H. Bennett of the Soil Conservation Service reports that runoff on a forested slope in New York during 9.47 inches of rain was only 0.5% on a 27% slope, whereas the runoff from a 14% slope in a cultivated crop of potatoes was 88%.

Raphael Zon of the Lake States Forest Experiment Station quotes data from run-off and erosion measurements from ungrazed and grazed woodland at the LaCrosse Soil Conservation Experiment Station, showing that during the rains of the summer of 1935, some of which were of the greatest intensities ever recorded in Wisconsin, the ungrazed woodland only lost 0.15% of the rainfall as run-off, whereas the grazed woodland lost 9%. This difference in run-off represents a flood stage of 10 days duration in a drainage area of 1300 square miles. Erosion from the grazed area amounted to 8 tons of soil per acre; that from the ungrazed area was only 17 pounds per acre.

Granulation studies on virgin and cultivated forest soils show that the virgin soil is from 50 to 100% more granular or crumb-like than the cultivated soil. This is quite important from the standpoint of maintaining a favorable soil structure by the growth of trees. These studies indicate the possibilities of run-off and erosion control on the
rolling to hilly forest lands in Missouri. They point out the causes of the present status of soil depletion on land that should be productive timber. Inasmuch as many of the streams within these areas are excellent fishing streams, with exceptional recreational possibilities, it is essential that flooding and silting be minimized through the development and protection of a forest cover on the steep slopes of the region.

Forestry Measures to Combat Soil Erosion

Removal of the causes of soil erosion, described in the preceding paragraphs, is the solution of the erosion problem. This involves proper land use, and as far as forest land is concerned this means good forest management practices. Fire and grazing must be controlled on all timberland to allow organic matter to accumulate, and to permit ground vegetation to become established. Heavier forest cover must be developed either by tree planting or by natural re-vegetation, where practical, on areas where the existing forest cover is thin. Maintenance of a well-stocked timber stand by conservative cutting is essential where the forest cover is now adequate. Further land clearing should be discouraged. Volunteer forest growth, usually of an undesirable character, coming in or already established on inferior pasture-land or abandoned crop land should not be destroyed. It is bringing about natural control of erosion. Eventually the value of this land for timber production can be increased by interplanting with more valuable species. When tree growth persists in establishing itself under continued grazing in parts of a pasture where the soil is thin or infertile, as it often does, the indications are strong that trees should be the vegetative cover on this land, not grass.

The restoration of forest cover on cleared land too poor for agriculture and on slopes so steep that grass cannot effectively hold the soil in place is essential to a successful program of soil erosion control. Trees alone, or trees and check dams where active gully erosion is serious, have proven their merit in the control of soil erosion. Stabilization of soil is ordinarily effective in two or three years after planting. Black locust has proven particularly effective. It quickly develops an extensive root system thereby soon holding the soil in place. Furthermore, by increasing the nitrogen content of the soil, it encourages the establishment of grasses and other plants thus increasing the vegetative cover, and thereby the effectiveness of stabilization. Shortleaf pine, although slower in its effect, has proven highly satisfactory for the rehabilitation of eroded soil. Cottonwood, river birch, and various willows have been effective along banks of streams and in other wet situations subject to soil erosion.
GAME AND FISH HABITATS

By Rudolf Bennitt and Werner O. Nagel

University of Missouri

Missouri contains a greater variety of game habitats than any of the eight states that adjoin it. On the glaciated lands of the north, the great plains of the west, and in the Ozarks and Mississippi Lowlands of the south and southeast, Missouri supports types of wildlife similar to those of all the adjoining states. Among these, only Arkansas has as many species that can legally be hunted, and this is because Arkansas has brief open seasons on prairie chicken, pheasant, and beaver, which are present but protected in Missouri. Counting rabbits, squirrels, and foxes as one each, and eliminating migratory waterfowl, the resident species are as follows:

<table>
<thead>
<tr>
<th>State</th>
<th>Resident Species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Game</td>
</tr>
<tr>
<td>Arkansas</td>
<td>11</td>
</tr>
<tr>
<td>Missouri</td>
<td>8</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>6</td>
</tr>
<tr>
<td>Kentucky</td>
<td>6</td>
</tr>
<tr>
<td>Illinois</td>
<td>6</td>
</tr>
<tr>
<td>Kansas</td>
<td>4</td>
</tr>
<tr>
<td>Tennessee</td>
<td>3</td>
</tr>
<tr>
<td>Nebraska</td>
<td>3</td>
</tr>
<tr>
<td>Iowa</td>
<td>3</td>
</tr>
</tbody>
</table>

The following species, usually regarded as game, are native to Missouri woodlands and were originally present in all parts of the state:

- **Rare or vanishing:** Ruffed grouse, beaver, otter (ruffed grouse and beaver are now protected).
- **Present in small numbers, generally decreasing:** Wild turkey, deer, raccoon, mink, weasel, gray fox.
- **Abundant and maintaining their numbers:** Opossum, skunk, squirrels, red fox.

Except for the last four, there is now not a single species of forest game in Missouri that is one-tenth as abundant as it was 75 years ago. On the other hand, the numbers of every one could be increased at least fivefold (in most cases much more) by sound management.

Fully as important as the birds and mammals are the fish that inhabit the streams flowing from or through Missouri woodlands. While the tendency in the country at large is to place increasing reliance upon fish production in hatcheries, it must be remembered that no hatchery system can alone produce a satisfactory annual catch.
in a state as populous as Missouri. The restoration of Missouri fish, like that of birds and mammals, must in the end depend upon natural production in restored habitats. This means that the whole problem is basically one of proper land and water utilization; and it is evident that everything done to control erosion and to improve lands and streams, whether in the forests or not, is of the utmost value to forest wildlife of all kinds. Improvement of habitat is the foundation of game and fish management, which is just as necessary as the management of any other natural resource.

Of the 44 million acres in Missouri, about half are now devoted to uses that make present or future wildlife management unlikely or impossible. Yet the improvement of even these lands must have a profound effect upon the streams; and there still remain some 20 million acres of land which can in the future be managed for the production of wildlife food and cover without interfering with other necessary land-uses. Four-fifths of this is woodland, about half of which is on the farms, half in wild forest cover.

The U. S. Forest Service now owns and administers over a million acres of woodland and directly influences the use of a great deal more. However, since most of the other 15 million acres of woodland will in the future be administered by private agencies, the problem of forest game and fish restoration becomes one for the general public and not for the state and federal governments alone.

The two principal causes of the great depletion of game and fish have been: (1) Reduction in amount of suitable range; most of this has been an unavoidable part of the agricultural and industrial development of the state, but some has been due to the ill-advised clearing and drainage of lands not fit for successful agriculture. (2) Reduction in the quality of the range, through fire, lumbering without reforestation, overgrazing, too-clean farming, and other practices, followed by excessive erosion and a run-off that has washed away the topsoil and filled the streams. A third important cause of the decline of some species (notably deer and turkey) has been the large amount of illegal killing that still prevails, a situation that can only be improved by better economic conditions, education, and more effective enforcement of the laws.

Game and fish can be permanently restored to Missouri in usable numbers only by restoring productive conditions on the lands and in the waters. Restocking from hatcheries and game farms, further restriction of hunting, predator "control," and similar activities can have no lasting effect as long as food and cover remain deficient, be-
PLATE IV.—Streams adequately shaded and protected from silting by a heavy forest cover are ideal fish habitats, and their beauty is an outstanding attraction to the recreationist. (Photo by courtesy U. S. Forest Service.)
cause it is mainly food and cover that determine the "carrying capacity" of the land and the stream for the wild species that inhabit them. If any proof of this statement were needed, it could be found in the experience of Missouri for the past thirty years, during which restocking, hunting, and fishing restrictions, and the slaughter of predators have been the three points in the wildlife program. The steady decline of wildlife during that period indicated clearly that these are not the fundamental needs of a restoration program.

Under proper management, which involves no basic measures conflicting with the management of woodlands for other purposes, most forest game species can be restored to usable numbers many times greater than are now present. The following figures are based on a survey of the resident game and furbearers of Missouri, conducted by the writers in 1934-1935 and published in 1937 by the University of Missouri:

**Table 5.—Potential Game Production in Missouri.**

<table>
<thead>
<tr>
<th>Specie</th>
<th>Estimated Population in Missouri, 100 Years Ago</th>
<th>Spring Breeding Population, 1935</th>
<th>Conservative Estimate of Possible Restoration in Missouri under Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deer</td>
<td>700,000</td>
<td>1,800</td>
<td>85,000</td>
</tr>
<tr>
<td>Wild turkey</td>
<td>250,000</td>
<td>2,500</td>
<td>50,000</td>
</tr>
<tr>
<td>Ruffed grouse</td>
<td>400,000</td>
<td>100</td>
<td>98,000</td>
</tr>
<tr>
<td>Raccoon</td>
<td>?</td>
<td>19,000</td>
<td>133,000</td>
</tr>
<tr>
<td>Otter</td>
<td>1,700</td>
<td>70</td>
<td>1,100</td>
</tr>
</tbody>
</table>

These figures represent only suggestions as to what is possible in Missouri. Judging from the experience of some other states, much heavier populations may in the future be produced here. The population density will not of course be the same in all Missouri woodlands, for environmental conditions vary greatly, but the average figures for the state are based on results obtained under management elsewhere in this country in recent years.

To illustrate in another way what can be produced on well-managed forest lands, let us refer to a state less than two-thirds as large as Missouri, with a much larger human population and greater industrial development, by comparing the 1935 legal kill of several forest species in Missouri and Pennsylvania:

**Table 6.—Comparison of 1935 Kill, Missouri and Pennsylvania.**

<table>
<thead>
<tr>
<th>Specie</th>
<th>Missouri</th>
<th>Pennsylvania</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deer</td>
<td>103</td>
<td>70,470</td>
</tr>
<tr>
<td>Wild turkey</td>
<td>500*</td>
<td>4,498</td>
</tr>
<tr>
<td>Ruffed grouse</td>
<td>0</td>
<td>190,955</td>
</tr>
<tr>
<td>Raccoon</td>
<td>25,000</td>
<td>33,579</td>
</tr>
<tr>
<td>Bear</td>
<td>0</td>
<td>402</td>
</tr>
</tbody>
</table>

*Game and Fish Department estimate.
Great increases in the carrying capacity of forest lands do not come in a year or in ten years, for land restoration is a slow process. Yet thirty years ago Pennsylvania forests were not in much better shape than Missouri forests are today, and if the present forest improvement program in Missouri is continued for the next twenty or thirty years, we may expect to increase our supply of forest game and fish very greatly in that period.

Along with this there must be a workable set of game laws, properly enforced. There must be scientific research, without which the utilization of any natural resource becomes a haphazard business. Most of all, there must be a growing public understanding of the idea of management for future use. This applies not only to game and fish, but also to songbirds, forests, wildflowers, soil, streams, and everything that goes with them. It applies not only to Missouri forests and the streams that flow through them, but also to prairies, the farmlands, and their water-courses. In the last analysis it is impossible to separate the welfare of Missouri’s forest wildlife from the restoration of all lands and waters, and wildlife restoration should be only one of many motives for working toward this common goal.

RECREATION

By Members of Staff
Missouri State Planning Board

Forest areas afford much opportunity for public recreation of the types related to the enjoyment of natural scenery. Where proper provision is made, recreational activities can be conducted without serious injury to or interference with the forestry program. In recent years the National Forest Service has made provision for extensive recreational opportunities within the national forests. In 1932 more than 30,000,000 persons took advantage of this opportunity. It is reasonable to suppose that public recreational use of the national forests will increase because of greater leisure time, more good roads and cheaper transportation.

Forest areas have many of the characteristics of national or state parks. Specific types of areas that may provide recreational use are described in the National Plan for American Forestry1 as follows:

Superlative areas—Those with unique scenic values so surpassing and stupendous in their beauty as to be of unusual interest and inspiration.

Primitive areas—Tracts of old growth timber in which human activities have never upset the normal processes of nature.

Wilderness areas—Those without permanent inhabitants or means of mechanical conveyance, and of sufficient size to permit a week or two of travel without crossing one's own tracks.

Roadside areas—Timbered strips adjoining important roads.

Residence areas—Those set aside for private homes, hotels, etc. (Often leased to private individuals on long term leases.)

Campsite areas—Those set aside for campers, etc.

Outing areas—Those not seriously impaired scenically, on which one can get away from the sounds of the highway.

Within the National Forest areas it is estimated that the total extent of land "which will probably be needed primarily for forest recreation, including 11,000,000 acres already withdrawn from timber use, is:

Superlative areas ....................... 3,000,000 acres
Primeval areas ......................... 9,500,000 acres
Wilderness areas ....................... 10,000,000 acres
Roadside areas ......................... 4,000,000 acres
Campsite areas ......................... 1,500,000 acres
Residence areas ....................... 6,000,000 acres
Outing areas ........................... 11,000,000 acres
Total .................................. 45,000,000 acres

Recreation in the National Forests of Missouri

Of the 43,985,280 acres of land in the State of Missouri it is estimated that 7,500,000 acres are soils definitely submarginal for crop production and an additional 8,000,000 acres are thought to be better suited to forestry than to agriculture. A great majority of this land is found south of the Missouri River where the present program of the National Forest Service contemplates Federal ownership by the state or by the counties, or both, for forestry purposes. Within these forest areas, ample provision should be made for recreational facilities. There are many reasons which justify such use. They are within easy reach of such large population centers as St. Louis, Kansas City, and Memphis and would be accessible to a large additional population from smaller communities. The Ozark area has unusual charm. It is
PLATE V.—Picnic facilities in the woods are attracting more people to the forest each year. This is an important recreational use of forest land. (Photo, Montauk State Park, Dent County, Missouri.)
uniformly one of the most interesting scenic areas in the United States. It is a logical recreation center for a large percentage of the population of the Middle West and of the South. In addition to exceptional possibilities for the development of fish and game, it offers innumerable opportunities for the development of several of the types of recreational areas described in the National Plan for American Forestry above referred to, and more particularly the campsite areas and outing areas.

Since the National Forests in Missouri will be larger in size than either state or county forest units, it is believed that an unusually high percentage of these areas should be set aside for recreational purposes since within these National Forest units will probably be found a majority of the areas of greatest scenic charm.

Relation to State Park and Forests and Recreation Plan

Approximately 83,742 acres of land have been acquired for state park and forest purposes in Missouri. While the great majority of this acreage in state lands is found in the Ozark area of southern Missouri, it comprises a relatively small fraction of the land which is unsuited for agricultural use. It is doubtful if the park system can be greatly enlarged. It would be far better for the vast majority of the submarginal lands to be acquired for forestry purposes because of its suitability for such use and because of the ultimate economic advantage.

Within the state parks are found many beautiful springs, excellent fishing streams and splendid campsites. Generally speaking, the park areas, present and future, will be more intensively used. Viewed from the standpoint of the total recreational demands to be met, however, it would appear that both the national and the state and local forest areas must play a very large part. The function of the several forest areas and parks and the provisions which should be made in each are as yet undetermined. Such determinations will presumably be made during the current year through the state recreational surveys now being conducted under the auspices of the Missouri State Planning Board and the National Park Service. At this early stage of the development of the comprehensive forestry program it is quite appropriate that a state-wide recreational survey should be undertaken to determine needs and to determine which facilities should be provided for in the various types of public areas in order that there may be a maximum of coordination.

Since the forestry program, national, state, and local probably will not contemplate removal of population, although there may be some readjustment in location, it should be borne in mind that the unusual
recreational advantages of the Ozark region have a potential economic value perhaps equal to that of the forestry program. Thus, a wise coordination of forestry and of public recreation can be combined to promote the welfare of the state as well as greatly to improve the social and economic well being of the people.

ECONOMIC AND SOCIAL OBJECTIVES

CONRAD H. HAMMAR, University of Missouri
E. A. MAYES, Resettlement Administration

The first and really great economic objective of forest restoration in Missouri is to place in productive use some 15½ million acres of land that is at present essentially non-productive. The great bulk of these lands lie in the eastern portion of the Ozarks, though a considerable acreage is found elsewhere as well. As indicated in the opening section of this report there is a large and contiguous group of townships in these Ozark counties where 60% of the land is not included in farm ownership.

These lands which once had upon them a fine stand of oak, pine, and hickory, have for the last quarter of a century or more, grown only a small fraction of the timber that they could produce. They are used for grazing, but their production of grass is small. They have been so persistently burned over that the trees upon them have either been destroyed or have been fire-scarred until they are seriously defective.

While the primary objective of forest restoration is to bring into productive use these unused lands, there are a number of secondary objectives. Since the decline of the forest industry in Missouri, which began about 1900, the Ozark area, in which the bulk of these lands lie, has not been prosperous. With the disappearance of forest industries, farmers of the region lost their nearby market for hay and other farm products and much of their opportunity for profitable winter employment. Their incomes suffered and even in 1929 the bulk of them had a gross return of less than six hundred dollars each from their farms.

During the depression large numbers of families in these counties were upon public relief of one kind or another. Had it not been for the expenditures made in connection with recently established Federal Forest Purchase Units the direct relief would have been still larger. As it was, more than twenty per cent of the rural families in these counties were at times on relief.

One of the secondary objectives, then, and from many viewpoints a primary objective, is to enable these Ozark people to become more
nearly self-supporting. The extent to which governmental advances have been made since the relief program began is indicated by $11,236,603 spent for relief activities by Federal, state, and local agencies for the years 1932 to 1936 inclusive in 34 rural Ozark counties. It is just these counties in which forest restoration is most needed and will accomplish most good.

Fig. 7.—Number of persons per 100 population on Relief (Local, state and Federal) in Missouri in 1935. Data from 1935 report of Missouri Relief Commission.

But if the incomes of the people have been low, so have those of government in these same counties. For the 5-year period 1930 to 1934, inclusive local units of government in Atchison County (in a rich, agricultural section of the state), including the county itself, road districts and school districts, etc., spent approximately $25 per capita in providing governmental services. In Shannon County, representative of the Ozarks and the areas most in need of forest restoration, the expenditures of the government were only $8.41 per capita, or only about one-third as much as in Atchison.

School children appear to be the worst victims from this lack of money for governmental services including education. In a recent study by the Department of Agricultural Economics of the College of Agriculture, it was found that in two of the poorer forested counties,
Shannon and Carter, teachers' salaries were lower, teachers had poorer training, children dropped out of school at an earlier age, and illiteracy was much greater among the persons ten years of age and over than in the more wealthy counties to the north and west. Even the great program of state aid for schools had been unable to "iron out" the great differences in opportunities for education that exist between the Ozark and the more wealthy counties of the state.

There are, therefore, a number of economic and social objectives of forest restoration in Missouri. First is the great obligation to plant and protect trees upon 15,500,000 acres of land now producing very little of anything. Second is the need to restore to the people a chance to become more nearly self-supporting and to reduce the present great burden of relief that is centered in these counties. In many states with similar lands, timber growing and recreation together have proven much more profitable than farming upon rough, stony lands. Third is the need to improve the local institutions of government and education by increasing per capita taxable wealth and thereby the public revenue to be obtained from lands that have been reforested.
III. Prospective Contributions of Forest Restoration to Wealth and Income.

WEALTH AND INCOME FROM TIMBER PRODUCTION

CONRAD H. HAMMAR AND R. H. WESTVELD

University of Missouri

Trees must be started about fifty years before the harvest and Missouri has no choice but to begin her forest restoration program with the knowledge that for many years costs will be far greater than income. This long period between the seed time and the harvest has the additional grave disadvantage that it makes so difficult the forecasting outcome. Prices may change greatly over a period of as much as fifty years and the consumption of lumber and other timber products may change quite as greatly. There is some comfort, however, in the fact as noted in the chart below that the course of prices of lumber products has been upward far more rapidly than the prices of products generally. And there is further comfort in the fact that while other products have been in recent decades displacing wood rather rapidly, they have done so when the prices of wood products have been relatively high so that cheaper prices for wood may uncover a whole host of new uses. Furth-

![Chart showing price index of lumber products and all commodities from 1890 to 1930.](chart.png)

**Fig. 8.**—Since 1890 prices of lumber products have risen very much more rapidly than prices of commodities generally.
ermore, even during the period when cement, structural steel, and brick have been increasingly substituted for wood, great new uses for wood have also been found. The rise of the consumption of wood pulp for the manufacture of paper has, for instance, been a remarkable feature of this character.

Forest Restoration and Income

Even upon a very conservative basis it is possible to forecast that forest restoration will have a very great effect upon both wealth and income in Missouri. The forecast was made, for instance, in a previous section of this report that upon some 12,500,000 acres of land managed with reasonable intensity for forest production the annual production of timber products will be 2,187,500,000 board feet per annum. This outcome will, of course, occur only after a long period of restoration and may not be realized fully for a half century or more. Upon these same lands the growth at present is estimated at 312,500,000 board feet per annum so that the net increase in production after forests have been fully restored will be 1,875,000,000 board feet per annum.

A conservative price for this production under present circumstances would be $7.50 per thousand board feet on the stump. Many would think this too conservative a figure and it is quite possible that $10.00 or even $15.00 per thousand would be more nearly accurate. Accepting this conservative figure, however, the value to the state of the annual total production of 2,187,500,000 board feet per annum would be $16,400,000 per year while the annual income to be derived from the increase in production, that is, the 1,875,000,000 board feet will be approximately $14,000,000 per annum.

Perhaps it is worthwhile also to call attention to the fact that this added income of $14,000,000 is based upon the production of 12,500,000 acres of forest land in the state. In actual fact, there are in Missouri from three to three and one-half million more acres of land in tree cover; the total forested or tree covered acreage in the state being somewhat more than 15,500,000 acres. The 12,500,000 acres was chosen because it unquestionably represents more accurately the acreage that will ultimately be brought under some form of forest management. Yet quite surely the additional three or three and one-half million acres could also be made to add its grist of additional timber even if it is included in farm woodlands, wild life areas, or for protection of critical water sheds, in all of which situations timber production may be secondary rather than primary in importance.

This $14,000,000 of added income is, however, only a start. It is the income that will be derived directly from the forests themselves.
There will be, of course, much additional income to be gained from the fabricating of this huge volume of timber products. Saw mills will need to be restored again. There may be place for pulp mills. There will be ample raw material for furniture factories, stave mills, handle mills, veneer mills, and all sorts of other finishing plants. To estimate the board foot value of these finished products when there are so many of them, is an extremely hazardous matter. It seems very conservative, however, to estimate them upon the basis of $25.00 per thousand. If this $25.00 per thousand is approximately correct the total income to be obtained from this added volume of timber production, that is, the 1,875,000,000 board feet, will be approximately $46,000,000 annually.

Even this would be by no means all of the added income since there would be created much traffic for railroads that now have little or none and for trucking companies that would be needed to supplement the railroads. There would be a market for part of the vast quantities of electrical power that may be so readily developed in the Ozark upland and for which only the shadow of a market exists at present. It has been estimated, for instance, that the total production of more than 2,000,000,000 board feet per annum would justify the reestablishment in the region of from a half dozen to a dozen large saw mills, all of which would use a great amount of power. These would be in addition to a large number of small portable sawmills. In 1899 there were in the state, 1,169 sawmills of all kinds, some of them very large. In 1925 the total number was only 313, all of them small.

As pointed out in a previous section, also, the restoration of the forests would have the effect of stimulating the development of recreational resources of Missouri and this, too, would be a source of additional income. And finally, farmers in the Ozark region, particularly, would enjoy that market for locally produced farm products that was once so important a factor in their obtaining a livelihood and which disappeared when the virgin forests were cut off.

The prospective contribution of forest restoration to income in Missouri may be illustrated in a somewhat different manner by estimating the number of people to which the fully restored forests would give employment. Foresters have estimated that by and large forest land of the quality that Missouri possesses will support in both the forestry and manufacturing ends of timber production approximately one person per 250 acres of forested land. As stated above, of the 2,187,000,000 board feet of total production after forest restoration, essentially 1,875,000,000 board feet will be added production. The acreage needed to produce this added volume will be about 10,700,000
acres which, upon the basis of 250 acres per man, will provide work for 42,850 additional workers. Counting these workers as heads of families in which there were four persons altogether, the total additional population supported by forestry and wood manufacturing industries would be more than 170,000.

Since this work would be provided in the very counties in which relief during the depression has been greatest and in which the level of per capita wealth is at present painfully low, this feature of the restoration of the forests in Missouri is a most acceptable one.

Forest Restoration and Wealth in Missouri

There are two ways rather than one of estimating the wealth that may be brought to Missouri by the restoration of her forests. The first method is to compare the assessed valuation of the forested counties during the period when the virgin timber stands were being harvested with their assessed values at present. While much of the virgin timber had been harvested by 1890 one can obtain a fair idea of the value of these forests to the Ozark counties by noting their assessed valuations during the 1891 to 1895 period.

It may be presumed, for instance, that the taxable wealth of the Ozarks was a larger percentage of the total assessed valuation in the state during the period when these forests still remained than it was later after the forests were cut off. In the table below, for instance, the assessed valuation of unplatted lands in five of the most heavily forested counties of the Ozarks are compared with the total assessed valuation of lands of the State as a whole for the 5-year periods extending from 1891 to 1895 and 1931 to 1935. While the assessed valuation of lands in these Ozark counties constituted in the early (1891-1895) period 2.11% of the total assessed valuation of lands in the State, they constituted only 1.4% in 1931-1935. The return of forests will serve to value if a large share of the lands are moved into public ownership as
is contemplated. However, the contribution of forest restoration to wealth generally will be the same whether it is in private or public hands.

In the map below an estimate of the percentage increase in assessed valuation of land in Missouri counties after the full restoration of forests is given. The percentages are based upon the presumption that restoration would bring the assessed valuations of lands in these Ozark

...Figure 9—Percentage increase in assessed valuation of unplatted lands if forests were restored to a high level of productiveness in Missouri.

...and a few north Missouri counties back essentially to the point at which they were in 1891 to 1895 in relation to the assessed valuation of lands for the state as a whole. In one county, Reynolds, assessed valuations of land would be increased by 136%. In ten counties in the Ozark region the increase in assessed valuation of lands would be, upon this basis, 75% or more.

Because prices and the value of the dollar are so changeable it is difficult to translate these percentage figures into the increase in assessed valuation of lands in terms of dollars, but upon the basis of the levels of assessed valuation from 1930 to 1934, it appears that Missouri would gain approximately $75,000,000 of assessed valuation by the complete restoration of its forests. This figure is obtained by increasing present day assessed valuations of lands to such a figure that they would
have the same relation to the total valuation of lands today that they
had in 1891-1895. Between $65,000,000 and $70,000,000 of the total
would be gained in Ozark and Ozark border counties. This latter fact is
important because it is in these very counties that the per capita
assessed valuation or taxable wealth is the lowest for the state and where
the most critical problems of local government occur.

The increase in assessed valuation of reforested lands of $75,000,-
000, important as it is, would, of course, by no means be the whole of
the gain. One needs only to remember that to harvest approximately
two billion additional board feet of timber each year would not only
require great new industries but would give added value to railroads,
electrical utilities, and to towns, and even to farms. Also, if, as is hoped,
a considerable recreational development is stimulated by the forests,
this, too, will bring in added taxable wealth. Just what the grand total
of added wealth might be is too hazardous a matter to forecast at this
distance. Perhaps these industrial and supplementary aspects would
raise by 25 or 50% the value added by the restoration of forests upon
the land itself.

As a check upon these first estimates, the additional value added
to land may be calculated by an alternative method. If, on the full
restoration of forests the added production of timber is 1,875,000,000
board feet to be grown upon approximately 11,000,000 acres, the
wealth of the State will obviously be increased. The added production
per acre would be 150 board feet per year. Applying the stumpage
figure of $7.50 per thousand to this 150 board feet, the annual value of
the added crop would be $1.12. From this $1.12 must be subtracted
an amount for taxes and costs of development, estimated at about 40
cents per year, leaving a net income per acre of 72 cents per year. If
the rate of interest, or in more technical language, the capitalization
rate, is 5%, this 72 cents per year is the equivalent of a value of about
$14.40 per acre. Since interest rates have declined during much of the
twentieth century and are below rather than above 5% upon a con­
servative investment at present there is justification for accepting this
low capitalization figure.

At $14.40 an acre 11,000,000 acres are worth approximately $160,-
000,000. Assuming assessed valuations made at approximately 50%
of sales value, as they commonly are, this $160,000,000 would result
in an added assessed valuation of approximately $80,000,000, a figure
somewhat higher than the $75,000,000 arrived at in previous paragraphs
by the first method of calculation but not violently different never­
theless.
Between them these two results suggest, therefore, that the addition to wealth ultimately to be anticipated from the restoration of Missouri forests may indeed be very considerable; probably not less than $200,000,000, including the increases both for lands and new industries, and conceivably running above this figure. If even a much smaller figure, for instance only $150,000,000 constituting a very conservative estimate indeed, were to be forecast, the goal would appear to be one greatly worth striving for.

SUPPLEMENTARY INCOME AND WEALTH FROM RECREATION

Conrad H. Hammar
University of Missouri

Prospective increases in wealth and income from the development of recreation are so important that they deserve some special mention. Reforestation and other aspects of conservation, particularly of wildlife, go hand in hand with recreational development. The relationship appears quite as often to be historical as one of cause and effect. A state that is vigorously pushing a program of reforestation and restoration of wildlife is an interesting place in which to travel and spend a vacation. At any rate, conservation and recreational development are boon companions.

Missouri has both advantages and disadvantages from a recreational standpoint. Summer temperatures in Missouri are comparatively high. These high temperatures are not entirely a disadvantage for recreational development in the Ozarks, however. The Ozark upland stands well above the remainder of the state in altitude. While most of Missouri is well below a thousand feet above sea level much of the Ozark upland rises above 1500 feet and in spots to 1600, 1700, and rarely to 1800 feet. Furthermore, the rugged topography resulting from the mature geological dissection of the Ozark upland gives it unusually good air drainage.

While, therefore, Ozark summer temperatures are high in relation to those of the more northerly recreational areas bordering on Canada, they are appreciably below those of the surrounding lands of lower altitudes. A summer vacation in the Ozarks for people living in cities, on prairie lands surrounding this upland, and in lowland regions to the south, may, therefore, be a genuine treat and a real relief from oppressive temperatures. Particularly is this true for people living on lands to the immediate south and west of the Ozarks. The extraordinarily
rapid development of recreational facilities about Lake Taneycomo and the Lake of the Ozarks, both located in the western edges of the upland is evidence enough of the agreeableness of the change that a trip to the Ozark uplands affords in summer to people from the surrounding areas.

A measure of the rapidity of this recreational development about the Lake of the Ozarks is contained in the table below. In Camden County farm and village lands are of small importance and their declining assessed value (since 1932) does not therefore appreciably affect the increasing valuations that have resulted from resort and other recreational development that has been taking place.

<table>
<thead>
<tr>
<th>Year</th>
<th>Camden County</th>
<th>Missouri</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Valuation</td>
<td>%1932</td>
</tr>
<tr>
<td>1932</td>
<td>$5,188,270</td>
<td>100%</td>
</tr>
<tr>
<td>1933</td>
<td>5,833,294</td>
<td>112%</td>
</tr>
<tr>
<td>1934</td>
<td>6,655,597</td>
<td>128%</td>
</tr>
<tr>
<td>1935</td>
<td>6,511,612</td>
<td>128%</td>
</tr>
<tr>
<td>1936</td>
<td>6,633,988</td>
<td>128%</td>
</tr>
</tbody>
</table>

*Data from Reports of State Board of Equalization.

While the assessed value of property in the State as a whole had declined by 1936 to 86% of its 1932 level, values in Camden County in 1936 had mounted to 28% above their 1932 level. Bagnell Dam was finished in 1933 so that the 1932 figures represent the situation before, and the 1934 to 1936 figures, the situation after the creation of the Lake. The dam itself is not in Camden County and the valuation figures include no element of increased utilities value from this source. In other words, the increased valuations represent almost wholly recreational developments. Taking place as these have during a severe depression, the developments are a striking illustration of the drawing power of an Ozark area to vacationers and others.

Recreational development in Missouri is also reported to be at a disadvantage because of occasional annoyance by the chigger and wood tick, but neither of these insects produces any serious effects. Also the Ozarks are relatively free from mosquitos, both because of the almost total lack of stagnant water and because of the control exercised on such large bodies of still water as the Lake of the Ozarks.

With respect to water the situation is also varied. Of still water there is little as compared to the lake regions of Minnesota, Wisconsin, and Michigan. The Lake of the Ozarks and Lake Taneycomo, both artificial, have provided two large bodies of water, and if other potential
power sites are ultimately developed, eight added lakes with a surface area of approximately four times that of the Lake of the Ozarks will be created thus giving the region large areas of well distributed still water with hundreds of miles of shoreline. One of the proposed lakes (behind Table Rock Dam site on the White River) would be as large or larger than the Lake of the Ozarks.

With respect to its springs and caves, the Missouri Ozarks have a great advantage over the lake regions and its streams are about on a par with those of the northern recreation areas.

At present the Ozarks are, perhaps, not as attractive a hunting and fishing ground as are the lake regions. However, forest and wildlife conservation should do much to change the present disadvantage to a positive advantage. As noted in a previous section of this report, there are some startling possibilities in game and fish restoration in the Ozarks and in the State as a whole.

To what extent reforestation will contribute to the development of recreation is problematic, but it offers possibilities. Its effects may be listed as below:

1. Since tree-clad slopes are far more beautiful than those denuded and burned over it will greatly improve the scenery.

2. The fire control program that goes with reforestation will make recreational property such as lodges and cabins much safer from destruction than at present.

3. Stream flow should be more regular making both streams and springs more beautiful and the shorelines as building sites more valuable.

4. Protected tree growth will provide greater cover and more food for wildlife, and, because of its effect on stream flow, a superior habitat for fish.

5. A policy of grazing control, that is an integral part of the program, will also stimulate the return of a greater abundance of wildlife.

6. Forest road building programs will open wilderness areas of great scenic beauty now quite inaccessible.

7. Public acquisition of land for reforestation will insure the preservation of large areas for public enjoyment and prevent the confining of recreation that sometimes develops where private control by ownership is pushed too far.

To translate into terms of dollars and cents the wealth that recreational development can bring to Missouri is most difficult. Perhaps a brief review of what other states have found may be safest. In a num-
ber of states such as Colorado, California, Florida, and others, recreation has at one time or another been counted either the largest or one of the largest industries.

The expenditures of travelers in Minnesota and Michigan were estimated at $90,000,000 and $100,000,000 respectively, even in depression years and more recently estimates for Michigan have been set at $300,000,000.1 Wehrwein and Parsons2 estimated the tourist expenditures in Wisconsin for the years 1923 to 1929 as running about $140,000,000 annually.

The additions to wealth developing out of tourist and vacation traffic are equally important. A study of recreational uses of land in Connecticut, a small but densely populated state, includes the statement that in 1930, "The total assessed valuation of this recreational property reaches $202,277,288 of which 64.6% is in summer homes and lots; 33.3% in municipal and town parks; athletic fields, etc.; 0.8% in summer camps; 0.4% in state parks and forests; and 0.3% in hunting and fishing clubs."3

Wehrwein and Parsons in the study referred to above found that in certain forested counties of northern Wisconsin recreational property not only constituted a considerable percentage of the tax base but they also found that in an area where tax delinquency was very heavy recreational lands were "comparatively free from delinquency."4 They state, "Finally the relation of the recreational land owner to local governments is a peculiar one. Being summer residents only, their children attend the city schools; so while they are paying taxes to support the schools of northern Wisconsin, tourists make few demands upon them."5 Considering the critical state of the finances of local governments in the Ozarks (see Part V of this report) this statement is of great significance.

Forest restoration will add materially to the wealth and income of Missouri and so will the recreational development that is its logical accompaniment.

1. See also Hedrick's analysis of receipts from tourists in Michigan in Michigan Agricultural Experiment Station Special Bulletin, No. 287, "Recreational Use of Northern Michigan Cut-Over Lands."
3. See Storr's Agricultural Experiment Station Bulletin, No. 194, p. 36.
5. Ibid. p. 28.
IV. The Problem of Protection--Fire Control and Grazing Control.

FIRE CONTROL

Paul D. Kelleter and E. Murray Bruner
U. S. Forest Service

Everyone who has any appreciation at all of the various practical steps that must be taken in order successfully to produce successive crops of timber will readily admit that continuous protection of the forest area from fire is an absolutely necessary requirement. From the moment the mother tree drops the nut, acorn or tiny winged seed on the ground, or the young sprout springs up from the stump of the parent tree which has been cut, or from the time a tree is planted, the entire forest area must be protected from the ravages of fire if a valuable new crop of timber is to be grown.

The idea that forests are valuable only for growing timber is rapidly giving way to the much broader concept which embodies the idea of multiple use; that is, use of all the resources of the land and water. The present day forester thinks of himself as a manager of forest or wild land areas. When specifically assigned to the management of any such area he considers it his responsibility to protect, develop and wisely use every readily discernible and potential economic and social resource or value the area possesses. His first major job, therefore, is to make a painstaking inventory of the various actual and potential economic and social resources of the area. Upon the basis of this inventory, his next job is to formulate a land use plan which will evaluate as accurately as possible these various resources and outline for each a definite program of development properly correlated with respect to the various other development programs which go to make up the completed land use plan.

The Forest Fire Situation

Causes.—With very few exceptions all forest fires on woodland or timber lands within the state of Missouri are caused by man. The majority of these are set intentionally for various reasons. One of the main purposes of such fires is to clear the land for agriculture or grazing use or for some similar reasons. There is sometimes the desire to set fire to the woods for the purpose of destroying underbrush and other cover, although the destruction of this material does not benefit agriculture or grazing. Many fires are also started in order to dispose of piles of debris or like accumulations. These fires in themselves do no
particular harm but are often left unattended and permitted to escape to the surrounding forest. A small percentage of the forest fires classed as intentionally set must be considered of incendiary origin. These fires are set for no other reason or purpose than that of malicious destruction of property and are usually directed at some particular individual or agency administering certain forest areas.

A large percentage of the fires which occur in the woodlands of the State are of accidental nature and occur because of neglect or because of circumstances over which the responsible individuals have no control. Such fires may originate from steam engines, burning sawdust piles, chimneys of buildings, exhausts of tractors, unextinguished camp fires, discarded matches or cigarettes, and a host of other ways similar to those mentioned.

The available records indicate that considerably less than one per cent of the forest fires of the State originate from causes other than man. It has been recorded, however, that some fires have occurred in the past due to spontaneous combustion or from bolts of lightning. Obviously, very little can be done toward reducing the number of fires originating through these causes. On the other hand, the number of fires in this category is so insignificant that it affects the fire prevention problem very little, leaving ample room in the man-caused fire field to occupy the time of the interested individuals.

**Damage by Fire.**—The direct damage caused by fires in the forest is largely in the destruction of timber and the loss of property. Fires burn through the forest, killing outright, a large percentage of the trees which are of value for the production of forest products. In addition to the direct loss of timber, other property is often consumed at the same time. Buildings, rail fences, telephone poles and the like are the secondary victims of a spreading fire passing over the woodlands.

Of far-reaching importance are the indirect losses which are directly attributed to the forest fire. Some trees are not killed outright but the damage to them is such as to reduce or completely to eliminate any annual growth or increment that might have been attained should no fire have occurred. This loss each year is a tremendous one and cannot be overemphasized. It is particularly heavy in the trees of the younger age classes which are to contribute to or be the basis for forest restoration in the State. Fires are also detrimental to the recreational resources of the vicinity due to the fact that they destroy or impair the scenic value of the land through the destruction of vegetation and the curtailment of growth. They also cause a tremendous loss in the fish and game resources of the immediate area; game cover and nesting
grounds are destroyed. Many of the younger animals are killed outright and others are driven from the area. The ashes, debris and other resultant effects of fire are particularly detrimental to fish life in the streams which pass through areas being burned over. Another type of damage, particularly in areas where repeated fires are permitted to burn, is that done to watersheds. Fires reduce the waterholding capacity of the surface soil and thus permit more rapid runoff and thereby attribute directly to serious erosion problems. The control of runoff through watershed protection reduces the loss of the fertile top soil and mitigates the filling in of the storage ponds and reservoirs below. It also reduces the serious eroding away of the stream banks and river bottoms throughout the course of the lower drainage.

The tabulation given below represents the extent of fire damage on the Clark National Forest for the years 1934-'35-'36. These are the only years for which accurate statistics are available. The gross area represented by this forest is 1,971,818 acres.

### Table 9.—Number of Fires and Area Burned on the Clark National Forest During 1934, 1935 and 1936.

<table>
<thead>
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<th>10-Day Period</th>
<th>1934</th>
<th>1935</th>
<th>1936</th>
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<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Area</td>
<td>Number</td>
</tr>
<tr>
<td></td>
<td>Fires</td>
<td>Burned</td>
<td>Fires</td>
</tr>
<tr>
<td>Jan. 1 to 10</td>
<td>--</td>
<td>--</td>
<td>1</td>
</tr>
<tr>
<td>Jan. 11 to 20</td>
<td>2</td>
<td>30</td>
<td>5</td>
</tr>
<tr>
<td>Feb. 1 to 10</td>
<td>1</td>
<td>500</td>
<td>6</td>
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<tr>
<td>Feb. 11 to 20</td>
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<td>7,373</td>
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</tr>
<tr>
<td>Feb. 21 to 28</td>
<td>--</td>
<td>--</td>
<td>1</td>
</tr>
<tr>
<td>Mar. 1 to 10</td>
<td>1</td>
<td>941</td>
<td>80</td>
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<tr>
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<td>6</td>
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<tr>
<td>Apr. 11 to 20</td>
<td>23</td>
<td>1,187</td>
<td>14</td>
</tr>
<tr>
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<td>24</td>
<td>172</td>
<td>10</td>
</tr>
<tr>
<td>May 1 to 10</td>
<td>4</td>
<td>35</td>
<td>4</td>
</tr>
<tr>
<td>May 11 to 20</td>
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<td>110</td>
<td>2</td>
</tr>
<tr>
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</tr>
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<td>126</td>
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<td>289</td>
<td>4</td>
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<tr>
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<tr>
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<td>Aug. 11 to 20</td>
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<tr>
<td>Aug. 21 to 31</td>
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<td>1,182</td>
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<tr>
<td>Sept. 1 to 10</td>
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</tr>
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<td>Nov. 21 to 30</td>
<td>33</td>
<td>1,583</td>
<td>16</td>
</tr>
<tr>
<td>Dec. 1 to 10</td>
<td>12</td>
<td>723</td>
<td>6</td>
</tr>
<tr>
<td>Dec. 11 to 20</td>
<td>32</td>
<td>1,182</td>
<td>2</td>
</tr>
<tr>
<td>Dec. 21 to 31</td>
<td>18</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>
The Fire Protection Program

The definite protection program for the State of Missouri must be based upon the three accepted divisions for this activity; namely, fire prevention, presuppression and suppression.

Prevention.—The job of preventing forest fires is one which must rest directly upon every agency or individual having to do with the protection of tracts of forested land. The first step in this program is that of adequate education in conservation. Those concerned with the fire problem should utilize every opportunity to present to the schools of the state, by talks or otherwise, the message of fire prevention and control. This program should be put over on a plan-wise basis directed to reach the students of all grades from the more elementary classes up to the colleges and universities. The work with the schools should consist of talks, written material, and actual field trips. This information should be compiled or arranged in such a manner as definitely to reach the various aged groups involved. A concerted effort must also be made to reach that large group of individuals not to be found in the schools. This program must also be on a plan-wise basis utilizing all possible media. Public talks by platform and radio should be made. Well-edited pamphlets dealing with the subject in an interesting and instructive way should be compiled and widely distributed in the various groups to which this phase of the work is directed. Inspection and demonstration trips should be resorted to wherever and whenever such is possible. The proper parties should take upon themselves the responsibility of showing the people the results to be obtained through forest protection and the resultant elimination or reduction of fires in the woodlands.

Each agency or person responsible for the administration of any particular tract of forest land should put into effect a definite preconceived plan for forest demonstration areas. These areas should be devised for the purpose of definitely showing what can be done or is being done through the channels of good forest protection. It should be the responsibility of private timber owners who possess tracts of mature timber to bring out to the public the vast reservoir of actual employment that such a tract of timber embodies. If some such area as this would be placed upon sustained yield and thereby put in effect a perpetual operating forest business, the cause of forest restoration would be materially aided thereby. Such a demonstration would bring out something of the possibilities carried by good forest management work. The State and the Federal Government in their forest restoration program can sell the forest fire prevention principle in the same
manner by showing on areas set up for that purpose that fire prevention and employment go hand-in-hand. On the bulk of the land involved this program is naturally one of long time planning. Definite growth study areas will also be of material value in illustrating the financial gains to a community through the adequate protection of the forest. The results of such studies can be brought home to the people either through actual examination on the ground or by the publication of the facts derived from the study.

In a manner somewhat similar to that given above, the definite results to be obtained from watershed protection can be demonstrated. This would necessitate the adequate protection of definite areas and then correlating the run-off as shown by established stream gauges with the annual rainfall over certain areas. Such a study for the purpose of selling fire prevention to the public would be the responsibility of both the State and the Federal Government on any particular area or drainage where the land status is such as to permit such work.

Adequate law enforcement is also one of the steps needed to put over a successful fire prevention program. This activity carries with it the responsibility of not only apprehending fire law violators but in building up an active support of the fire laws in the minds of the local population.

Fire Presuppression.—Forest lands cannot be adequately protected from fires without resorting to definite presuppression planning for any forest area under consideration. All parties or agencies who are charged with the responsibility of protecting such lands whether they be private, state or federal, should initiate their program along these lines. Such plans should usually be of a written nature and take into consideration first of all the status and location of the lands to be protected. These lands should be subdivided into protection units and individual plans made for each unit. The plan should take into consideration the character, location, and availability of the labor supply. Prompt mobilization and the transportation facilities should be fully considered and lines of action determined beforehand. The specific technique of fire line construction should be fully thought out and varied in the plan according to the topography or ground cover to be encountered on the unit.

Presuppression must naturally be much broader than mere planning. It should take into consideration the necessity of needed improvement to be used in putting into effect the actual protection work. Some road construction will be necessary in most cases and these should be built to a standard adequate to serve the particular purpose.
PLATE VI.—Lookout towers are essential for effective forest fire protection. (Photo by courtesy U. S. Forest Service.)
In many cases, all that will be necessary will be the clearing out and making passable old woods roads or trails to the point where they will accommodate wagon or truck transportation. It is also necessary to connect key points or individuals with some kind of dependable communication. Telephone lines have proven the most successful under average conditions. Lookout towers or other forms of observation points are also essential. These should be constructed on radii sufficiently restricted to permit a good coverage of the area to be protected.

Falling under the presuppression work is also the matter of proper equipment and its location. The necessary fire fighting tools should be secured and placed at strategic points which are specifically designated in the prearranged plan for the area.

Forest Fire Suppression.—The actual suppression of fires should follow naturally when the presuppression plans are put into effect. This makes it all the more important that sufficient emphasis be placed on the planning and that the plans be given every opportunity to work smoothly and efficiently. The actual work of suppressing the fires which occur will naturally bring to light certain defects in the presuppression plan. Such defects should be recorded in the plan in such a way as to preclude their occurrence in the future. The keynote of the whole suppression system should be that of prompt action, efficiently conducted and carried through to the point where there is no question but that the fire is completely extinguished. Where it is necessary to return to the area to do the job a second time, the cost is thereby increased to the extent of making forest protection unduly expensive.

The problem of financing protection insofar as forest restoration is concerned is naturally a difficult one. During the stages of reestablishment direct expenditures are essential and at the same time the soil itself is returning but little in a financial way to defray such direct costs. In most cases the returns through receipt will aid but not completely cover the protection costs during the transition stage. The funds secured in this manner will of necessity have to be augmented by some system of taxation devised to yield the needed funds. A small direct assessment brought about by legislation is the most feasible and equitable system of securing this financing. Once the forest has been restored and is managed on a sustained yield basis, a portion of the revenue derived from the land can be diverted, through proper statutes, to the purpose of protecting the property. Protection is of primary importance in forest management and if adequate plans, and the finances for operating them, are not devised at the outset, forest restoration becomes a difficult if not impossible problem.
Analysis of District Costs

As a basis for determining equitable distribution to the states of federal funds for fire protection under the Clarke-McNary Law, the Forest Service has analyzed each state's needs. The latest revision of these data made in 1936 is the basis for the figures which follow.

For the purpose of analyzing the forest fire situation in Missouri, the State has been divided into six districts with total areas and forest land areas in state and private ownership as shown in Table 10 and Figure 10.

![Figure 10-Ozark Fire Protection Regions.](image)

### Table 10.—Fire Protection Districts in Missouri

<table>
<thead>
<tr>
<th>District</th>
<th>Number of Counties</th>
<th>Total Area Acres</th>
<th>Gross Area Acres</th>
<th>Reduced to Acres</th>
<th>Percentage of Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeastern</td>
<td>8</td>
<td>2,608,096</td>
<td>1,422,203</td>
<td>1,420,000</td>
<td>60.6%</td>
</tr>
<tr>
<td>North Central</td>
<td>9</td>
<td>2,896,800</td>
<td>1,700,803</td>
<td>1,700,000</td>
<td>58.7%</td>
</tr>
<tr>
<td>Northwestern</td>
<td>13</td>
<td>3,548,156</td>
<td>1,761,102</td>
<td>1,760,000</td>
<td>49.6%</td>
</tr>
<tr>
<td>Southwestern</td>
<td>12</td>
<td>3,906,080</td>
<td>2,174,698</td>
<td>2,170,000</td>
<td>55.5%</td>
</tr>
<tr>
<td>South Central</td>
<td>8</td>
<td>4,197,640</td>
<td>2,692,175</td>
<td>2,690,000</td>
<td>64.0%</td>
</tr>
<tr>
<td>Southeastern</td>
<td>9</td>
<td>2,721,312</td>
<td>1,578,439</td>
<td>1,570,000</td>
<td>57.7%</td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>19,877,084</td>
<td>11,329,420</td>
<td>11,310,000</td>
<td>56.0%</td>
</tr>
</tbody>
</table>
A survey in 1936 showed that only 100,000 acres or less than 0.9% of the 11,310,000 acres of state and privately owned forest land was being protected from fire. The results of this survey showed that the cost of giving adequate protection* to all state and privately-owned forest land would be $233,459.00. This cost is divided as follows between the different districts: Northeast, $31,036; North Central, $34,535; Northwestern, $35,963; Southwestern, $43,691; South Central, $54,998; Southeastern, $33,231.†

It is obvious from Figure 10 that protection districts have been outlined only for those parts of the State that need organized or systematic protection. In other sections of the State forest land is so scattered as to make fire protection an affair of the individual owner or of voluntary neighborhood effort.

Summary

Fire protection is a matter which must receive considerable emphasis if the program of forest restoration is to be successful. It cannot be done by one agency or group of individuals; every property owner must be reached directly. These owners should in turn realize the responsibility placed upon them and attack the problem on a plan-wise basis, doing first everything that is possible to prevent fires, and then following up with a fully developed plan which applies to specific areas so that the fires which actually occur can be handled most economically and with the least possible loss to the forest cover.

* Adequate protection is defined as a system of protection that will keep the annual burned area to 0.5% of the area protected.

† These cost figures were arrived at by determining the cost of the needed field personnel, improvements and equipment, and fire fighting for each district and adding to this the cost of centralized overhead administration in proportion to the size of the district. District costs include ½ district forester’s, field assistant’s and fire warden’s salaries and expenses, ⅔ stenographer’s salary, ⅔ fire tower observer’s wages, fire fighting at 0.5 cents per acre per year, 1 fire fighting outfit per 2500 acres, fire tower construction and maintenance, field quarters, telephone line construction and maintenance. Centralized overhead administrative costs include the following: ½ state forester’s salary and expenses, ⅔ of two assistant state forester’s salaries and expenses, ⅔ of the stenographer’s, clerk’s and janitor’s wages, ⅔ of the cost of printing office supplies, etc., ⅔ the cost of forestry exhibits and campaigns, and ⅔ the cost of four travelling picture truck projects.
Grazing Control
By R. R. Hill and Others¹
United States Forest Service

Nature of the Problem

Regulated grazing of forest land by domestic livestock has been practiced successfully in many sections of the United States, particularly in the West. In Missouri, woodlands have been used freely for grazing by cattle, sheep, goats and hogs without any attempt at control. This practice has led to rather general depreciation of the forage, and in some cases to damage to the soil and to trees, particularly those of reproduction size. Yet grazing use of forest land has economic implications which cannot be ignored since many livestock producers, particularly in the Ozarks, must find some forage on lands outside of their farms if they are to continue raising livestock, a product which forms a substantial part of the income of many Ozark farmers. Table 11 shows that an appreciable portion of the State’s livestock is in the forested counties of the Ozarks.

Table 11.—Cattle, Sheep and Swine Populations of Forested Counties in the State of Missouri (1935 Census).

<table>
<thead>
<tr>
<th>Area</th>
<th>Number of Counties</th>
<th>Per cent Number of Cattle</th>
<th>Per cent Number of Hogs</th>
<th>Per cent Number of Sheep</th>
<th>Per cent Land Area of State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Ozark</td>
<td>29</td>
<td>19.1</td>
<td>14.6</td>
<td>5.1</td>
<td>29.37</td>
</tr>
<tr>
<td>Border Ozark</td>
<td>12</td>
<td>9.1</td>
<td>6.5</td>
<td>12.6</td>
<td>10.14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>41</strong></td>
<td><strong>28.2</strong></td>
<td><strong>21.1</strong></td>
<td><strong>17.7</strong></td>
<td><strong>39.51</strong></td>
</tr>
</tbody>
</table>

The 41 Ozark and Ozark border counties have 28.2% of all cattle in Missouri, 17.7% of all sheep, and 21.1% of all hogs. Twelve of the 41 counties are Ozark border counties in which an appreciable share of the land is well suited to agriculture. For the remaining 29 counties, constituting 29.4% of the State’s land area, in which forestry will be the major consideration in future land use, there were in 1935 only 19.1% of the State’s cattle, 5.1% of the State’s sheep, and 14.6% of the State’s hogs. Thus, while the forest counties fail by a wide margin to have livestock numbers in proportion to their relative area, they are important sources of animal products in the State.

Annual incomes of Ozark farmers are low and are likely to be until they can be supplemented materially by work in the woods or timber utilization plants, an opportunity which will develop only gradually—not immediately. Since these people, for the most part do not have the

financial means to move to localities where they could make a better living, land use plans should attempt to sustain present incomes and to provide larger future incomes. Proper grazing use of forest land is a possible aid in the solution of this problem.

In this connection, the following quotation from a recent unpublished report resulting from a brief observational study of this problem is significant: "The objective in land use planning under conditions prevailing in the Ozarks should be to make the natural resources of the locality contribute as much as possible, on a conservative basis, toward the maintenance of the resident families. With this objective as a basis on land capable of supporting perennial, herbaceous and shrubby vegetation economically valuable for grazing purposes and adequate to conserve the soil, grazing use is legitimate. The extent to which such lands should be used for grazing should be based on the following factors: (1) the demand for grazing lands and the outlook for modifying that demand as a result of probable economic and social adjustment; (2) the cost of developing land for grazing purposes; (3) the value within the near future of tree crops growing on the land; (4) the extent to which grazing would interfere with the most desirable long range objectives with respect to the use of land; (5) the feasibility of using the land for purposes incompatible with grazing which would contribute more to the economic and social welfare of the dependent population."

In the final analysis the extent to which forest land should be used for grazing and the regulation methods that should be applied can be determined only after a considerable amount of research which considers all of the factors referred to in the foregoing paragraph.

Effects of Past Grazing Use

The effects of past use of woodland for grazing are different in the extensive woodlands independent of farms, chiefly in the Ozark region, than in the farm woodlands usually of small acreage and often used in conjunction with other pasture. Because of these differences, each class of woodland will be discussed separately.

Farm Woodland.—Grazing of any class of livestock in Missouri farm woodlands has caused extensive damage due to overstocking, a practice that is very difficult to control in a practical way. The forage crop in farm woodlands well stocked with trees is so sparse that 10 to 20 acres would be required to carry a steer through the summer, and correspondingly less area for sheep or goats. In spite of this fact large numbers of livestock have, in the past, been turned into small woodland areas and in consequence the types of damage to be described have followed. Rarely is it financially sound or practical to regulate grazing
in productive farm woodlands. Studies in Indiana woodlands under conditions similar to those in Missouri have shown that a steer allotted six acres of woodland for a six months' grazing season weighed no more after six months' grazing than at the beginning of the experiment.  

Other studies in Indiana under similar conditions demonstrated the following forms of damage to the farm woodland by grazing: (1) almost complete destruction of tree seedlings, (2) increase of undesirable tree species, (3) less frequent seed crop on the forest trees, (4) destruction of litter and humus, (5) exposure and injury of tree roots, and (6) decreased growth of tree seedlings. If continued long enough, these forms of damage result in the gradual elimination of the farm woodlands. Extended observations in Missouri indicate that the effects of the grazing of farm woodlands by cattle are essentially the same as in Indiana. Grazing of the same intensity by sheep, goats, or hogs is even more damaging.  

Extensive Woodland Areas.—Damage to the soil, forest and forage by grazing in extensive unfenced forest areas like those of the Ozark region has occurred but is not particularly noticeable to the casual observer. Probably the most serious damage has been done to the forage which has deteriorated in amount and quality.  

In the mature virgin hardwood stands early settlers reported a thrifty growth of tall perennial grasses. Subsequently logging followed by fires and long continued grazing have so modified the physical conditions that relatively little palatable forage occurs now on the forested lands. Old openings commonly support considerable native herbaceous cover rather low in palatability. On more favorable sites introduced species such as blue grasses, timothy, clover, lespedeza, etc. afford some good grazing. But on the whole in the woodland type the forage is in the marginal or submarginal class from the standpoint of economical grazing. The exclusion of fires from this type over a period of years will not result immediately in an increase in forage production. But as the crown canopy opens up as the younger trees approach maturity some increase in forage density should occur. The experience of farmers in the Ozarks indicates quite conclusively that in order to develop and maintain a stand of vegetation suitable in quality and adequate in quantity to provide economical grazing and at the same time protect the soil against erosion, it is necessary to maintain an open type as far as timber is concerned and maintain the most

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favorable soil conditions possible. This means in practice the clearing of most trees and the exclusion of fires. It may mean, too, fertilizing the soil to a limited degree. Extensive reseeding with the better pasture grasses and legumes is distinctly needed.

**Factors Responsible for Grazing Damage to Forest Land.**—Such factors as unsuitable class of livestock, too many animals, poor distribution of stock and improper seasonal use are commonly held responsible for the grazing damage to forest lands in Missouri. Of these the outstanding factor is too many head of stock for the available feed. Generally speaking, such damage as is caused by sheep and goats is due to the fact that they are concentrated on too limited an area rather than to anything inherent in the type of food which these animals consume. In the case of cattle damage on flats and along drainage lines, the real difficulty is generally due to an attempt to run a sufficient number of cattle to consume all forage available on perhaps a section of land whereas the cattle will choose to concentrate on forty acres or less. Often it is impracticable to attempt to keep the animals distributed over the larger unit and the only safe thing to do may be to base the total number of cattle upon the capacity of the concentration areas. The evils of improper seasonal use are usually associated with too early spring grazing. Actually, the difficulty generally lies in the fact that not only are the grazing animals turned out to graze when the first green leaves and buds appear but they are maintained in such numbers that the plants are not allowed to develop adequately and become stunted and starved. There is much evidence to show that the damage caused by hogs is due to the fact that they are generally turned loose at all seasons of the year regardless of the amount of suitable food available and with no provision for keeping them distributed or restricting the amount of rooting. Generally speaking, the remedy for the damage caused by grazing animals is to make it feasible for them to secure an adequate amount of forage. To the extent practicable this should be done by improving pastures and providing supplemental winter feed. To a limited extent the desired result can be attained by distributing salt where the cattle should feed rather than where they are inclined to congregate and by more extensive fencing and herding. These and similar means will doubtless have to be supplemented by restricting numbers of grazing animals to the conservative capacity of the food supply.

**Fire in Relation to Grazing**

Many farmers favor light burning of the woods as an aid to grazing. Undoubtedly fires have played an important part in keeping
the canopy of timber open and allowing greater production of herbaceous and shrubby forage. The benefits, however, have been short-lived and more apparent than real. As a rule the vegetation which came in following fires has not been adequate especially on heavily grazed slopes to prevent erosion of soil. New tree growth crowding out the forage plants made it necessary to repeat the process of burning the woods with consequent further depletion of the site. Thus the vicious circle was continued. Obviously as a permanent practice fires tend to destroy the grazing resource. Sooner or later burning must give way to a more conservative management practice.

Some Range Management Needs.—Typically in the Ozark hills trees and coarse shrubs gradually crowd out much of the better forage plants if fires are excluded. Positive management measures are needed if a sufficient quantity of palatable forage is to be maintained to make grazing economically feasible. To accomplish this it will be necessary on selected areas to keep the canopy of trees quite open through means other than fire. Some farmers have found it practicable to do this by logging followed by severe “goating” or by hiring the brush cleared at 2 to 3-year intervals until the old stumps no longer sprout. The native herbaceous plants are not highly palatable. To make first-class pastures it is necessary to replace the native species with such valuable forage plants as bluegrasses, clovers, orchard grass, lespedeza, timothy, etc. This is not a difficult process on productive soils in a section receiving as much rainfall as occurs in the Ozarks. Less fertile soils from present indications do not warrant the expenditure of labor or investment in fertilizers that would be required to make them support satisfactory pastures which would prove to be adequate watersheds. It will probably be advisable to continue to use such sites for grazing purposes as long as they produce enough forage to justify grazing use with the expectation that they should be managed for the production of timber, recreation and wildlife and only incidentally for the grazing of domestic stock.

No attempt is made here to list the soil types according to their suitability for pasture management purposes or to estimate what proportion of the land in the Ozarks would justify the expenditure necessary to develop satisfactory watersheds. It is clearly necessary, however, that before any planned use can be projected for the agricultural resources of the Ozarks an extensive soil survey and classification based upon productivity and management needs will be essential.

The problem of free grazing is quite troublesome in several counties shown in black in Figure 11. In these counties owners of stock are not
required to keep the animals under fence. Much of the land is of such low value that the owners do not feel justified in fencing to exclude trespassing stock. Consequently much of the area is used as open range by settlers without permission of the owners. The evils that usually attend unrestricted grazing prevail here—overgrazing of favored flats and drainage bottoms, poor quality of stock with consequent low prices, extra hazard to travelers along the highways. The remedy for this situation is not simple. It is not economical to fence most of the submarginal range land found in these counties. The evils of overgrazing and poor quality of animals can be remedied by community cooperative control of numbers of stock and quality of bulls. In the lands that are to be managed for forage production it is expected that the improved carrying capacity will justify the cost of fencing and self-interest of the users of these lands will probably lead to fencing them.

Lands Having Possible Grazing Priority

Within the vast Ozark section of Missouri there is a considerable area of land, some of it tree-covered at present, part of it devoid of trees, that may be more suitable to grazing use than forest use. One of these land types is the so-called glades occupying a considerable acreage, estimated at 30 to 50% of the land in some townships, in the
southwestern counties, Christian, Douglas, Ozark, Taney, Stone, Barry, and McDonald. The glades have a thin soil, steep slopes, and shelved rock outcrops, and usually face south or west. They support little or no forest growth, always a shrubby type. The herbaceous and shrub cover is likewise sparse and largely of unpalatable species, although the carpet of annuals provides considerable forage for a brief period in the spring and early summer. To a certain extent the present condition doubtless represents depletion of perennial grasses and soil due to overgrazing. Typically the soils are now so shallow and the underlying limestone strata so near the surface that these glades are unsuited for more than a sparse growth of perennials of any description—either trees, shrubs, or herbs. Research is needed to determine the practical possibilities of establishing a cover on the glades which will first of all be adequate to prevent further erosion of the soil, will lead to soil improvement and will be of as much value as practicable for forage. In the meantime, grazing use of the glades should be restricted to the point where such cover as is produced will contribute as much as practicable toward soil improvement.

Other lands which may have greater value for grazing than for forestry are the flat plateau uplands, chiefly Lebanon or Clarksville silt loam. These soils are very old, heavily leached, and have shallow top soil and impervious subsoil. Trees make inferior growth and develop poor form on this land. Although not good soils for grass, perhaps they may be more profitable in grass than in trees. It must be recognized that control of sprouts present a problem on these soils, however.

There are undoubtedly other types of land less extensive in area that may have priority for grazing. The Gum and Denman ranches on stony or gravelly uplands in northern Oregon county suggest the possibility of the grazing value of these lands. On the Gum ranch, under management for more than 30 years, it has been possible to establish and maintain a good stand of palatable grasses and legumes by keeping the hardwood sprouts down by goats and by maintaining a scattered stand of shortleaf pine which by its shade aids the cultivated grasses. How profitable this land has been under this type of management is not known. From a management standpoint the results obtained on Gum ranch are chiefly interesting because they represent positive and planned management in contrast with haphazard results attained through burning and overgrazing. They as well as other cases demonstrate quite clearly that if ranges in the Ozark forests are to be improved the land must be devoted primarily to forage produc-
tion. The land must be kept fairly clear of trees and suitable cultivated forage species planted. More records are needed to determine the economic feasibility of these measures. While lands of this character devoted to pasture purposes cannot be expected to produce timber in commercial quantities they are subject to several other types of multiple use, such as wildlife, watershed and as supplements to farm units. The last mentioned use is, after all, probably the highest use to which land in the Ozarks can be put until such time as the heavy human population (four families per square mile) can be much more adequately provided for elsewhere. Particularly is this true of lands adjacent to stream-bottom farms. The income from these farms which typically is inadequate to support a family satisfactorily can be materially supplemented if the operator can pasture a few head of cattle on adjacent woodlands. If later developments indicate that the selected lands which under this program would be given high priority for grazing purposes, should be devoted to the production of timber or to other exclusive purposes, their use in the meanwhile for conservative grazing with an open overstory of valuable timber species would merely delay to a greater or less degree the period of transition back to a timber type.

It must be recognized that use of forest land by domestic livestock conflicts with some forms of wildlife restoration unless the carrying capacity of the range can be materially increased. Deer particularly and several other forms of wildlife to a much lesser degree, utilize many of the same foods as do livestock. Elsewhere in this report ("Game and Fish Habitats," on page 40) it has been shown that large increases in wildlife are possible by improvement of habitats and other measures. Wise discrimination will be needed in working out the grazing and wildlife programs.

Where intensive recreational areas such as camp and summer home sites are developed, livestock are likely to be a nuisance. Elimination of grazing from such and limited areas of adjacent land appears necessary.

**The Problems of Controlled Grazing**

The preceding paragraphs which outline the situation regarding grazing of forest or wild lands in Missouri suggest possible methods of control. First there is the possibility of setting aside certain lands of greater value for forage than timber production and managing them as intensively for this purpose as economic conditions will permit. Such areas should be fenced. Before lands can be developed in this way the lands must be carefully classified after detailed study and research.
Second there is the possibility of continuing multiple use of certain wildlands whose low forage productive capacity does not justify high grazing priority rating. Having eliminated fires as a management measure because it is believed fires cannot be justified, it would be anticipated that the grazing capacity of these lands would gradually be curtailed due to the invasion of tree reproduction. Moderate grazing would not seriously interfere with the regeneration of the forests under these conditions and should be allowed to continue as long as it is economically feasible. Perhaps moderate hog grazing except in plantations could be continued without serious injury indefinitely on these lands particularly when mast is available. While this would mean a gradual reduction in numbers of grazing animals on lands where grazing has not been very profitable this might be more than offset by increased numbers of livestock or managed pastures.

On these lands with low priority for grazing domestic livestock, it is believed that wildlife could be supported in fair abundance, particularly if small openings and fringes were maintained.

The application of these measures will present some difficult administrative problems. The topography of the Ozark region is not sufficiently broken to make possible the control of numbers and distribution of animals through natural topographic units as extensively as is done in western forests. Furthermore land is in many ownerships, mostly of small size; even the national forests are not now well consolidated and never can be as well blocked up as in the West. Fencing will be difficult and costly but some fencing may be necessary. The control problems thus presented can be met successfully in many instances provided communities of stockmen can make arrangements to use in common fairly solid blocks of range. Through mutual agreement they could restrict the number of livestock to a conservative basis: improve the quality of breeding stock and overcome by limited riding and by careful salting some of the situations which otherwise could be met only by extensive system of fencing.

The foregoing are suggestions based on the very fragmentary information now available. Obviously considerable research must be done before a comprehensive program of grazing can be developed for the Ozark region.
V. Problem of Local Government Maintenance During the Transition Period.

TAX DELINQUENCY AS A FACTOR

By Conrad H. Hammar

University of Missouri

After decades of having been cut over and burned over the Ozark counties are poor in taxable wealth. On a per capita basis the assessed value of real and personal property in the Ozarks is only a fraction of that in the more wealthy farm and urban counties of the state.

In Table 12, for instance, average per capita valuations for Shannon and Carter counties were, during the five years 1930-1934, only $432 and $685 respectively. For the two farming counties of north Missouri—Atchison and Johnson—they were $2,000 and $1,468. It is these assessed valuations that keep down the expenditures by the governments in these Ozark counties. Atchison County spent about three times as much as Shannon County on schools, roads, and other governmental services.

Table 12.—Assessed Valuation and Expenditures of Local Governments in Eleven Missouri Counties, 1930-34.

<table>
<thead>
<tr>
<th>County</th>
<th>Assessed Valuation</th>
<th>Per Capita</th>
<th>Expenditures</th>
<th>Per Capita</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atchison</td>
<td>$28,161,212</td>
<td>$2,000.22</td>
<td>$344,242.91</td>
<td>$24.45</td>
</tr>
<tr>
<td>Boone</td>
<td>30,354,174</td>
<td>974.17</td>
<td>588,757.19</td>
<td>18.90</td>
</tr>
<tr>
<td>Callaway</td>
<td>20,650,330</td>
<td>968.89</td>
<td>501,890.61</td>
<td>14.59</td>
</tr>
<tr>
<td>Carter</td>
<td>4,221,220</td>
<td>684.81</td>
<td>63,343.14</td>
<td>10.28</td>
</tr>
<tr>
<td>Franklin</td>
<td>31,730,814</td>
<td>1,016.43</td>
<td>409,302.19</td>
<td>13.11</td>
</tr>
<tr>
<td>Howard</td>
<td>18,039,684</td>
<td>1,289.46</td>
<td>246,391.54</td>
<td>17.91</td>
</tr>
<tr>
<td>Johnson</td>
<td>34,471,300</td>
<td>1,016.43</td>
<td>420,551.54</td>
<td>17.91</td>
</tr>
<tr>
<td>Howard</td>
<td>19,309,337</td>
<td>655.84</td>
<td>251,311.55</td>
<td>17.25</td>
</tr>
<tr>
<td>Newton</td>
<td>14,286,588</td>
<td>1,348.55</td>
<td>182,710.93</td>
<td>15.80</td>
</tr>
<tr>
<td>Ralls</td>
<td>3,376,327</td>
<td>491.75</td>
<td>104,776.62</td>
<td>8.41</td>
</tr>
</tbody>
</table>

Ozark counties were not always so poor in comparison to the northern counties. Not only did they have a heavy growth of virgin pine, oak, and hickory to begin with but for a long period settlement in the Ozarks was scattered and populations small. These virgin stands of timber were a rich taxable resource and, as long as they lasted, provided much public revenue. Furthermore the lumber camps, logging railroads, and saw mills that were active all during the lumbering period provided additional taxable property. When the forests were cut off these went too.

Farms came in upon the valley lands as the timber was cut and assessed valuations continued to grow until about 1929 in the Ozarks.
Since then they have declined because little new land was being developed for farming and the last of the forests were being cut away.

In five typical Ozark counties, Texas, Shannon, Carter, Reynolds, and Iron, assessed valuations of lands in 1891 to 1895 were 37.5% as great as those of five typical farming counties of north and west Missouri (See Table 13) including Atchison, Davies, Linn, Monroe, and Henry. Much of the timber still remained in the Ozark counties at these early dates. With the timber being cut in the Ozarks and farms being developed in the north and west, however, the Ozark counties lost ground. In 1921 to 1925 the assessed value of land in the five Ozark counties was only 17.2% as great as in the five farm counties. There was a small gain between those years and the 1931 to 1936 period to 22.2%. That the cut over counties have lost ground over the 45-year period as a whole is, however, clear. If the timber could be restored some of this loss could be regained and Ozark counties could support government much better than at present.

<table>
<thead>
<tr>
<th>Period</th>
<th>Total Ozark</th>
<th>Total Northern and Western Mo.</th>
<th>Ratio Ozark to N. &amp; W.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1891-1895</td>
<td>30,505,617</td>
<td>81,436,716</td>
<td>37.5%</td>
</tr>
<tr>
<td>1896-1900</td>
<td>32,223,930</td>
<td>92,583,277</td>
<td>34.8%</td>
</tr>
<tr>
<td>1901-1905</td>
<td>32,222,215</td>
<td>102,939,651</td>
<td>31.3%</td>
</tr>
<tr>
<td>1906-1910</td>
<td>35,928,022</td>
<td>121,833,496</td>
<td>29.5%</td>
</tr>
<tr>
<td>1911-1915</td>
<td>43,236,402</td>
<td>130,835,216</td>
<td>33.0%</td>
</tr>
<tr>
<td>1916-1920</td>
<td>58,590,958</td>
<td>168,124,227</td>
<td>34.8%</td>
</tr>
<tr>
<td>1921-1925</td>
<td>93,688,458</td>
<td>545,937,076</td>
<td>17.2%</td>
</tr>
<tr>
<td>1926-1930</td>
<td>89,777,110</td>
<td>489,095,982</td>
<td>18.2%</td>
</tr>
<tr>
<td>1931-1936</td>
<td>89,626,791</td>
<td>404,594,692</td>
<td>22.2%</td>
</tr>
</tbody>
</table>

The Period of Transition

A long time will be needed, however, to restore the forests in the timberland counties. Even twenty-five years of growth will go only a moderate distance toward bringing back the merchantable timber and a total of fifty years may be needed before the yield of timber products that may be harvested each year will reach a near maximum.

The transition period between the present one of low taxable value because of the dearth of forest wealth and the period when the timber is restored to its full income producing capacity then will be fifty years or more. During much of this fifty years local government in the forest counties will remain relatively poor.

Yet there is possibility that must not be overlooked of bringing per capita taxable wealth in these counties back to a much more reasonable equality with that in the northern farming counties. Prices of
lumber and of timber products have since 1890 advanced far more than have prices of farm products. Furthermore, there has, since that time been a great increase in population in areas near the Ozarks so that the market for Missouri timber has improved. These high timber prices and improved markets make the ultimate restoration of a higher level of taxable wealth in the Ozarks much brighter. The real problem is to find a means of financing these forest land counties during the transition period of 25 to 50 years.

The Problem of Tax Delinquency

The things that need to be done to finance these counties during the transition period must take account of tax delinquency in the Ozarks. Most taxes levied to support local government in Missouri counties are property taxes and property tax delinquency in the Ozarks has been extraordinarily heavy during recent years.

It has been much heavier than in other portions of the state as Figure 12 below reveals. In ten Ozark counties an average of 35.6 per cent of current taxes were uncollected in 1934 as against an average of only 19.4 per cent in ten northern farming counties and 28.2 per cent in six urban counties.

Furthermore, in the Ozarks there is much long time delinquency. Much land has had no taxes paid on it for two, three, four, and even five years. Table 14 makes this fact clear. In the fourteen counties 41.1% of the land was delinquent one year or more, 22.1% for two years or more and 10.7% for three years or more. In some of the more...
rugged congressional townships, that is where there were almost no farms and only forest land, the delinquency for one year or more often ran as high as 80% of the area. On the more rugged forest lands delinquency even for periods longer than two years ran persistently over 50% and sometimes reached 70%.

TABLE 14.—Acreage Tax Delinquent in Various Ozark Counties for Varying Periods. Delinquency as of March 1, 1933.

<table>
<thead>
<tr>
<th>County</th>
<th>1 Year Acreage</th>
<th>% of Rural Area</th>
<th>2 Year Acreage</th>
<th>% of Rural Area</th>
<th>3 Year Acreage</th>
<th>% of Rural Area</th>
<th>4 Year Acreage</th>
<th>% of Rural Area</th>
<th>5 Year Acreage</th>
<th>% of Rural Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phelps</td>
<td>192,623</td>
<td>45.8</td>
<td>98,914</td>
<td>23.5</td>
<td>58,977</td>
<td>14.0</td>
<td>36,614</td>
<td>8.7</td>
<td>8,763</td>
<td>2.08</td>
</tr>
<tr>
<td>Dent</td>
<td>170,707</td>
<td>57.3</td>
<td>82,426</td>
<td>18.0</td>
<td>38,085</td>
<td>8.3</td>
<td>10,015</td>
<td>2.2</td>
<td>6,255</td>
<td>1.4</td>
</tr>
<tr>
<td>Miller</td>
<td>69,393</td>
<td>18.9</td>
<td>24,417</td>
<td>6.6</td>
<td>11,040</td>
<td>3.0</td>
<td>4,832</td>
<td>1.3</td>
<td>2,362</td>
<td>0.7</td>
</tr>
<tr>
<td>Washington</td>
<td>120,358</td>
<td>26.3</td>
<td>69,224</td>
<td>15.2</td>
<td>39,178</td>
<td>8.6</td>
<td>14,949</td>
<td>3.3</td>
<td>4,637</td>
<td>1.0</td>
</tr>
<tr>
<td>Pulaski</td>
<td>117,362</td>
<td>34.5</td>
<td>55,761</td>
<td>12.9</td>
<td>29,386</td>
<td>6.8</td>
<td>9,600</td>
<td>2.8</td>
<td>4,168</td>
<td>1.2</td>
</tr>
<tr>
<td>Shannon</td>
<td>299,039</td>
<td>47.9</td>
<td>149,028</td>
<td>33.8</td>
<td>51,929</td>
<td>11.8</td>
<td>16,358</td>
<td>3.4</td>
<td>4,036</td>
<td>0.9</td>
</tr>
<tr>
<td>Marion</td>
<td>104,904</td>
<td>32.0</td>
<td>56,293</td>
<td>14.7</td>
<td>17,103</td>
<td>4.1</td>
<td>6,437</td>
<td>1.6</td>
<td>3,025</td>
<td>0.8</td>
</tr>
<tr>
<td>Camden</td>
<td>152,647</td>
<td>38.0</td>
<td>73,586</td>
<td>18.3</td>
<td>27,171</td>
<td>6.7</td>
<td>17,872</td>
<td>4.4</td>
<td>2,604</td>
<td>0.6</td>
</tr>
<tr>
<td>Iron</td>
<td>352,610</td>
<td>43.8</td>
<td>189,577</td>
<td>25.7</td>
<td>47,313</td>
<td>9.9</td>
<td>11,040</td>
<td>2.2</td>
<td>3,727</td>
<td>0.8</td>
</tr>
<tr>
<td>Ripley</td>
<td>214,928</td>
<td>54.2</td>
<td>120,838</td>
<td>30.5</td>
<td>46,296</td>
<td>11.7</td>
<td>17,039</td>
<td>4.1</td>
<td>4,828</td>
<td>1.1</td>
</tr>
<tr>
<td>Oregon</td>
<td>197,042</td>
<td>40.0</td>
<td>110,794</td>
<td>22.5</td>
<td>54,262</td>
<td>12.2</td>
<td>20,693</td>
<td>4.9</td>
<td>5,873</td>
<td>1.3</td>
</tr>
<tr>
<td>Reynolds</td>
<td>290,538</td>
<td>56.1</td>
<td>194,139</td>
<td>37.5</td>
<td>116,721</td>
<td>25.5</td>
<td>41,739</td>
<td>8.8</td>
<td>7,759</td>
<td>1.4</td>
</tr>
<tr>
<td>Crawford</td>
<td>171,277</td>
<td>36.3</td>
<td>75,189</td>
<td>15.9</td>
<td>51,196</td>
<td>11.1</td>
<td>15,588</td>
<td>3.3</td>
<td>3,727</td>
<td>0.9</td>
</tr>
<tr>
<td>Carter</td>
<td>189,530</td>
<td>60.1</td>
<td>134,774</td>
<td>24.2</td>
<td>70,846</td>
<td>14.7</td>
<td>22,486</td>
<td>4.6</td>
<td>5,008</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Total: 2,443,443 41.1 1,314,960 22.1 652,702 10.7 279,269 4.7 121,372 2.0
Total Rural Acreage: 5,940,110 Acres.

Furthermore, attempting to collect taxes on this land by bringing suit or selling tax certificates is by no means successful. In fact, in the six year period 1927 to 1932 inclusive, before the present law for the sale of tax certificates went into effect most tracts of land sold for taxes in nine Ozark counties did not bring in enough to pay the costs of the sale. See Table 15. Out of 1001 sales of such tracts 602 failed to bring enough to cover the costs of the sale leaving the county nothing. On only 399 or about 40% of the total sales did the county get any net revenue.

TABLE 15.—Analysis of Relationship of Costs and Considerations Involved in Tax Deed Transfers in 9 Ozark Counties, 1914-1932.

<table>
<thead>
<tr>
<th>County</th>
<th>Number Tracts</th>
<th>Costs Exceed Consideration</th>
<th>Number Tracts</th>
<th>Consideration Exceeds Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camden</td>
<td>39</td>
<td>19</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>Carter</td>
<td>8</td>
<td>146</td>
<td>40</td>
<td>13</td>
</tr>
<tr>
<td>Crawford</td>
<td>20</td>
<td>9</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Iron</td>
<td>96</td>
<td>19</td>
<td>15</td>
<td>43</td>
</tr>
<tr>
<td>Pulaski</td>
<td>49</td>
<td>56</td>
<td>408</td>
<td>44</td>
</tr>
<tr>
<td>Reynolds</td>
<td>66</td>
<td>112</td>
<td>66</td>
<td>48</td>
</tr>
<tr>
<td>Texas</td>
<td>28</td>
<td>98</td>
<td>0</td>
<td>171</td>
</tr>
</tbody>
</table>

Total: 313 483 602 541 591 399
The 1933 law, called the Jones-Munger Act, attempted to make it easier for the county to get its money. In the Ozarks this law has had little apparent effect, however. The real reason that selling tax lands cannot be successful in the Ozarks is because so often the taxes amount to more than the land is worth. The Jones-Munger Law did nothing to change this situation.

These figures on property tax delinquency indicate that tax levies in the Ozarks are now at so high a level that there is beginning to be serious difficulty in making tax collections. In fact, tax rates in these Ozark forested counties are among the highest in the state. To push them still higher would surely increase delinquency and probably would not increase revenues collected. Apparently some means other than taxes collected locally from property must be found to finance the forested counties during the transition period.

FINANCIAL DIFFICULTIES OF FOREST LAND COUNTIES

By Estal E. Sparlin
Resettlement Administration

The financial status of forest land counties in Missouri is generally poor and in many instances approaches insolvency. Communities, for all the courage of their people, fall into decay with poorly equipped schools, ill-kept roads, high relief costs, and mounting tax delinquency. Many governmental units have already experienced the sad necessity of paying current obligations with protested warrants, allowing unpaid bills, to accumulate undergoing suits for these unpaid bills, and issuing judgment bonds to pay off what amounts to current expenses. The voters of several counties vow that they will vote no more such bonds. The resulting impasse is not pleasant to contemplate.

Bonded Indebtedness Higher in Forest Counties

If urban counties in the State be eliminated, 21 forest counties have less than 25% of the total assessed valuation, yet the bonded debt of these units is 44% of the total bonded debt of all rural counties in the state. Saddest of all things about the bonded debt of these Ozark counties is that much of it was incurred to pay for current expenses. The percentage of road and courthouse bonds is much lower in the forested counties than in north Missouri.
Unpaid Warrants Common

Protested warrants are encountered only too commonly in the forested counties of the State. With few exceptions, all Ozark counties have had some unpaid warrants within the last five years. In most of the forest counties protested warrants have become chronic with thousands of dollars in unpaid current obligations jammed up against the inability of the county government to raise funds with which to retire them.

For purposes of comparison, 21 typical Ozark forested counties were selected and their situation weighed against a like number of typical agricultural counties north of the Missouri River. The total accumulated protested warrants per forested county was $38,226 as compared with $19,675 per agricultural county. This is in the face of the fact that the northern counties spend currently two, three, and four times as much as the forested counties. The volume of protested warrants per capita is two and one-half times as great in the Ozarks as in the north despite the sparser population in the Ozarks. The forested counties have $84.61 in protested warrants per one thousand acres of area as compared to only $52.16 in the north. A comparison on the basis of “farm land” makes the picture even more vivid. There are $156.81 of unpaid warrants per thousand acres of farm land in the forested counties, but only $57.94 per thousand farm acres in the north. On the basis of total assessed valuation, forested counties have accumulated $4.98 in protested warrants per $1,000 of value, while the northern counties have only 95 cents.

Reynolds County an Example

Reynolds county furnishes an example of the plight of a county which at one time had valuable forest resources, but which today has in its place a large amount of unused land too rough and stony for agriculture. The fiscal condition of the county is acute, with chronic tax delinquency a serious problem. Of the 518,925 acres of land on the 1936 assessment lists in Reynolds county 206,856 acres were delinquent. Nearly half the land area of the county is behind on tax payments. One-third of this land has not paid any taxes for four years or longer, showing it to be chronically delinquent. The “year-acres” of delinquency, calculated by multiplying the number of acres delinquent by the years those acres are behind on tax payments, is over 700,000. That is, the total year-acres of delinquency is greater than the area of the county in acres. The accompanying map pictures the wide distribution of land tax delinquency in Reynolds county.
The county government of Reynolds county has (as of October 1936) $52,012.78 of outstanding, unpaid, and protested warrants. These obligations draw 6% interest. In addition, there remains unpaid $58,000.00 of the $60,000.00 in bonds voted in 1931 to pay warrants put in judgment. These protested warrants had then accumulated to such an extent that a group of holders sued the county and got judgment against it. The only recourse for the county was to pay the judgment with bonds. This actually amounted to paying current expenses by borrowing. Wright county, about 60 miles west of Reynolds county, will issue similar bonds in 1938 provided the voters sanction them.

Fig. 13.—Land tax delinquency in Reynolds county in the forested areas of the Ozarks.
In August, 1936, only about one-third of the warrants issued for the year 1935 by Reynolds county had been paid. None of the 1936 warrants had been discharged. Banks and merchants will no longer buy or accept county warrants as payments on debts or merchandise even though protested warrants bear 6% interest and are offered at a discount in exchange for goods and services.

Problems Not Solving Themselves

Although the forested counties lost population from 1920 to 1930, their loss was less rapid than losses of population in the agricultural counties. School expenditures constitute a major cost of local government. A recent publication on Missouri government points out that the forested counties are actually gaining in enumerated school children¹ and presents the accompanying figure to substantiate its contention.

![Figure 14. Index number of enumerated children in eleven Missouri counties, 1914-1934.](image)

"A notable fact," the publication states, "revealed by these figures on school children enumeration is the much greater net decline in the number of school children in the wealthier two groups of counties. (All of them non-forest counties.) In the four wealthiest counties there were only 75% as many school children in 1934 as in 1914. In the inter-

mediate counties there were 87% as many, but in the poorest counties (forested counties) there were slightly more children enumerated in 1934 than in 1914. Furthermore, the downward trend in numbers of children from 1914 to 1930 was notably more rapid in the wealthier counties than in the poorer and particularly the poorest counties."

While the forested counties have been losing population only slightly, or even gaining in certain instances, their index of assessed valuation has remained on a comparative level with similar indices for agricultural counties. These relative decreases in assessed valuation and increases in population definitely point toward a great decline in per capita assessed valuation in the forested counties as compared to other areas. The undesirable human, economic, and governmental problems of the forest counties are not being solved by the adjustment of population to resources. Under present land use practices, the situation is actually being aggravated instead of alleviated.

The impact of the misuse of forest land for agriculture seriously affects government in the Ozarks where a forestry economy might offer much toward a better life, economically, socially, and governmentally.

SUGGESTED READJUSTMENT DURING THE TRANSITION PERIOD

By Conrad H. Hammar
University of Missouri

The two conclusions brought out in previous sections of this report pertaining to local government in the Ozarks are, first, that these governments are now in a genuinely critical situation because of tax delinquency and inability to finance current costs, and second, that after the restoration of forests has been largely accomplished, the prospects are for a great increase in total, and it is to be hoped, per capita, taxable or public wealth. The critical period in local governmental finances in the forested counties occurs, therefore, during the so-called transition period: that is, the period of development and rejuvenation of the now deforested lands. This period will be a long one and will extend, as far as the forests are concerned, until a considerable volume of harvestable timber is in the offing.

The subject of this section of the report is, therefore, to make such suggestions as seem promising to piece out the income of local governments and the local population in the forested areas during the period
of the present and immediate future years when income from local revenue sources will continue to be very low.

**Subsidies to Local Governments and People**

The two methods of approach that might be used in meeting the problems of the low income period during the transition stage are perhaps obvious. People might, if that were feasible, be moved away from the forested lands and into environments where their earning power could be made greater. Such a process would involve a greater amount of interference with individual affairs than modern American traditions favor and in any event will be accomplished only slowly. The second method, having considerable established precedence, is to subsidize local governments and local people to aid them to remain more comfortably in the area and to facilitate their progress toward self support.

**Support for Schools**

A number of such subsidies, both to governments and individuals, are already employed in Missouri. The 1931 school law, for instance, contained provisions for a minimum guarantee of $750.00 and $1,000.00 per teacher for elementary and high schools respectively to all school districts that levy at least a twenty cent (per one hundred dollars of assessed valuation) school tax. The state has been able to finance the provisions of the 1931 law only partially so far but in the ensuing school year, that is the one beginning July 1, 1937, expects to be able to meet fully its obligations under the law because of the increased receipts from the doubled sales tax and other sources. Counties in the forested regions of the state commonly receive very much more under these subsidies than they pay to the state government in taxes. Increasing the state's ability to finance the provisions of the 1931 school law will almost certainly greatly increase the amounts received as state aid over the amounts paid to the state in taxes. As far as schools are concerned, therefore, part of the needed increased subsidies to local governments in the forested counties have already been provided for.

**Support for Roads**

Another form of subsidy already in existence is that which arises out of the state construction of highways. The state has taken over in recent years a large mileage of the most important and most traveled highways in all counties. The recent Legislature enacted a provision to increase the gasoline tax from two cents to three cents per gallon. Missouri is already collecting $10,000,000 a year under the gasoline tax. Increasing the tax by 50% should raise the amount to approximately
PLATE VII.—All areas within the national forest units of southern Missouri are being made reasonably accessible by motor car. In the upper picture is shown a fire protection road, and in the lower a scene on State Highway 78 in the Pond Fork National Forest. (Photos by courtesy of U. S. Forest Service.)
$15,000,000 a year and enable the state to increase markedly its responsibility for roads throughout the state and thus further to relieve many local taxing units of financial burdens they are at present incapable of carrying.

The Forest Service as part of its ECW work is carrying on a substantial road building program which will make a real contribution to the road system of the Ozark region. Maintenance of these roads is also provided by the Forest Service.

**Old Age Assistance**

Another virtual subsidy having an indirect rather than a direct effect upon the adequacy of local governmental revenues was provided in the State Old Age Assistance Act and the Federal Old Age Security Program. Under the provisions of these acts small monthly stipends (averaging ten or eleven dollars) are being or will shortly be paid to persons over seventy years of age and without means of support. The qualifying age, it is currently reported, may in time be reduced from 70 to 65 years. Such stipends, while small, go a long way toward the support of aged persons and can be counted upon to lessen materially the costs to local governments for pauper support. The financing of the program will be from revenue sources and will not be a direct burden upon the local people. Since both the level of incomes and the percentage of population in the older age groups are greater in the forested, particularly the Ozark counties, than in the remainder of the state, this form of subsidy is a material one and may become even more important in future years.

**Subsidies in Other States**

Other states in similar circumstances use various methods of subsidizing counties. Wisconsin, Michigan, and Minnesota all have laws providing for small subsidies from the state to reimburse local governments for losses of revenue from land entered under timber tax laws. Lands entered under these laws pay only a nominal sum to the local governments and state governments step in to compensate the local governments for such loss as they may suffer. Many state governments undertake to finance a considerable portion of the cost of fire control and in states with active conservation programs a considerable amount of state expenditures on developmental work in forested counties is constantly going forward.

Another important form of subsidy arises under the tax reversion laws of a number of states. Much idle cut-over and burned-over land is tax delinquent and provides no revenue to either state or local
governments. Under tax reversion laws these delinquent lands, after a suitable period, revert to the state which in turn releases the county from its obligation to pay accumulated state taxes upon these lands and, in many cases also, when title to the land is taken by the state, pays to the county the accumulated arrears in local taxes as well. An application of a tax reversion law with similar provisions in Missouri would aid local governments to wipe out accumulated deficits of which, as noted in the preceding section, there are a considerable number.

It is perhaps worth noting also that other states go as far and a few of them somewhat farther than Missouri in taking over the burden for support of schools and roads in the State.

**Federal Subsidies**

In the immediate future the most active program of land acquisition by public agencies will be that carried out in the present National Forest Purchase units of which there are eight in the State. These eight units embrace 3,321,000 acres of which to date (July, 1937) approximately 1,000,000 acres have been purchased. These 1,000,000 acres of publicly owned lands have already made a material reduction in the taxable resources of the counties within whose borders the purchase units lie, since federally owned lands are not subject to local taxes.

The Federal Government has, however, recognized the need to reimburse local governments for their loss in taxable wealth because of these purchases. It has been provided, for instance, that the Federal Government will pay to the local governments, to be used for schools and roads, 25% of the gross revenue received by the Forest Service from the land under its ownership and management. A great share of such income is received from the sale of timber but an appreciable percentage is also obtained from special use permits such as those granted for cabin sites and other recreational purposes. In addition to this 25% of gross receipts granted to the local government, the Forest Service also appropriates 10% of these same receipts to be expended on roads within the forest area from which the revenue is received. This 10% goes a considerable distance in constructing and maintaining roads in the forest units. Since these roads are also available for local traffic they tend to lighten the cost of roads to the locality.

The difficulty with these Federal subsidies, as far as Missouri is concerned, is that the amounts of them cannot be large until the period of the timber harvest begins or until the critical transition period is over. It is small comfort to those now wrestling with problems of local government to reflect that in the distant future their successors in office
will receive considerable amounts of income from timber sales made from public forest lands.

There is need, therefore, for recognition of the responsibility of the Federal Government to make immediate rather than delayed payments to local governments within whose jurisdiction land purchases have been made. The critical need of the local governments is now or in immediately succeeding years. It will not be so great when forests both public and private are reestablished and when the vanished forest industries are again paying some of the costs of local government.

In other words, an obligation rests upon the Federal Government to take suitable steps to meet the problem created by its purchases of land. One method of so doing would be to allow to the local government an annual payment calculated upon one of two possible bases. One basis, and probably the simplest and most effective, would be to pay to the local government annually a percentage of the current appraised value of the property. The percentage should be computed to approximate, over a timber rotation, payments equivalent to 25% of the gross receipts. Such a system would go far to meet the present distressed conditions, would guarantee a fairly stable income rather than one which will fluctuate from year to year with the volume of timber sale and other receipts, and would increase with the value of the property. An alternative method might be to project upon the basis of past data both the prospective assessed valuation of the land and average tax rates of the counties for purposes of arriving at a suitable payment in lieu of the taxes previously collected. Both types of payments could be used as a substitute for the 25% and 10% of gross revenue now extended to local governments.

Methods of Increasing Income and Wealth

One further method for strengthening local governments would be to take steps to increase the income and wealth of the community upon which it depends for revenue. Dependence upon forest restoration for this purpose is impossible because of the long time needed to grow trees. Certain other types of development can be made to produce more immediate results. Perhaps the most promising of these types of development is for recreation. As a preceding section points out, the Ozarks have excellent possibilities for recreational development. These may best be fostered and promoted in two ways. Perhaps the most immediate feasible way is to increase the amount of wild life. A preceding section has indicated both the feasibility and possibilities of increasing wild life as very promising.
The second method is in the making of artificial lakes and ponds. The Ozarks lack still water and wherever still water has been provided immense recreational developments have sprung up very quickly. One needs only to point out the recreational facilities around the Lake of the Ozarks in Camden, Morgan, and Benton counties; Lake Taneycomo in Taney County, and Lake Killarney in Iron County. The proposed construction for reservoir purposes of a dam upon the St. Francis River would quite surely be followed by like effects and a great number of other suitable lake sites both large and small exist throughout the entire region. Research is needed to discover the location of sites that may economically be developed for their recreational value alone and without reference to their potential power uses.

Unlike the growing of timber, recreational development can be made to yield results very quickly. As pointed out in a previous section the assessed valuation in Camden County increased by approximately $1,500,000 between 1932 and 1936 almost wholly because of recreational building and improvement around the newly created Lake of the Ozarks. Furthermore, recreational property is seldom delinquent and has proven in Missouri as well as in other states an excellent source of local revenue.

Perhaps, however, even the increased recreational development will come too slowly to provide the needed income during the early transitional period. One other possibility may need, therefore, to be used somewhat more than it is at present. Foresters and conservation departments in most states of the Union have made abundant use of relief funds under what is called the ECW (Emergency Conservation Work) program. Employment under this program has provided a large amount of revenue to Ozark inhabitants during the recent depression and all the years from 1933 to the present. However, the depression in the Ozarks is not only an economic depression. It is in very large part a chronic depression because of the depletion of the underlying natural resources. While the economic depression has largely disappeared at the present writing (July, 1937) the depression because of the depletion of natural resources will last very much longer. Plans to make use of the ECW program in the Ozarks should take grave account of the causes of Ozark depression. It is a depression that will continue until forests are restored and ECW programs may be needed until that stage is reached.

Facilitation of Migration and Resettlement

As mentioned above, an alternative program for meeting the problems of the transition period would be to reduce the number of
people depending upon forest areas until these are again in a more highly productive stage. There may, therefore, be some possibilities in facilitating migration away from the Ozarks. Techniques of directing migration and of encouraging resettlement are indeed in an early stage. Not much is known about them. A number of states are, however, using various means of facilitating migration and resettlement. Perhaps the best known of all these programs is that of the state of New York. The New York program is a very simple one. Provision is made for the purchase of lands now farmed but unsuited to that use for purposes of reforestation in units as small as 500 acres. The sole part in the relocation of people now on these lands played by the state is to provide the money to purchase the land. It is deemed best to permit the individuals to make their own adjustments and to do their own relocating. So far the program has been counted a successful one as a recent unpublished report of the Cornell Agricultural Experiment Station indicates. That is, the people on these lands have made what are counted as satisfactory relocations and readjustments without further aid from the government.

A number of states have adopted much more paternalistic attitudes toward people needing relocation and the Resettlement Administration has made some effort in the past in assisting them to move, in providing loans to aid in establishing them in new locations, and even in supervising their beginning operations after relocation.¹

**Costs of Local Government**

Practically all methods and procedures that have been suggested above have one important fault. They fail to place upon the shoulders of local inhabitants a sufficient responsibility for their own and their government’s position. Only part of the present depletion of resources in the forested counties can be made a responsibility of local residents. Nevertheless some of the responsibility is local and to make of the entire program of regeneration too effective a thing would be to eliminate entirely the need for and desire to adjust on the part of the local inhabitants themselves. To complement the other aspects of the program, therefore, there is need to take vigorous steps to reduce the cost of local government in the forested counties of Missouri. Numerous methods of reducing such costs have been proposed and advocated. Among them are county consolidation, county zoning, provision for district almshouses, consolidation of school districts, consolidation of road districts, and a great many other similar proposals.²

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¹ For a discussion of resettlement experience, see the article by Nowell, R. I., in the February, 1937, Journal of Farm Economics, pp. 206-224.

² For a recent discussion of this topic see Hammar, Conrad H., “The Farmer and the Cost of Local Rural Government in Missouri,” Agricultural Experiment Station Bulletin, No. 385.
Of even more direct concern to the individual also is the need to employ more effective methods of agricultural production upon such lands as are suited to crop production, to increase the use of suitable forage plants, notably Korean lespedeza and to follow more effective grazing practices. There is great need also for effort to change the attitude of these same inhabitants toward burning. Most Ozark forest fires are incendiary and spring from the entrenched belief that fires improve the early and perhaps the total amount of grazing. Along with effort to be expended by state and federal governments, therefore, there is great need for consideration by local inhabitants in forested counties of the adjustments they can effectually make on their own initiative.
PLATE VIII.—Properly managed forests (as in upper picture) yield high quality timber products, control erosion, and conserve water. Heavy cutting, heavy grazing, and fire destroy (as in lower picture) the forest litter and vegetative cover, so that the remaining growth has little value.
VI. Federal Aids in Forest Restoration and Maintenance.

By A. G. HAMEL

United States Forest Service

Introductory Statement

It is the policy of the United States Forest Service to cooperate as an active associate with all states desiring federal financial aid and assistance in the protection and development of state and privately owned forest lands. The national interest in forest restoration, protection, and development on state and private lands has been recognized by acts of Congress whereby financial support of the Government is available to states engaged in this work. The passage of the Act of June 7, 1924, commonly known as the Clarke-McNary Law, and the Fulmer Act of August 29, 1935 as well as legislation now pending in the Congress is a recognition of the principle that all sections of the country are directly interested in the protection of a vital national resource, regardless of its location.

In addition to acts designed principally to further forest restoration on state and private lands, the Government has given aid in a national program of forest conservation by establishment of national forests, forest experiment stations, a forest products laboratory, and conservation work agencies notable among which is the Civilian Conservation Corps.

Federal Aids in Forest Protection

Authorization.—The State of Missouri is one of the nine states comprising the North Central Region or Region 9 of the U. S. Forest Service. The cooperative work under the Clarke-McNary Law, maintained with the states in Region 9, is handled by the regional forester with headquarters at Milwaukee, Wisconsin.

The Clarke-McNary Law is “an Act to provide for the protection of forest lands, for the reforestation of denuded areas, for the extension of national forests, and for other purposes, in order to promote the continuous production of timber on lands chiefly suitable therefor.” Section 1 of the Act provides: “That the Secretary of Agriculture is hereby authorized and directed, in cooperation with appropriate officials of the various states, or other suitable agencies to recommend for each forest region of the United States such systems of forest fire prevention and suppression as will adequately protect the timbered and cut-over lands therein with a view to the protection of forest and water resources...”
and the continuous production of timber on lands chiefly suitable therefor."

Section 2 of the Act further provides: "That if the Secretary of Agriculture shall find that the system and practice of forest fire prevention and suppression provided by any state substantially promotes the objects described in the foregoing section, he is hereby authorized and directed under such conditions as he may determine to be fair and equitable in each state, to cooperate with appropriate officials of each state, and through them with private and other agencies therein, in the protection of timbered and forest-producing lands from fire. In no case other than for preliminary investigations shall the amount expended by the Federal Government in any state during any fiscal year, under this section, exceed the amount expended by the state for the same purpose during the same fiscal year, including the expenditures of forest owners or operators which are required by state law or which are made in pursuance of the forest protection system of the state under state supervision and the Secretary of Agriculture is authorized to make expenditures on the certificate of the state forester, the state director of extension, or similar state official having charge of the cooperative work for the state, that state and private expenditures as provided for in this Act have been made. In the cooperation extended to the several states due consideration shall be given to the protection of watersheds of navigable streams, but such cooperation may, in the discretion of the Secretary of Agriculture, be extended to any timbered or forest producing lands or watersheds from which water is secured for domestic use or irrigation within the cooperating states."

General Policy on Federal Aid Under Sec. 2 of the Clarke-McNary Law.—The administration of Section 2 is designed to increase state protection effort and to stimulate and develop local protective participation. With this in mind allotments are made with three definite objects in view:

1. To stimulate state, county, town and private efforts:

2. To encourage cooperation among the various agencies interested and engaged in protection work; and

3. To assist in the organization and development of protection work in the cooperating state.

Special consideration is given to the needs of states whose resources are limited and in which general and efficient protection from fires has not yet been developed.

The purpose of forest fire cooperation under the Clarke-McNary Law is permanent and adequate protection not only of timbered, but
also of cut-over lands with a view to the extension and restoration of forest and water resources and the continuous production of timber on lands chiefly suitable for that purpose. In order that a state system of protection may substantially promote the purpose of the law it should meet the following minimum requirements:

1. It must be organized on a dependable and efficient basis.

2. It must be state-wide in principle, that is, the state law must authorize protection over the entire state where justified by the values at stake and hazards encountered, although, because of inadequate resources, the protection may be temporarily localized.

3. It must provide for the protection of all classes of state and private forest land in need of protection.

The extent of federal aid will vary according to the degree of compliance by the state with the full protection program. After a reasonable time for developing the legislative and police features of state protection up to the full program the continuation of federal cooperation will depend upon the adoption of measures regarded as vital to the success of the cooperative efforts and upon expenditures sufficient to put them into effect.

The plan used in allotting federal funds for each state hinges upon the determination of the average cost of adequate protection over a period of years. An estimate of this cost is required in order to establish a standard toward which the Federal Government and the states may work on some proportionate basis. The cost of adequate protection as estimated by the states and correlated by the Forest Service is not a final figure but will require correction as changes occur in standards, methods, and unit costs.

Reimbursability.—All expenditures which are commonly accepted as necessary for the organization and maintenance of the cooperative project will be recognized for federal reimbursement, and will include:

1. Expenditures by state forestry department;

2. Expenditures by other public cooperating agencies when under the supervision of the state forester and as part of the comprehensive protection plan for the state; and

3. Expenditures from private funds deposited with the state forestry department or other public agencies cooperating with the state; or

4. Expenditures of private funds made directly by private agencies when—

   a. They are required by state law or are made voluntarily in pursuance of the approved protection system;
b. They are covered by written agreement with the state forester and subject to his supervision;
c. Protection is provided for all classes of forest land; and
d. Satisfactory supervision, audit, and certification of accounts are provided by the state.

With the federal authorization under this section of the Clarke-McNary Law limited as at present to a sum not greater than $2,500,000, an expenditure equal to 25% of the cost of adequate protection of State and privately owned land represents somewhere more than the amount which can be disbursed by the Federal Government under this authorization. On the basis that the national interest is best served by nation-wide protection, the first obligation resting upon Federal funds will be to get a fair start by every forested State.

Federal Aids in Production and Distribution of Forest Planting Stock Authorization.—Section 4 of the Clarke-McNary Law provides: "That the Secretary of Agriculture is hereby authorized and directed to cooperate with the various states in the procurement, production, and distribution of forest-tree seeds and plants, for the purpose of establishing windbreaks, shelter belts, and farm wood lots upon denuded or nonforested lands within such cooperating states, under such conditions and requirements as he may prescribe to the end that forest-tree seeds or plants so procured, produced, or distributed shall be used effectively for planting denuded or nonforested lands in the cooperating states and growing timber thereon: Provided, that the amount expended by the Federal Government in cooperation with any state during any fiscal year for such purposes shall not exceed the amount expended by the state for the same purposes during the same fiscal year. There is hereby authorized to be appropriated annually, out of any money in the Treasury not otherwise appropriated, not more than $100,000, to enable the Secretary of Agriculture to carry out the provisions of this section.

General Policy on Federal Aid under Section 4 of the Clarke-McNary Law.—This section of the Clarke-McNary Law is a recognition by Congress of the farm forest planting problem and of the desirability of joint state and federal effort to solve it by the most practical means. This seems to be through the establishment and operation of nurseries for the production and distribution of forest planting stock and the collection of forest tree seeds. The purpose is to encourage timber growing on the farms in woodlands, windbreaks and shelter-belts. The planting of forest trees on farms is to be given greater
impetus by financial assistance to the States in growing and distributing such trees so that their cost can be lowered and their planting thus made more attractive and feasible. The law does not provide for cooperation in the growing and distribution of trees for ornamental or shade purposes.

Federal aid will be extended to any state in the event that:

1. Its laws permit distribution of forest trees to farmers by a State agency;
2. It is engaging or with federal cooperation will engage in such distribution;
3. It will expend from appropriated funds an amount at least equal to the federal expenditure;
4. The federal allotment and the qualifying state funds shall be expended exclusively in procuring, producing, and distributing forest planting material for farmers;
5. In states which make a charge for planting stock, reimbursement shall not exceed in any fiscal year the net amount expended by the state, not including expenditures from funds obtained by the sale of trees; and
6. The plans and practices of the state are effective in bringing about a reasonable degree of success in the planting of the trees grown and distributed under the cooperative project.

Cooperation under this section will not be extended to meeting a part of the costs of the actual planting of the trees on the farms.

State policy varies as to financing the growing and distribution of trees but most states recover some part of the cost. The Forest Service believes that the best results will accrue if the recipient of forest trees pays a fair and reasonable price for them.

Cooperative Agreements

The conditions and requirements prescribed by the Secretary, U. S. Department of Agriculture, to govern federal cooperation under Sections 2 and 4 of the Law are set forth in the form of cooperative agreements. These agreements enumerate the conditions which are to be met by the cooperating state and federal agencies and are signed by the responsible state official and the Secretary of Agriculture. One of the provisions is that the whole agreement or any modification of it can be terminated by either party upon 30 days written notice to the other.

In addition to the provisions of the Clarke-McNary Law for federal aid to the states for forest protection and distribution of forest
tree planting stock, as outlined above, the Law also authorizes the Secretary of Agriculture to cooperate with the various states to:

1. Study the effects of tax laws, methods, and practices upon forest perpetuation;
2. Assist in such investigations and in devising tax laws designed to encourage conservation and growing of timber;
3. Investigate and promote practical methods of insuring standing timber on growing forests from losses by fire and other causes;
4. Assist the owners of farms in establishing, improving and renewing woodlots, shelterbelts, windbreaks, and other valuable forest growth;
5. Examine, locate, and recommend for purchase as national forest lands such forested, cut-over, or denuded lands within the watersheds of navigable streams as in his judgment may be necessary to the regulation of the flow of navigable streams or for the production of timber.

Federal Aids in Cooperative Establishment and Administration of State Forests Authorization.—The Fulmer Act authorizes the Secretary of Agriculture to cooperate with the several states for the purpose of stimulating the acquisition, development and proper administration and management of state forests and for coordinating federal and state activities in carrying out a national program of forest land management. The Forest Service of the U. S. Department of Agriculture, subject to the approval of the Secretary and the National Forest Reservation Commission, where it is involved, has been designated as the agency within the Department to administer the Act.

The purpose of the Act can best be given by quoting directly the first section of the Act which reads as follows: "Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the purpose of stimulating the acquisition, development, and proper administration and management of state forests and of insuring coordinated efforts by federal and state agencies in carrying out a comprehensive national program of forest-land management, the Secretary of Agriculture is hereby authorized to enter into cooperative agreements with appropriate officials of any state or states for acquiring in the name of the United States, by purchase or otherwise, such forest lands within the cooperating state as in his judgment the state is adequately prepared to administer, develop, and manage as state forests in accordance with the provisions of this Act and with such other terms not inconsistent therewith as he shall pre-
scribe, such acquisition to include the mapping, examination, appraisal, and surveying of such lands and the doing of all things necessary to perfect title thereto in the United States: Provided, That, since it is the declared policy of Congress to maintain and, where it is in the national interest to extend the national-forest system, nothing herein shall be construed to modify, limit, or change in any manner whatsoever the future ownership and administration by the United States of existing national forests and related facilities, or hereafter to restrict or prevent their extension through the acquisition by purchase or otherwise of additional lands for any national-forest purpose: Providing further, That this Act shall not be construed to limit or repeal any legislation authorizing land exchanges by the Federal Government, and private lands acquired by exchange within the limits of any area subject to a cooperative agreement of the character herein authorized shall hereafter be subject to the provisions of this Act."

The Fulmer Act is one of the results of cooperative efforts by state foresters throughout the country, the U. S. Forest Service, and other National and state forestry agencies to develop an effective and officially recognized program of state forest land management and use. With adequate financial support and proper administration it will fill a need widely recognized by conservation interests of the country. The Act establishes a reasonable method of financing additional state forests, both for the Federal Government and for the states, by providing for non-interest bearing loans to the states until sufficient revenue is received from the operation and administration of the property to repay the loan.

It is not the present policy of Federal Government to acquire under the Fulmer Act the total area officially recognized for state ownership, but rather to purchase only an area sufficient to establish a nucleus of state forests in each of the several states. Coordination shall be effected with all other state and federal land buying programs in order to insure a broad and satisfactory regional and national forest land administration set-up.

Principal Qualifications for Cooperating States.—The Fulmer Act provides that no cooperative agreements may be entered into under the authority of the Act unless the state concerned complies with certain provisions set forth in the Act. The principal qualifications as required by the Act for each state are as follows:

1. Adequate legal authority to acquire land under agreement, to make expenditures for administration, to sell products
from the land and to utilize receipts to reimburse the Federal Government for the cost of the land.

2. Appropriate state tax delinquency laws, where such laws are lacking, that will terminate a system of indeterminate and unsound ownership together with adequate provisions for their enforcement should be developed prior to June 30, 1942. Subsequent to that date no additional state forests will be acquired under the Fulmer Act unless these conditions have been met.

3. The state shall work out a mutually satisfactory plan defining forest areas within the state which can be most effectively and economically administered by the state. This land use plan when completed and officially approved by agencies involved and having jurisdiction, will be followed in setting up state forests as provided by the Fulmer Act.

4. The state in cooperation with the Forest Service shall prepare such standards of forest administration, development and management as are necessary to insure maximum feasible utility for timber production, watershed protection and other forms of forest land uses, and will apply them to the state forests under the Fulmer Act.

5. The state shall provide for the employment of a state forester who shall be a trained forester of recognized standing, and for personnel under him who are adequately equipped by training and experience satisfactorily to handle the work of administering state forests created under the Fulmer Act.

6. After state forests have been established under the provisions of this Act and the title vested in the Federal Government, the state shall pay the entire cost of administering, developing and managing such lands except to the extent that Federal emergency relief funds may be available for this purpose.

When a state or political unit thereof acquires under tax delinquency laws title to forest lands without cost to the United States and which lands are included within a state or other public forest, the Secretary of Agriculture, on behalf of the Federal Government, may contribute annually out of any funds made available under this Act not to exceed one-half the cost of administering, developing and managing said lands.

The total cost of acquiring state forests under the Fulmer Act shall be paid by the Federal Government. This cost shall include the
mapping, examination, appraisal, and surveying, and the doing of all other things necessary to perfect title thereto in the United States. When title to the land becomes vested in the Federal Government it remains in that status until the state reimburses the Federal Government for the total cost of acquiring the land. The cooperative agreement between the state and Federal Government will provide for repaying the Federal Government by applying one-half of the gross receipts from the lands covered by the agreement until the total cost of the land has been returned to the Federal Government.

Thus the Fulmer Act establishes a reasonable method of financing additional state forests, both for the Federal Government and for the states. It provides for non-interest bearing loans to the states until sufficient revenue is received from the operation and administration of the property to repay the loans. Since reimbursement will be made by the states to the Federal Government through the application of 50% of the gross proceeds from the lands, there is no obligation against the taxing power of the states to satisfy the loans.

**Federal Aids in Forest Restoration through Emergency Conservation Work Programs**

The Act of March 31, 1933, now generally known as the CCC (Civilian Conservation Corps) Act has become a great force in all phases of forest restoration throughout the entire country. The continuance of this form of federal aid through creation of a permanent CCC is now being definitely considered by the Congress. The enormous contribution in form of labor and materials provided by the CCC together with other federal emergency unemployment programs made available during periods of social and economic stress and readjustment, should be taken definitely into consideration in planning restoration of the forest resources of any state. Forest protection and restoration is a phase of conservation that can continue indefinitely to provide high priority classes of work in all sections of the country and without serious competition with existing fields of private work or public undertakings.

**Federal Aid in Farm Forestry**

The Cooperative Farm Forestry Act, the most recent federal aid to forestry, signed by President Roosevelt, May 18, 1937, authorizes the federal government to cooperate with the states and territories in the development of farm forestry. The Act provides "that in order to aid agriculture, increase farm-forest income, conserve water resources, increase employment, and in other ways advance the general welfare
and improve living conditions on farms through reforestation and afforestation in the various states and territories, the Secretary of Agriculture is authorized in cooperation with the land-grant colleges and universities and state forestry agencies, each within its respective field of activities, according to the statutes, if any, of the respective states, wherever such agencies can and will cooperate or in default of such cooperation to act directly, to produce or procure and distribute forest trees and shrub planting stock; to make necessary investigations; to advise farmers regarding establishment, protection, and management of farm forests and forest and shrub plantations and the harvesting, utilization, and marketing of the products thereof; and to enter into cooperative agreements for the establishment, protection, and care of farm or other forest land tree and shrub plantings within such states and territories; and, whenever suitable government-owned lands are not available, to lease, purchase, or accept donations of land and develop nursery sites for the production of such forest planting stock as is needed to effectuate the purpose of this Act, but not including ornamental or other stock for landscape plantings commonly grown by established, commercial nurserymen, and no stock grown in government and cooperating nurseries shall be allowed to enter regular trade channels. No cooperative reforestation or afforestation shall be undertaken pursuant to this Act unless the cooperator makes available without charge the land to be planted. There is hereby authorized to be appropriated annually not to exceed $2,500,000 for carrying out the purpose of this Act. This Act shall be known as the Cooperative Farm Forestry Act.”

The Forest Service of the United States Department of Agriculture, the agency which will administer this Act has not worked out the details of administration, so at this time the extent to which Missouri can benefit from this Act is not definitely known.
VII. Divisions Between State, Federal and Local Responsibilities.

By Lyle F. Watts

United States Forest Service

The problem of forest restoration is a challenge to all conservation agencies in Missouri. The welfare of the citizens of the State demands that all of the natural resources be maintained at a very high level. Renewable resources can not be destroyed through improper use without having a serious reflection on the cash income of the State, on the ability of the State to furnish employment to its people, and on the standard of living its people should enjoy. Approximately 43% of the total land area of the State has been classified as potential forest land, practically every acre of which is at present producing less than its full benefits to the people of the State. The situation demands the fullest participation by state, federal and local agencies to bring about the best solution of the problem in the shortest possible time.

Responsibility of the State in Forest Restoration

The division of responsibilities for a forest restoration program might well be based in part on the abilities of the various agencies to discharge these responsibilities, and in part on the benefits which should accrue to each from the successful establishment of the program. On this basis the State of Missouri must take over the responsibility for rehabilitating a major part of its deteriorated forests. Missouri is potentially a wealthy state. The first benefits from the natural resources within the state remain at home. The laborers used in the forests and wood-using industries are largely local people. The citizens of the state are the first to enjoy the recreational and wildlife opportunities of the forest. The control of erosion and run-off, and water conservation are of first importance to the state. Thus, an obligation rests squarely upon the state itself to participate to the fullest extent possible in the work of forest restoration.

The first responsibility of the state is to secure the benefits of protection from fire to all forest lands which are judged to be in need of such protection. In a large measure the cost of adequate protection for the state and private forest lands must be financed by the State. (See “Federal Aids in Forest Restoration and Maintenance.”) The estimated cost of protection for Missouri is set forth in another section of this report. (See “Fire Control.”) There can be no truly effective forest
restoration program until forest and woods burning practices are brought under control. Repeated burning year after year has destroyed reproduction, increased the defect in the remaining timber (Missouri has a cull per cent of about one-third the total merchantable volume) destroyed fish and game, caused erosion of the top-soil and greatly lessened the water conserving capacity of the forest floor and soil.

The second responsibility of the State should be to provide an adequate system of State forests to serve as demonstration projects, protect critical watershed areas, and help solve—in a large measure—the land-use problem in the State. In 1934, in preparing the State’s contribution to the National Resources Board Report, the State Planning Board, in cooperation with interested federal agencies, estimated that the State should ultimately acquire approximately one million acres of forest land, of which the great bulk would be handled as state forests. It is believed that the planned State participation is far too low. Sufficient information is probably not available at present to determine accurately the acreage which should ultimately be acquired as state forests, but it certainly should be the maximum area that the State can finance, rehabilitate, and manage. Areas should be selected to assure early revenue if that is possible. The establishment of state forests means the expenditure of material sums for fire protection; for the purchase of land; for the planting of trees; for timber stand improvement, and for the upbuilding of the property for multiple use forestry, including recreation, wildlife and water conservation. It must be realized also that the investment will have to be made with hope of only small immediate cash returns, as forest crops grow slowly. There is no magic wand to wave over the areas of abused lands to replace the forests. This generation must return to the land a part of the wealth which the past generation took from the land. In the final analysis it means that the people of Missouri are willing to buy heavily in the capital stock of Missouri.

The third responsibility of the State is to set up a strong Conservation Department based on merit and kept free from undue political influence in order that long-time policies may be secure. Other sections of this report have considered the administrative agencies needed to carry out a forest restoration program. Recent events serve to strengthen the belief that the citizens of Missouri are genuinely interested in an effective program to conserve and restore the natural resources of the State. The mandate of the electors in November, 1936 directs attention to this need and provides for a Conservation Commission to work out such a program. Authority also is provided for the establishment
of a conservation department which should be responsible for a complete forest restoration program.

As further responsibilities the State should:

(a) Provide for an adequate farm forestry program through cooperation under Sections 4 and 5 of the Clarke-McNary Law and the Norris-Doxey Farm Forestry Act recently passed by Congress.

(b) Engage in forest tree production and distribution to encourage reforestation of idle forest lands by private owners.

(c) Enact tax legislation to provide for reversion of tax delinquent land inside forest protection districts to some public agency to be administered for forest conservation purposes.

(d) Engage in cooperative efforts with private timberland owners to bring about the maximum participation on the part of such owners in the forest restoration program. This would include providing equitable forest taxation for private owners of forest land, who will agree to handle their land on forestry principles.

The final responsibility of securing a coordinated program of land use planning and natural resource conservation must rest with the State. This will mean securing the effective cooperation of all state, federal and local agencies to work together to produce the best possible plan of action and accomplishment for the restoration of the forest resources of the State.

Responsibility of the Federal Government in Forest Restoration

It is recognized that the Federal Government has an interest and responsibility in the work of forest restoration. The national interest in this respect is evidenced by the numerous federal aids provided by law to assist the states in programs of forest restoration. The decline of the forest resources, as noted in the figures on lumber production; the loss of top-soil through erosion; the irregularity of stream flow and occurrence of disastrous floods; the economic losses and social maladjustments, are all part of the train of evils attendant upon the deterioration of any great natural resource. The national welfare can probably best be served by continuing in Missouri those cooperative projects and undertakings which have aided other states to make a start in the direction of forest conservation.

The task of forest restoration on the estimated 15,500,000 acres of potential forest land in Missouri is undoubtedly beyond the capacity of the State in the limit of time in which the job should be handled. The federal government upon request by the State, should assist in this program.
The first responsibility of the federal government should be to assume a portion of the work of forest restoration by outright purchase and management of forest lands. The State Legislature, by special enactment, has invited the Federal Government to acquire lands in Missouri for national forest purposes. In line with this request, and by agreement with the State Planning Board and conservation interests, the Federal Government has already set up in the southern part of the State, eight purchase units, with a gross area of 3,321,000 acres, of which 2,757,000 acres are estimated to be available for purchase. At the present time, 1,019,000 acres have actually been purchased or approved for purchase. As a first responsibility the federal Forest Service should accelerate its land acquisition program to complete the purchase of the remaining available lands within its present purchase units. This should be accomplished as rapidly as funds can be made available for land purchases.

The second responsibility of the federal government should be to assist the State, through the cooperative provisions of the Clarke-McNary Law, to set up an effective system of organized protection for all State and private forest lands in need of protection.

The third responsibility should be to assist the State in acquiring nuclei of State forests, through provisions of the Fulmer Act and Exchange procedure, around which the State would plan to build an adequate system of State forests.

The fourth responsibility should be to devise with the State and at the State's request, a program of national forest expansion which should be undertaken to properly balance the ultimate division of forest land ownership between the State and Federal Government. It appears all too certain that the bulk of the forest land in Missouri will ultimately be forced on public ownership. The National Resources Board report in 1935 estimated that slightly over 8,000,000 acres of forest land in Missouri is destined for public ownership. The same report assigned about 7,000,000 acres of this land for National Forest ownership. The exactness of this figure is of small account; the important conclusion is that the problem will require the combined forces of both agencies if reasonable progress is to be made in accomplishment.

The fifth responsibility should be to assist the State through the cooperative provisions of the Farm Forestry Act and Clarke-McNary Act to promote farm forestry.

Other federal responsibilities are:

(a) A proportionate share in forest research for the region, to include forest management; forest economics; forest pathology; forest
influences; forest production; forest entomology and wild life, in cooperation with appropriate State agencies.

(b) Provision for the extension of forest credit facilities to private forest land owners who are looking toward the preservation of the forest resources for continuous production and will agree to comply with prescribed practices.

Local Responsibility in Forest Restoration by Private Owners of Forest Land

It is believed all can agree that development through private initiative is the American way and that private ownership and management is to be fostered where it has a chance to succeed. At the same time the fact remains that private ownership of forest lands in Missouri has left an immense area too low in productiveness to support private capital, or in fact, even to remain on the tax rolls. Thus it must be recognized that private ownership is preferred only where it can be retained with adequate assurance that the permanent public interest will be protected.

There are several reasons why public aid is justified to assist private owners. The principal one is that many of the benefits from the forest flow to the public and return no tangible, direct income to the owner. The maintenance of a satisfactory watershed cover in Missouri may mean more to people living along the rivers and even outside the State than it does to the owner of an individual tract of land. The privilege of hunting, fishing and recreational use seldom returns a revenue to the owner, yet the improvement of the forest increases these values to the State and the Nation. Forest fires often result from these and other public uses. Clearly, state and federal aids are fully justified in cooperative fire control and in the promotion of forestry practices on the private lands. Even granting this aid, it is clear that private ownership of commercial forest land will be attractive only on highly productive lands. Clearly, the area to be properly managed in private ownership will not be large if satisfactory practices are to be had.

County, towns, and other local interests have a definite responsibility in the furtherance of the conservation program. Primarily they should cooperate to the fullest extent in the fire control activities, both prevention and suppression, support adequate law enforcement of all conservation measures to the end that public opinion will promote the development of the forest lands of the state with all their varied resources.
PLATE IX.—The variety of timber growth, shrubs, and flowers along cool, swiftly flowing streams make these forest areas delightful to the seeker of recreation. (Photo, Greer Spring, Oregon County, Missouri.)
VIII. Relations Between Public and Private Forest Management.

DIVISION BETWEEN PUBLIC AND PRIVATE OWNERSHIP OF FOREST LANDS

By R. H. Westveld

University of Missouri

The major part of Missouri's forest land is now in private ownership. Public ownership at present consists of approximately 1,000,000 acres to which the federal government has title and approximately 75,000 acres of state parks owned by the State. Included within the boundaries of the national forests is a gross area of three and one-third million acres. There is a considerable amount of land which is not purchaseable by the federal government, some of it good agricultural land. As funds become available all purchaseable forest land within the boundaries of the present national forests (approximately 1,750,000 acres) will be bought and will then become a part of the existing units.

That public ownership must be increased greatly is obvious from the attitude and objective of many landowners, particularly in the Ozark region, and the deteriorated and depleted condition of the forest resource on much of the land in private ownership. Public ownership will have to be concentrated in the Ozark region because the small size and the lack of consolidation of the forest land tracts in other parts of the State preclude extensive public acquisition. There are several areas of moderate size, outside of the Ozark region, which would be suitable for state forests.

Because of the conditions just outlined the ultimate division between public and private ownership of forest land should be a natural one. The six million acres of farm woodland should remain in private ownership because it would be impractical to handle it otherwise. Beyond this private ownership seems undesirable. Forest lands in the Ozarks are so badly depleted that little revenue can be expected from them for at least thirty or forty years. It has been demonstrated in every forest region of the United States that owners of this class of land, when they own little or no marketable timber in conjunction with it, are not willing to invest money to restore deteriorated forest land to productivity. It is therefore unlikely that owners of such land in Missouri will care to retain ownership of the land and develop it for future benefits in which they may not participate. This means that
eight million acres of forest land must ultimately be in public ownership. Just how this acreage should be divided between state and federal government is difficult to predict. Since the major benefits from the forests stay in Missouri and Missouri's citizens profit from them more than anyone else, the State has an obligation to its citizens to take an active part in the program of forest restoration. It must spend money for the acquisition of land for state forests, and it must provide funds for rehabilitating this land. Certainly, the state should ultimately acquire a minimum of one million acres for state forests, preferably more. Even if it extended its purchases to two million acres the State would own only 25% of the public land, leaving 75% for the federal government.

**EXTENT AND CHARACTER OF FARM FORESTRY**

*By Ralph H. Peck*

*University of Missouri*

Forestry, as a branch of farm management in Missouri, is directly concerned with an area of 8,900,000 acres of land in forest or brush cover, according to figures of the 1935 census. This area includes only those wooded lands within the boundaries of tracts owned and operated as farms and does not include lands in public ownership nor those held by persons or corporations for exploitive purposes such as production of timber, minerals, water power, recreational facilities, etc.

Compared to other states, Missouri ranks fourth in farm woodland area, and is exceeded only by Texas, Georgia and North Carolina. Therefore, in no state outside the southern region is farm forestry concerned with so extensive an area as in Missouri, and in no other comparable state are facilities for assisting and guiding farmers in protection and improvement of existing farm woodlands, and in the forestation of marginal farm lands, so limited and so completely inadequate.

Moreover, the farm woodland area is growing rapidly, as is evidenced by the increase of 1,203,000 acres during the five-year period 1930-1935. This increase of 15.6% was due in a large measure to the recent movement toward retirement from cultivation of marginal croplands. The present general trend is from cropland to improved pasture, and from wornout, eroded, over-grazed pasture to woodland, although some cropland is being retired directly to woodland, chiefly where forest planting is possible. Also the recent "back to the farm" migration, during the depression period, resulted in many newly established farms in generally less fertile sections, most of which contain rela-
tively large percentages of woodland which had heretofore been classed as timberland rather than farm woodland.

According to figures published by the Bureau of Agricultural Economics, forest products sold from Missouri farms in 1934 amounted to $1,968,000. Moreover, this income benefitted over one-half the farm families of Missouri, amounting to an average of slightly less than $13.00 each to 153,500 families of a total of 297,800. Prorating this forest products cash income over the total farm woodland area of the State (8,903,000 acres), each acre produced approximately twenty-two cents worth of wood products.

Therefore, although the area of Missouri's farm woodlands is extensive, the cash return per acre is woefully small. This fact is largely responsible for the belief of many Missouri farmers that woodlands are unproductive areas, owned only because they cannot be disposed of, and utilized only for home wood needs and the meager forage obtained by grazing stock.

Specific branches of forestry directly connected with farm management, and in which the demand for public aid and instruction is steadily increasing, are as follows:

1. Forestation, or planting of lands which are submarginal for crop production and are not at present in forest cover. Such areas total roughly 2,000,000 acres, and planting to forest trees will serve not only to produce managed crops of marketable wood products, but will play an important part in soil and water conservation.

2. Protection of existing farm woodland. This includes reduction of damage from fire, over-grazing, insects and disease, through education and construction of such improvements as fences and fire breaks.

3. Improvement of existing farm woodlands. While closely related to protection, woods improvement, through selective cuttings, inter-planting and other silvicultural practices for increased production, must be delayed until protection is established. Here field instruction and the establishment of local permanent demonstration areas, based on practical application, are necessary, in order to show results over long term periods.

4. Marketing wood products. While markets for rough wood products are generally adequate throughout the state to handle most of the merchantable materials produced, increased yields from farm woods, resulting from more intensive management, will require additional marketing facilities.
At present there are two agencies, the Missouri Agricultural Extension Service, and the Federal Soil Conservation Service, actively engaged in assisting farm woodland owners toward improved management of forest and soil resources. Both of these agencies are distinctly limited in their respective fields of activity; the former due to limited technical personnel and the latter by the relatively small areas within which demonstrational work can be carried on.

The forest planting program initiated by the Missouri Agricultural Extension Service during the spring planting season of 1937 resulted in the planting of 681 acres, or 681,000 tree seedlings, by Missouri farmers. Under this program planting stock was purchased at cost of production and the planting done by the individual farmers under the direction of the respective county agents and the Extension Forester. Planting stock distributed was grown as a matter of cooperation in nurseries of the U. S. Forest Service, the Soil Conservation Service, and the neighboring states of Arkansas and Tennessee, and was provided to stimulate planting under the Agricultural Conservation Program. Inasmuch as no Missouri state funds are available for the growing of forest planting stock for farmer distribution, the entire Extension Service planting program for 1937 was dependent upon seedling stock occurring as surplus in these nurseries. However, to insure stock for farm planting in 1938, the U. S. Forest Service will have available roughly one million seedlings at its Licking, Missouri, nursery in anticipation of federal and state legislation providing for expansion of tree distribution activities. Federal funds available for tree planting under the existing Clarke-McNary Act of 1924, and those proposed under the Norris-Doxey Act, have been discussed under "Federal Aids in Forest Restoration and Maintenance."

Soil Conservation payments for forestry practices available to Missouri farmers under the 1937 Agricultural Conservation Program include per acre payments of $7.50 for planting trees with a minimum of 1000 trees per acre, and $2.50 for improvement of existing farm woodland areas, both in accordance with good tree culture practice and conforming to recommendations officially adopted by the Missouri Agricultural Conservation Committee. While the great majority of tree plantings directed by the Extension Service will qualify for benefit payments under these recommendations, actual payments will be made on considerably less than one-half the areas, due to maximum payments having been previously taken up, in many cases, through other soil building practices.

The success of this initial reforestation program, and the great demand by farmers for tree planting stock, the supply of which failed
to meet requests by nearly two hundred thousand trees, well illustrates the interest in establishing and improving farm woodlands for the production of planned crops of wood products. Missouri clearly fails to meet her responsibility to farmers through failure to appropriate funds to be matched by available federal money, for restoring, protecting and improving farm woodlands, to the point where they may become valuable farm assets, not only to the owner, but to the entire public.

SUGGESTED AIDS TO PRIVATE FORESTRY

By Ralph H. Peck
University of Missouri

Long term land planning in Missouri is faced with the problem of the productive management of extensive aggregate areas of forest and idle land, totalling roughly one-third of the State's land surface. The majority of this vast acreage will remain for an indefinite period in private ownership. Benefits in the form of early concrete returns resulting from such management must be negligible, while ultimate gains through production of raw material, renewal and stabilization of wood using industries, increased demand for labor, and benefits resulting from forest influences, are shared by the entire public. Forestry cannot be considered a profitable short term investment for private capital when a start must be made with depleted stands. There is, therefore, a definite need for legislative action to encourage and assist the private timber and farm woodland owner toward protecting and improving his timber for future returns in which the public will share. Suggested aids, adaptable to Missouri, are briefly outlined below.

1. Cooperative Aid under Clarke-McNary Act of 1924

Federal funds available to cooperating states complying with provisions of the Clarke-McNary Act, described fully in Part IV of this report, Federal Aids in Forest Restoration and Maintenance, are shown in Table 16 below for the fiscal years 1935-1937.

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount Appropriated for the Fiscal Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>For the prevention and suppression of forest fires, and</td>
<td>1935</td>
</tr>
<tr>
<td>for the forest taxation inquiry and the insurance study (Secs. 1-3 of</td>
<td>$1,573,619</td>
</tr>
<tr>
<td>the Clarke-McNary Law)</td>
<td></td>
</tr>
<tr>
<td>For the distribution of forest planting stock to farmers (Sec. 4 of</td>
<td>56,296</td>
</tr>
<tr>
<td>the same law)</td>
<td></td>
</tr>
<tr>
<td>For farm forestry extension (Sec. 5 of the law, administered by the</td>
<td>51,354</td>
</tr>
<tr>
<td>Division of Cooperative Extension)</td>
<td></td>
</tr>
</tbody>
</table>

Total funds used by cooperating states from private, state and federal sources in 1936, for cooperative forestry work under this act are given in Table 17 (pages 120 and 121) for fire control and distribution of planting stock.

Forest Fire Protection.—Section 2 provides for prevention and control of fire on privately-owned forest land. Money is used by the states to aid in the maintenance of a state forestry personnel, to pay wages and retainer salaries to wardens for labor expended in fire control activities, for construction of fire lookout towers, communication systems, roads and trails, for the purchase of transportation and fire fighting equipment and supplies, and for general public education in forest fire control.

Distribution of Forest Planting Stock.—Funds received under Section IV are used for the production and distribution of forest tree seedling and transplant stock to private landowners for planting farm lands which have proven unprofitable for other agricultural use. This includes purchase of nursery sites by states, and all phases of nursery administration.

At present Missouri is the only remaining state with any appreciable area of privately-owned timberland which does not provide for cooperation under this law. Establishment of a state forestry organization, under the Conservation Commission, and initiation of a broad program of protection and reforestation under the Clarke-McNary and other federal laws is highly desirable.

2. Public Forests

National, state and possibly county and municipal forests furnish an important aid to private forestry through demonstrating various phases of forest management and results secured over long periods of treatment. Lands may be acquired through purchase, donation, tax reversion and exchange, and many states have made notable progress in this direction, as shown in Table 1 of the introduction to this report. Recent federal legislation authorizes the expenditure of not over $5,000,000 for purchase of land to be administered by the various states as state forests.* Missouri, under the 1937 Conservation Commission, is now in a position to receive grants of federal funds to supplement a state purchase program, whenever such funds are available.

3. Aids to Farm Forestry

A limited amount of assistance in farm forestry is now available through the University of Missouri, Agricultural Extension Service,

which advises farmers in management of woodlands and cooperates in
distribution of planting stock and in demonstrating forest planting on
farms. To augment and expand this activity, federal legislation now
authorizes an annual appropriation of $2,500,000, forty per cent of which
will be administered by the various state and extension organizations,
and sixty per cent by the U. S. Forest Service for carrying on plantings
of the Great Plains Shelter Belt project.* This legislation will make
available increased supplies of tree seedlings for farm reforestation at
low cost. Farmers cooperating will furnish land for forest planting,
labor for site preparation and planting, and will maintain and protect
the resulting stands of trees. With a prospective planting program of
2,000,000 acres of Missouri farm land, this aid should be developed as
early as possible.

Still another aid for farm forestry is available under provisions of
the Agricultural Conservation Program, which provides for benefit
payments to farmers for carrying out recommended soil building prac­
tices. Missouri farmers are hereunder paid $7.50 per acre for planting
worn-out farm lands to forest trees, using a minimum of 1,000 trees
per acre, and $2.50 per acre for thinning and otherwise improving
existing stands of immature farm timber, under regulations of the
program. Payment for eliminating grazing in farm woodlands, through
fencing, was proposed by the Missouri committee, but not adopted as a
regional recommendation. Grazing damage to promising timber stands
is one of the most serious deterrents to farm forestry and encourage­
ment for elimination of stock is definitely needed.

4. Research

Systematic forest research, dealing with silvicultural treatment of
timber stands, multiple land use problems, artificial forestation, water
absorptive and runoff studies, economic problems of harvesting and
marketing, and social aspects of resettlement and land use planning,
is essential to a sound forestry program. Few such studies have yet been
made in Missouri. The two existing research agencies, namely, the
Central States Forest Station in Ohio, and the Agricultural Experiment
Station of the Missouri College of Agriculture, should be adequately
equipped to carry out a cooperative program of forest research dealing
with problems of this specific state and region. The Farm Forestry
Act of 1937, described in paragraph three of this section, provides for
farm forestry research studies under technical supervision by state
agricultural experiment stations. When funds under this Act become

*Norris-Doxey Law—Signed May 26, 1937.
TABLE 17.—COOPERATIVE EXPENDITURES FOR FIRE PROTECTION AND FOR THE DISTRIBUTION OF FOREST PLANTING STOCK, FISCAL YEAR 1936 (CLARKE-McNARY ACT, 1924)

<table>
<thead>
<tr>
<th>State</th>
<th>For Fire Protection</th>
<th>For the Distribution of Forest-Planting Stock</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Federal</td>
<td>Private Agencies</td>
</tr>
<tr>
<td>Alabama</td>
<td>$36,247.35</td>
<td>$10,357.00</td>
</tr>
<tr>
<td>Arkansas</td>
<td>38,720.00</td>
<td>14,889.31</td>
</tr>
<tr>
<td>California</td>
<td>139,980.00</td>
<td>216,123.90</td>
</tr>
<tr>
<td>Colorado</td>
<td>14,520.00</td>
<td>48,782.08</td>
</tr>
<tr>
<td>Connecticut</td>
<td>1,500.00</td>
<td>5,113.85</td>
</tr>
<tr>
<td>Delaware</td>
<td>67,760.00</td>
<td>35,221.89</td>
</tr>
<tr>
<td>Georgia</td>
<td>62,000.00</td>
<td>17,769.30</td>
</tr>
<tr>
<td>Hawaii</td>
<td>53,680.00</td>
<td>39,222.16</td>
</tr>
<tr>
<td>Idaho</td>
<td>6,900.00</td>
<td>11,817.34</td>
</tr>
<tr>
<td>Iowa</td>
<td>8,206.03</td>
<td>8,248.29</td>
</tr>
<tr>
<td>Kansas</td>
<td>41,780.00</td>
<td>20,202.86</td>
</tr>
<tr>
<td>Louisiana</td>
<td>49,150.00</td>
<td>31,658.38</td>
</tr>
<tr>
<td>Maine</td>
<td>10,725.00</td>
<td>13,989.31</td>
</tr>
<tr>
<td>Maryland</td>
<td>23,050.00</td>
<td>79,198.10</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>93,425.00</td>
<td>286,491.25</td>
</tr>
<tr>
<td>Michigan</td>
<td>44,278.49</td>
<td>23,177.07</td>
</tr>
<tr>
<td>Minnesota</td>
<td>85,450.00</td>
<td>204,399.38</td>
</tr>
<tr>
<td>Montana</td>
<td>22,385.00</td>
<td>17,971.32</td>
</tr>
<tr>
<td>Nebraska</td>
<td>2,200.00</td>
<td>211.00</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>15,430.00</td>
<td>31,658.38</td>
</tr>
<tr>
<td>New Jersey</td>
<td>24,068.00</td>
<td>120,936.24</td>
</tr>
<tr>
<td>New Mexico</td>
<td>56,160.00</td>
<td>13,989.31</td>
</tr>
<tr>
<td>New York</td>
<td>2,100.00</td>
<td>211.00</td>
</tr>
<tr>
<td>North Carolina</td>
<td>50,560.00</td>
<td>83,099.99</td>
</tr>
<tr>
<td>North Dakota</td>
<td>56,000.00</td>
<td>10,360.50</td>
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<tr>
<td>Ohio</td>
<td>11,904.68</td>
<td>7,904.72</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>92,570.00</td>
<td>118,107.53</td>
</tr>
<tr>
<td>Oregon</td>
<td>50,440.00</td>
<td>192,131.97</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>2,500.00</td>
<td>13,636.40</td>
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<tr>
<td>Rhode Island</td>
<td>30,240.00</td>
<td>29,271.62</td>
</tr>
<tr>
<td>South Carolina</td>
<td>700.00</td>
<td>2,573.77</td>
</tr>
<tr>
<td>Location</td>
<td>Appropriation</td>
<td>Unexpended balance</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Tennessee</td>
<td>19,600.00</td>
<td></td>
</tr>
<tr>
<td>Texas</td>
<td>40,550.00</td>
<td></td>
</tr>
<tr>
<td>Utah</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vermont</td>
<td>5,700.00</td>
<td></td>
</tr>
<tr>
<td>Virginia</td>
<td>31,760.00</td>
<td></td>
</tr>
<tr>
<td>Washington</td>
<td>88,150.00</td>
<td></td>
</tr>
<tr>
<td>West Virginia</td>
<td>27,100.00</td>
<td></td>
</tr>
<tr>
<td>Wisconsin</td>
<td>68,750.00</td>
<td></td>
</tr>
<tr>
<td>Wyoming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administration and inspection</td>
<td>101,120.00</td>
<td></td>
</tr>
</tbody>
</table>

**Total** | **$1,528,359.55** | **$2,671,130.41** | **$1,123,338.18** | **$5,322,828.14** | **$55,156.63** | **$196,017.87** | **$251,174.50** |

available, the Missouri Station will be in a position to initiate investigations of problems which confront not only farm woodlands but other classes of private ownership as well.

5. Tax Relief of Forest Land

Before forestry can become profitable for the private owner, taxes must be revised through state legislation so that annual assessments are directly proportional to returns rather than to estimated land values. Under present methods valuations tend to increase with the growth and improvement of immature timber, even though no appreciable cash return can be realized until stands have reached maturity. This tends to discourage private forestry to such an extent that a number of states have revised regulations dealing with taxation of forest land to make forestry economically profitable through reduced assessments. Tax exemption during non-productive growing periods of timber, yield taxes on timber products at time of removal, annual taxes based on productive value of soil, and temporary exemptions as awards for instituting improved forestry practices, are possibilities for consideration. Reports and recommendations of the Forest Taxation Inquiry Commission, authorized by Section 3 of the Clarke-McNary Law, and covering over eight years of intensive study and investigation of forest tax problems, furnish a number of suggested solutions to this intricate problem.\(^1\), \(^2\)

6. Other State Legislation

Additional legislation to protect State and privately-owned forest property from trespass, and resulting damage from fire, timber theft, game poaching and grazing, and more effective enforcement of these statutes are needed to protect owners from prevailing abuses.

Facilities to extend distribution of forest planting stock to private owners other than farmers, and field assistance in forestry methods and practices, are needed and should be included in a state program.

Public education in forestry and other conservation subjects in public schools, beginning in primary grades and continuing throughout high school, must be provided for through legislation. Educational materials, such as tree, plant and wildlife identification guides, illustrated booklets, posters, motion pictures, film strips, exhibits and lectures, made available through the state conservation commission to schools and other organizations, will prove effective in teaching younger generations the problems of conservation.

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It will be the problem of the Conservation Commission, cooperating with all existing conservation agencies, to work out a balanced program of regulation and assistance toward the end that private forestry be made possible and economically practical.

PUBLIC PARTICIPATION IN THE MANAGEMENT OF PRIVATE FORESTS

By R. H. Westveld

University of Missouri

Review of Past Efforts

Since the general public benefits through soil and water conservation, wildlife conservation, and recreational and employment opportunities from the application of good forest management practices on private-owned forests and since the public also subjects these lands to increased danger from fire when it uses these lands, provision should be made by public agencies for assisting the owners of private forests. The need for public participation in private enterprise has been recognized for many years in the case of the farm owner who has been assisted through the Agricultural Extension Service and the Agricultural Experiment Stations. More recently additional assistance has been given the farmer through the Soil Conservation Service and the benefit payments under the Soil Conservation and Domestic Allotment Acts. Farm woodland owners in Missouri now have an opportunity to benefit from all these forms of federal cooperation. The State has failed to meet its full responsibility to the farm woodland owner, however, by its failure to provide facilities for the production of forest tree planting stock.

Owners of the more extensive tracts of forest land not in farmer ownership have received practically no aid from the state or federal governments in spite of the fact that there existed federal enabling laws and appropriations. The failure of the State to provide funds and an organization (except for a short period, 1925 to 1932, on an entirely inadequate basis) to cooperate with and receive financial assistance from the Federal Government has been one of the factors responsible for the lack of interest by this class of forest land owner in applying even the simplest form of forest management. Indirectly then the lack of an opportunity to cooperate has contributed to the badly deteriorated condition of the forest resource on privately owned land. The small state appropriation of $20,000 made annually from 1925 to 1932, along
with smaller amounts of private and federal funds could accomplish little in the face of the estimated need for satisfactory fire protection alone (on all forest lands in the State) of more than $200,000 annually.

Existing Needs

With approximately 13,500,000 acres of forest land now in private ownership and the likelihood that not less than 6,500,000 acres will remain permanently in private ownership there now exists and will continue to exist a large opportunity and need for federal and state assistance in the management of private forests. Since, as indicated elsewhere in this report, a large proportion of the land that will remain permanently in private ownership will be in farm woodlands, particular attention should be directed to the development of a well-rounded program which will meet the needs of this class of owner. However, provision should be made also for cooperation with other private owners, many of whom will be interested only in protecting their land from fire until they can dispose of it to the state or federal government. If it is true that most of the privately-owned forest land, exclusive of farm woodlands, will ultimately go into public ownership and that these owners will be interested only in fire protection, and that only for a limited period, then the facilities for assisting this class of owner should be kept down to the minimum requirements.

Specifically there exists a need for public participation, satisfied only in part by existing agencies, in actual fire protection, in providing advice on tree planting, natural regeneration, stand improvement measures, methods of harvesting and marketing timber, and methods of management to provide a sustained yield of timber products. Intelligently to guide such a program of advice and actual participation in certain phases of work, provision must be made for a comprehensive program of forest research as outlined elsewhere.

Coordination of Effort

Inasmuch as there already exist three agencies; namely, the Agricultural Extension Service, the Soil Conservation Service, and the U. S. Forest Service which can participate by cooperative efforts in the management of private forests, it is very important that the work be properly coordinated and that the responsibility and activity of each be clearly understood by these organizations. The need for cooperation with private owners of forests is so great and the facilities so inadequate that there is plenty of work for all. Enlarged facilities are urgently needed, even though it might appear that the three existing agencies should be able successfully to formulate plans and to guide a conserva-
tion program for the State. The present inadequacy is in the fact that owners of private forests cannot get the type of assistance to which they are entitled because much as the federal government would like to cooperate with these land owners, it cannot since there is no state forestry organization nor state funds, prerequisite to federal assistance.

Specifically the state needs a forestry organization to act as an intermediary between the federal government and the private owner in cooperative fire protection, in producing forest planting stock, and in assisting other agencies in educational work, forest inventories, and management plans for private forest properties.

The state forestry organization should have full responsibility for fire protection on the lands of all private owners who wish to cooperate, and should play an important if not sole role in the production of forest planting stock for farmers and other private land owners.

The U. S. Forest Service through its recently created division of state and private forestry is able to assist owners of forest land not operated as a part of a farm in supplying specific data on forest resources, in the formulation of management plans, and actual demonstrations in good forestry practice, as well as educational work among such owners. This agency serves this class of owner in much the same way that the Agricultural Extension Service, through its extension forester, serves the farm woodland owner.

The Agricultural Extension Service has been in operation so long that it hardly seems necessary to make mention of its functions. In its forestry program, as in its other programs, it gives practical assistance to farm woodland owners in the management of existing timber stands, in the establishment of tree plantations, and in the harvesting and marketing of timber products. This is accomplished through lectures, newspaper articles, printed publications, and actual demonstration. There is a need for an expansion of this program in order that more farm woodland owners may be better equipped to practice intelligent forest management.

The Soil Conservation Service functions much the same as the Agricultural Extension Service in educational work in the restricted areas in which they are operating and goes a step farther by actually carrying out the recommended practices. It is important that there be a careful coordination of objective and effort between these two agencies.
Neither the state nor the federal government has met its responsibility to the owners of private forests in carrying on a program of forest research to supply the data needed as a basis for recommended practice. This is a form of public participation in the management of private forests which must be adequately provided for. The scope of such a program is discussed in "A research program."

Since damage to forests by insects and diseases can be adequately controlled only by the application of control measures on all properties regardless of ownership, the state and federal governments should provide funds for cooperative control work on privately owned lands.
IX. The State’s Ability to Undertake a Reforestation Program.

MISSOURI’S FISCAL CAPACITY COMPARED WITH THAT OF STATES WITH EXISTING PROGRAMS

By

R. H. WESTVELD, University of Missouri

AND

FRED R. GRAHAM, Resettlement Administration

The inauguration of a state forestry program will require an expenditure of funds for operation and acquisition of land. There can be little return on this investment for many years because practically all of Missouri’s timber land is so badly depleted of valuable trees (described in “Timber Production”) that saleable products will not be produced in quantity until a long period of forest restoration elapses. It is, therefore, important to take careful stock of the state’s fiscal capacity to engage in such a program. Such an analysis is difficult since ability for a state to undertake a forestry program is only partly financial, the remainder psychological. Some data included in the accompanying table may seem to have no relation to the state’s fiscal capacity, but are shown to demonstrate the attitude, as expressed by appropriations for conservation, that some representative states have taken toward forest and other conservation. It is not the intent that these data demonstrate actual financial ability, but rather, relative ability and willingness.

The fiscal data presented in the accompanying table are for the year 1931, since published statistics of more recent date are not readily available, no such data having been published by the Department of Commerce since then. Several of the states have increased very substantially their appropriations for forest conservation (see footnote of Table 17) and others have inaugurated programs since 1931. The data on land area were taken from the 1930 U. S. Census. The states which were selected for comparison are representative eastern states with forestry programs in various stages of development. New York, Pennsylvania, and Michigan are outstanding for their state conservation programs.

2. A neighboring state, Arkansas, began a forestry program in 1934 with a state appropriation of $10,000.
It is obvious from the data in column 2 of the table that Missouri is not as wealthy as several of the states with substantial forestry programs. On the other hand, it has greater total wealth than Minnesota and Tennessee, states that have made material progress in forestry.

Of greater importance in the State’s ability to undertake a forestry program is the state’s relative financial position as shown by ratio of receipts to assessed valuation (column 5, Table 18). Missouri compares favorably in this respect with other states.

Missouri has not seen fit to use its cash resources for forestry or other conservation to the extent that other states have (columns 6, 7, 8, 9, 10 and 11 of the accompanying table). Considering such outstanding states as New York and Pennsylvania, it is significant that only .291 and .799% respectively of the State’s revenue has been used for forestry. Several states have made material progress by using only .113 to .215% of their cash receipts for a forestry program. Column 14 of the table which gives the cash expenditures per acre of state owned forest land shows great variation between states. This is due chiefly to differences in land area under administration, current land acquisition, and the amount of forest land rehabilitation that has been done. In general, a small acreage is costly to administer. Likewise, substantial land acquisition and tree planting programs increase the cost per acre. Once the land is acquired, substantial progress in forestry can be made on an expenditure of around $0.40 per acre per year.

The important recognition given forestry in the conservation programs of the various states is indicated in column 11 of the table. These figures cannot be taken at their face value because of differences in methods of accounting. It is nevertheless obvious that forestry occupies an important place in the conservation programs of most of these states.

Columns 12 and 13, showing total land area and woodland area respectively, give some indication of the relative importance of the forest problem in the various states. These states namely, Ohio, Illinois, and Indiana with only 27 to 39% as much woodland as Missouri have spent from $44,000 to $134,000 annually while Missouri has spent practically nothing. The states of New York and Pennsylvania, with approximately the same forest area as Missouri, are leaders in expenditures for forestry. However, these states are wealthy and therefore able to finance a large forestry program.

The foregoing data demonstrate that Missouri compares favorably in cash resources with the eastern states for which data are presented. The state’s forest problem is large but its interest in a forestry program
Table 18.—Wealth, Annual Receipts, Expenditures for Forestry and Conservation, and Land Areas of Representative Eastern States with Forestry Programs, 1931.

<table>
<thead>
<tr>
<th>State</th>
<th>Total Assessed Valuation of Property Subject to General Property Tax</th>
<th>Assessed Valuation Per Capita</th>
<th>Aggregate Annual Expenditures for Forestry and Conservation</th>
<th>Ratio of Receipts to Assessed Valuation</th>
<th>Operating Expenditures</th>
<th>Capital Investment</th>
<th>Per Cent of Total Governmental Expenditure</th>
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</thead>
<tbody>
<tr>
<td>Missouri</td>
<td>$4,566,442,883</td>
<td>$1,252</td>
<td>$76,020,763</td>
<td>.017</td>
<td>2,873*</td>
<td>None</td>
<td>.003</td>
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<tr>
<td>New York</td>
<td>29,513,043,980</td>
<td>2,323</td>
<td>558,146,091</td>
<td>.019</td>
<td>1,223,972</td>
<td>$403,133</td>
<td>.291</td>
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<td>Pennsylvania</td>
<td>12,871,485,483</td>
<td>1,351</td>
<td>239,738,106</td>
<td>.019</td>
<td>1,135,495</td>
<td>781,139</td>
<td>.799</td>
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<td>Michigan</td>
<td>8,894,326,700</td>
<td>1,815</td>
<td>179,181,288</td>
<td>.020</td>
<td>192,757</td>
<td>10,234</td>
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<td>Ohio</td>
<td>13,457,208,156</td>
<td>2,018</td>
<td>136,566,476</td>
<td>.020</td>
<td>51,277</td>
<td>31,773</td>
<td>.097</td>
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<td>Illinois</td>
<td>8,249,429,161</td>
<td>1,073</td>
<td>138,767,989</td>
<td>.017</td>
<td>34,545</td>
<td>9,644</td>
<td>.031</td>
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<td>Minnesota</td>
<td>2,341,448,744</td>
<td>910</td>
<td>117,315,833</td>
<td>.050</td>
<td>7,420</td>
<td>None</td>
<td>.015</td>
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<tr>
<td>Wisconsin</td>
<td>6,606,246,678</td>
<td>2,236</td>
<td>84,028,797</td>
<td>.013</td>
<td>142,839</td>
<td>16,482</td>
<td>.215</td>
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<tr>
<td>Indiana</td>
<td>5,073,241,146</td>
<td>1,557</td>
<td>72,036,859</td>
<td>.014</td>
<td>69,025</td>
<td>65,761</td>
<td>.187</td>
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<td>Tennessee</td>
<td>1,709,334,171</td>
<td>650</td>
<td>46,761,187</td>
<td>.027</td>
<td>25,913</td>
<td>None</td>
<td>.055</td>
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<table>
<thead>
<tr>
<th>1</th>
<th>Annual Expenditures for All Conservation, Forestry, Fish &amp; Game Parks &amp; Other Recreational Areas</th>
<th>10</th>
<th>Ratio of Expenditures for Forestry to Expenditures for All Conservation</th>
<th>11</th>
<th>Total Land Area (Acres)</th>
<th>12</th>
<th>Total Woodland Area (Acres)</th>
<th>13</th>
<th>Annual Expenditures per Acre of State-owned Forests</th>
<th>14</th>
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<tr>
<td>Missouri</td>
<td>$144,444</td>
<td></td>
<td>2.0</td>
<td></td>
<td>43,985,280</td>
<td></td>
<td>15,595,664</td>
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<td>$8.00</td>
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<tr>
<td>New York</td>
<td>13,573,545</td>
<td>11.8</td>
<td>30,498,560</td>
<td>26,073,600</td>
<td>6,029,490</td>
<td>14,628,238</td>
<td></td>
<td>.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>2,971,570</td>
<td>64.4</td>
<td>28,692,480</td>
<td>36,787,200</td>
<td>21,063,627</td>
<td>15,311,686</td>
<td></td>
<td>1.16</td>
<td></td>
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</tr>
<tr>
<td>Ohio</td>
<td>1,343,827</td>
<td>12.2</td>
<td>26,073,600</td>
<td>35,867,520</td>
<td>6,120,561</td>
<td>13,061,627</td>
<td></td>
<td>0.99</td>
<td></td>
<td></td>
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<td>Illinois</td>
<td>542,531</td>
<td>21.1</td>
<td>26,073,600</td>
<td>51,749,120</td>
<td>22,994,600</td>
<td>17,426,885</td>
<td></td>
<td>0.48</td>
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<td>Minnesota</td>
<td>584,454</td>
<td>7.5</td>
<td>26,073,600</td>
<td>35,365,840</td>
<td>4,346,163</td>
<td>134,786</td>
<td></td>
<td>2.91</td>
<td></td>
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</tr>
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<td>Wisconsin</td>
<td>922,407</td>
<td>27.3</td>
<td>26,073,600</td>
<td>35,365,840</td>
<td>4,346,163</td>
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<tr>
<td>Indiana</td>
<td>630,560</td>
<td>21.2</td>
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<td>35,365,840</td>
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<td>0.48</td>
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<tr>
<td>Tennessee</td>
<td>1,238,898</td>
<td>10.8</td>
<td>26,073,600</td>
<td>26,769,680</td>
<td>12,755,802</td>
<td>12,755,802</td>
<td></td>
<td>0.56</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1930 figure.

*Aggregate receipts include both revenue and non-revenue receipts. The former are all receipts recorded in the books as having been received on revenue accounts. They increase the assets without increasing debt liabilities or decrease the debt liabilities without decreasing assets. Non-revenue receipts are all others and must be set up to secure a complete statement, although they do not result in an increase in net value of assets.

*Operating expenditures are those devoted to maintaining and operating the governmental departments.

*Capital investments comprise the amounts paid by the state for acquisition and construction of more or less permanent properties and public improvements.

*Increased to $357,351.00 in 1933-34.

*Increased to $415,430.00 in 1934.

*Increased to $547,000.00 in 1933-34.
as expressed by cash expenditures has been negligible. Missouri is wealthy enough to carry on a substantial forestry program if the record of neighboring states has any meaning. Considering the benefits to be derived from a constructive forestry program, discussed in “Purposes to be served by reforestation in Missouri” and “Prospective contributions of forest restoration to wealth and income in Missouri,” the state is justified in setting aside part of its cash resources for forestry.

NEEDED ADMINISTRATIVE AGENCIES

By R. H. Westveld
University of Missouri

Amendment 4 to the constitution of Missouri makes it possible for the State to undertake a forest restoration program. Among other things this amendment provides that “The control, management, restoration, conservation and regulation of the bird, fish, game, forestry and all wildlife resources of the State, including hatcheries, sanctuaries, refuges, reservations and all other property now owned or used for said purposes or hereafter acquired for said purposes and the acquisition and establishment of the same, and the administration of the laws now or hereafter pertaining thereto, shall be vested in a commission to be known as the Conservation Commission . . . . A Director of Conservation shall be appointed by the Commission and such director shall, with the approval of the Commission, appoint such assistants and other employees as the Commission may deem necessary.”

It is obviously the duty of the Conservation Commission to provide for the administration of the state-owned forest resources. The experience of states that have been successful in forest conservation demonstrates that such a program can be carried on most effectively by a separate department (Forestry Department or Division) responsible to the Director of Conservation. The head (State Forester) of such a department should be equipped with both technical training and experience in forestry. Included on the staff of the State Forester should be technically trained assistants to: (1) administer the state forests, (2) organize forest fire control on state forests and private lands in cooperation with the U. S. Forest Service and private land owners, and (3) promote the practice of forestry on private lands in cooperation with other state and federal agencies. This should be supplemented by a technically trained field force to administer individual administrative units and an adequate clerical force. Full details of the state forestry organization are set forth in the section “An administrative plan.”
X. A Long Time Plan for Reforestation in Missouri.

A RESEARCH PROGRAM

By WILLIS M. BAKER

United States Forest Service

A comprehensive, long-time plan for forest restoration in Missouri must necessarily include a program of research adequate to yield information that is essential to the successful realization of desired objectives. In the preparation of this report various interested agencies have been invited to contribute. This section dealing with a forest research program has been assigned to the Central States Forest Experiment Station, which represents the Research Division of the U. S. Forest Service in the central hardwood region.

The Necessity For Forest Research

Preceding sections of the report have stressed the importance of conserving and developing Missouri forests and the resources of timber, water, soil, and wildlife which forests foster and protect. The necessity for increased local and State effort as a part of the nation-wide conservation program to restore and perpetuate these essentials of basic wealth has been duly emphasized. It is equally important to recognize the dependence of such a program upon research. As is the case in every great enterprise, whether it be undertaken by private capital in industry or by conservation agencies for the public good, research must keep pace with practice and administration for successful accomplishment. Otherwise, lack of knowledge is certain to impede progress; costly mistakes and delays become inevitable. This fact must be kept constantly in mind by those engaged in, or responsible for, the forest restoration program in Missouri.

Forestry is still relatively new in this country. The application of sound practices and proven methods is retarded almost everywhere by lack of basic information. The development of forest resources and the management of forest lands involve a vast number of interrelated technical, economic, and social problems, the solution of which is absolutely dependent upon knowledge which can be obtained only from studies and experience.

When forest research has not been undertaken on an adequate basis well in advance of forest administration, it becomes necessary to
depend to some extent upon trial and error methods, with full recogni-
tion of the tremendous costs, the numerous mistakes, and the discourag-
ing delays inevitable in such a procedure. However, to proceed entirely
on this basis, without immediate provision for a comprehensive pro-
gram of research, is too short-sighted even to be considered.

The situation in Missouri is especially critical. In the proximity
of the prairie region climatic conditions unfavorable to the establish-
ment and growth of trees complicate the silvical problems of the for-
ester, already made difficult by the fact that the characteristic upland
oak-pine types represent relatively early and critical stages of forest
development. Many years of excessive cutting, repeated burning, con-
tinuous grazing, and serious erosion of top-soil have depleted the forest
growing stock and have further exhausted the Ozark soils which origi-

nally ranked none too high in the scale of potential forest productivity.
Added to all this is the fact that, until recently, very little forestry work
has been undertaken in Missouri, so that there is little local experience
or precedent to guide the foresters, most of whom have received their
training and experience in other regions.

Faced with this situation, Missouri cannot afford to jeopardize
the success of her forest restoration program by failing to provide
adequately and immediately for research.

Some Urgent Problems

An attempt to describe, or even to mention, each of the many
problems requiring investigation would necessitate a complete resume
of all sections of this comprehensive report. Compared with what
remains to be learned, relatively little is now known about the man-
agement of forests, their establishment, growth, improvement, protec-
tion, utilization, and regeneration. Sufficient information is lacking on
the influences of forests in the control of erosion and run-off, or in pro-
viding a habitat for wild life. The relationships between tree growth
and soil and climate are imperfectly understood. The economic aspects
of many phases of forest land use in relation to human development
and public welfare require more study and clarification. Problems of
forest ownership, organization, taxation, and finance are of great
importance.

One might continue at length to enumerate these major or exten-
sive problems, each of which is made up of a multitude of more intensive
or minor problems which require investigation, and so on indefinitely.
For example, forest planting is undertaken for many different purposes
under a wide variety of conditions. A large number of tree species may
be used. One of the first steps in any planting project is the production
of nursery stock, and one of the many nursery problems encountered is the selection of tree seed. To assure the best results seed studies are necessary, involving their origin, production, collection, treatment, and storage, and each one of these problems may require a number of interrelated investigations. To continue this breakdown for all major forestry projects mentioned in this report would serve no purpose other than to emphasize the vast scope of a comprehensive forest research program. It may be desirable, however, to describe briefly a few of the more urgent problems that demand immediate attention.

Forest Management.—Plans of organization are now being devised by State and Federal agencies to provide the best possible management of Missouri's extensive forested areas, now in such a deplorable condition through years of abuse and neglect. To carry out these plans successfully, the agencies concerned must know the methods of management which will restore and maintain forest productivity. In the Ozarks the problem of fire control requires immediate attention to determine the extent of damage caused by the general practice of annual burning. Does the amount of damage exceed any possible benefits of burning, and if so, what methods of fire prevention and control should be employed? The fire problem is closely associated with that of livestock grazing, and again the questions arise:—what are the actual benefits and financial returns of woodland grazing compared with the damages and disadvantages? Can timber and livestock production be carried on together satisfactorily, and if so, how? The problems of burning and grazing involve not only economic questions of land use and community development, but also those of silvics in timber production. Because of past practices, what is the present condition of the forests as to composition of species, thrift and vigor, rate of growth, value for certain products, and the amount, kind, and quality of their reproduction? How can any or all of these conditions be improved, if necessary? What methods of harvesting and utilization are necessary to provide maximum returns, and at the same time to guarantee satisfactory regeneration for sustained production?

Forestation.—Measures of proper land use require the restoration of a forest cover on abandoned, eroding, or depleted areas in all parts of Missouri, and public agencies are now sponsoring a greatly increased program of forestation on public and private lands. To assure the success of this undertaking it is first necessary to know the best tree species to plant for any given set of conditions. They must be suited to their intended use for certain products or for protective forest cover; adapted to the soils of the planting site and to local conditions of climate; able
to resist or survive the attacks of destructive insects, tree diseases, or other enemies likely to be encountered. It is also necessary to determine for each species what size, age, and condition of nursery stock is best able to withstand the hazards of field planting to give the most satisfactory establishment and survival on various soils and sites, and how such stock can be produced most efficiently and at the least cost in the nursery. Moreover, good nursery stock of desirable species must be handled, transported, and planted properly. Attention must be given to preparation of site, planting methods and equipment, spacing, mixture of species, subsequent protection, release from competing growth, and other measures of plantation establishment and management. Lack of essential information in any one of these many steps of a forestation project may result in complete failure.

Forest Influences.—The management of natural forest stands and the establishment of forests by planting may be undertaken primarily for the yield of products, for a protective cover to safeguard other resources, or for a combination of these purposes under carefully regulated multiple use such as is contemplated under the Missouri conservation plan. Accordingly it becomes necessary to learn more about the beneficial influences of forests, and how they may be maintained under different systems of management to meet various conditions. Recent disastrous floods and droughts emphasize the need for more information on the efficacy of forest cover in retarding the rapid run-off of rainfall and melting snow, in helping to maintain and regulate stream flow, and in conserving underground water supplies. The influence of trees in the control of soil erosion by water and winds needs more investigation, as well as the benefits of shelter belts and windbreaks to protect crops, livestock, farm homes, and communities. Success in restoring many kinds of game animals, birds, and other forms of wild life is dependent upon knowledge of management methods that adequately protect their shelter and food supply. The possibilities of more recreational use of Missouri's extensive forests and water by the public also require immediate investigation.

Economics.—The importance of further economic studies must not be overlooked, for the data they yield are often fundamental to the formulation of policies and to the establishment of organizations to carry them out. More information is needed on the relation of forestry projects to industry and to agriculture; on forest finance and taxation; on the problems of manufacturing, utilizing, and marketing forest products. We should have a better knowledge of conditions favorable to the expansion of private and farm forestry practices, as well as an
unprejudiced evaluation of the obstacles which may tend to obstruct the application of sustained yield methods, either generally or locally. An inventory of the forest resources of Missouri, similar to the forest surveys conducted by the U. S. Forest Service in other parts of the country, would prove most helpful to the agencies now organizing the forest restoration program.

Administrative Contributions to Research

All of the many problems referred to in this report, and others of importance which might have been mentioned, are closely interrelated. Therefore, it is self-evident that efforts toward their solution must be effectively coordinated if waste of time and money and duplication of effort are to be avoided. The cooperation of all interested agencies and individuals is essential. Yet it is not easy to direct attention to the intensive, technical problems of research at a time when most public agencies engaged in Missouri forestry are necessarily giving chief consideration to problems of organization and primary development.

The forest restoration program may be compared to an industry, in which the manufacturer builds and equips a factory so that certain products may be produced efficiently and sold profitably. Before he starts building he knows what he will manufacture and what methods of production he will use. The factory itself is not the main objective, but merely a means to an end. So we may conceive the efforts of public agencies engaged in acquiring, organizing, and developing Missouri forest lands: they are building and equipping the forest factory which will turn out its goods in the form of wood products, wild life, recreation, and beneficial forest influences. Unlike the manufacturer, however, conservationists have not yet learned all they need to know in order to get the results they want and expect. Now is the time to start obtaining this necessary information, and not after production is ready to start.

It cannot be too strongly emphasized that, until forestry and conservation projects are founded upon knowledge of facts resulting from fundamental research in basic sciences, many mistakes, delays, and even failures must be expected. On the other hand, projects already started cannot be postponed indefinitely awaiting the ultimate explanations of extremely intricate biological phenomena which eventually must be supplied through exact and time-consuming research. Certain activities must be carried on as well as possible under the existing circumstances with the information now available, and those in charge must often depend upon intuition and guesses in lieu of knowledge which should have been obtained before the work was started.
Faced with this difficult situation, every administrative agency and every individual engaged in forestry or associated projects should be alert to contribute as much information as possible to the deficient store of knowledge. This may be done through observations and progress records of work attempted. Reports of failure are valuable and may prevent others from making similar mistakes. Fact-finding investigations should be conducted at every opportunity. This job of acquiring all the knowledge needed is so large and so important that no possible contribution should be overlooked.

Information secured by what may be termed "non-research" agencies must be disseminated if it is to be used, and not buried in the files. Records and reports should be made available by publication in some form whenever possible, or else turned over to a research organization dealing with the particular problem. The closest possible contacts should be maintained by workers in the fields of administration and research. The investigator should be thoroughly familiar with the practical as well as the technical problems of forest work, so that he may anticipate the limitations often imposed upon his theories by actual conditions of woods operations. The administrator should know of research projects being undertaken and something of the methods of study used. His advice and suggestions are often invaluable.

Organization of Research

The ultimate success of the Missouri plan for forest restoration demands the immediate establishment or expansion of research agencies to carry on necessary experiments and studies. While the investigations, reports, and observations from all possible sources will prove most helpful and are needed to complement the organized research efforts, as has been pointed out, they alone cannot be expected to furnish more than a part of the information so urgently required.

Just how forest research should be organized in Missouri must be decided by the State and local authorities concerned. The prerogatives of the writer limit him to a general discussion of research organization which experience elsewhere has shown to be most efficient, and to a statement of present organization as it exists.

An effective research institution must have permanency of organization, finances and resources adequate to meet its objectives, and opportunity for continuity of effort. It must be relieved from interruptions so frequently imposed by various emergencies in administrative work; to insure this, organization upon a more or less independent basis is advisable. Correlation of research within an institution, and coordination of effort between research agencies, are very necessary to avoid
loss of time, waste of funds, and needless duplication. Concentration of research within a few organizations is an aid to coordination, whereas dissipation of effort among many makes this more difficult to achieve.

Various state and federal agencies and certain individuals have contributed the present knowledge pertaining to or associated with Missouri’s forest problem, but most of this has been in the related fields of land utilization, rural economics, soil and water resources, park administration, and game management. The extent and sources of this information are indicated in previous sections of this report, so they need not be repeated here.

The two major research institutions now chiefly and directly concerned with technical problems of forestry and forest land management are the Agricultural Experiment Station located at Columbia with the University of Missouri, and the Central States Forest Experiment Station, which represents the Research Division of the U. S. Forest Service in the central hardwood region. Since this section of the report deals primarily with forest research, further discussion and recommendations will be confined to these two institutions.

Much of the available information concerning the scope and economic aspects of Missouri’s forest problem in relation to land use is the result of investigations by members of the Agricultural Experiment Station and the University. Courses in forestry are now taught to students in the College of Agriculture and an extension forester has been employed to advise and assist farm woodland owners, but relatively little technical forest research has been attempted as yet. Minor projects now under way include studies of fence post durability, site requirements and growth of native tree species, artificial propagation of trees and shrubs, and the possibilities of Christmas tree crops. These should be continued and extended.

In view of the great need for more information dealing with forestry technic, methods, and results, it would appear logical and highly desirable to increase the program of forest research at the Missouri Agricultural Experiment Station and University, with special emphasis on important problems of farm forestry. This institution has a splendid background for such a program, with its established departments of forestry and horticulture, rural economics, botany, soils, zoology, biology, animal industry, agricultural engineering, and others. Its contacts with rural organizations and problems place it in a most favorable position to promote the practice of forestry on private and farm lands, and to cooperate most effectively with other agencies in the solution of all forest problems. The success of forest restoration in Missouri demands that the most be made of these opportunities.
The Central States Forest Experiment Station was created by act of Congress and established at Columbus, Ohio, in 1927, for the purpose of obtaining essential facts and information necessary to the development of sound forestry practices in the central hardwood region, which extends from Ohio to Iowa and south through western Tennessee and northern Arkansas. Since most forestry problems are not limited to one locality, but usually are common to a considerable region covering several states where forest, soil, and climatic conditions are similar, the region-wide approach of the Station to the solution of these problems is not only economical, but it also permits of very effective cooperation with many local, state, and federal agencies. This, in turn, provides for a comprehensive appreciation of all phases of a problem, as well as an excellent opportunity to promote coordination of effort in research.

The Forest Experiment Station has initiated studies pertaining to many phases of forestry, including the growth and yield of important tree species; grazing damage to farm woods and their recovery after removal of livestock; regeneration and silvicultural management of upland hardwood forests; causes and extent of timber defect; nursery practice and forest planting; relation of soil and site conditions to tree growth, and the protective influence of forest cover on the porosity and water absorption of soils. The U. S. Bureau of Entomology and Plant Quarantine has maintained an entomologist at the Station for forest insect investigations, with emphasis on locust borer control; a forest pathologist of the Bureau of Plant Industry provides regional service in forest nursery problems. Recently field branches have been developed on Experimental Forests set aside for the use of the Station on National Forest lands in the adjoining states of Arkansas and Illinois.

The territory served by the Station is so large, the agencies requesting help and cooperation are so many, the important problems requiring immediate investigation are so numerous, and the financial resources of the Station have been so limited, that very careful consideration of projects has been necessary to prevent an ineffective dissipation of effort. This situation still exists. Much of the Station's present work pertains directly to Missouri problems, and, recognizing the importance of the Ozark forest region, it is making every effort to expand its services here as rapidly as additional funds make this possible.

To summarize, the continuation and immediate expansion of forest research are vital to the success of the Missouri forest restoration program. This requires the active cooperation of all interested agencies
and individuals, in addition to an organized expansion of the research effort. The two major research agencies now organized to carry on in this field are the Missouri Agricultural Experiment Station and University, and the Central States Forest Experiment Station. Both are equipped to make contributions vital to the success of the forestry program, if their resources are expanded in proportion to the urgent need for more forestry knowledge. Needless duplication and waste of time and effort in research should be prevented by effective cooperation and by coordination of the investigative projects of all agencies.

A FISCAL PLAN

By Conrad H. Hammar

University of Missouri

Introduction

Considering the confusion of present-day taxation in Missouri it is a bold undertaking to attempt to outline a fiscal plan for the support of public aspects of reforestation. Perhaps some future confusion may be avoided, however, by attempting to lay down certain broad principles for such a plan.

The criteria of taxation are in actual fact many, but, aside from sheer expedience, only two or three are of major importance. These are, (1) taxation according to benefit, (2) taxation according to ability to pay, and (3) taxation of socially created incomes. The Missouri fiscal system as it now stands follows no one of these criteria. Some attention in formulating tax laws has been given to benefit, some to ability to pay, and a large amount to expediency.

The Tax Payer and the Benefits from Conservation

The consideration of benefit has been of some note. It underlies, for instance, the levying of gasoline and automobile license taxes upon those who benefit most from the use of roads to which the funds collected are devoted. It apparently underlies to a lesser extent the sales tax which weighs more heavily upon the poorer than the wealthier members of the population which is used to provide such social programs as relief and old age pensions which go chiefly to poorer people. Sales taxes are means by which the poor are taxed for the benefit of the poor.

From the viewpoint of benefits, taxes for the support of conservation may be given a very broad base because so many groups benefit. Indeed, so broad is the diffusion of benefit that such general taxes as
the sales tax, the general property tax, the income tax, and others of like nature are distinctly eligible fiscal devices for financing the programs.

However, among the general groups that benefit, some groups benefit most. Such, for instance, are those that own forest land that receives protection from fire because of public fire control programs, and the sportsmen (those interested in hunting and fishing), and the recreationers. For these groups application of some forms of taxation in direct accord with the theory of benefits will provide a certain amount of funds. Thus the Game and Fish Commission of Missouri that existed up to July 1, 1937, was supported almost wholly from fees derived from the sale of hunting and fishing licenses upon the obvious presumption that the department interested in the propagation and protection of game should be supported by those receiving the greatest benefits from its activities.

The closest parallel to this latter situation with respect to reforestation lies in the case of the benefit to property owners of the protection from fire. The prevention of fire as indicated in preceding sections is one of the primary requisites of forest restoration. Almost certainly, in time, it will be necessary to create fire districts, so-called, for the purpose of administration and control of burning. Where this is done, the levy of a tax on the protected property upon a special assessment basis is perhaps the most equitable way of financing the program. However, not only the property owner, but the public as well benefit in a number of ways from the control of fire. It makes recreational property as well as forest property safer. It protects wild life and facilitates the accumulation of forest debris and leaf mold which acts not only to check erosion but greatly increases the retentive capacity of soils for water and thus acts as a preventative of floods. Because the public is interested in these latter benefits a number of states have provided for an appropriation from general revenue drawn from a broad tax base to be used to supplement local levies collected to pay the cost of fire control. Financing the control of fire illustrates, therefore, the nice balance between private benefits on the one hand, and public benefits on the other as a basis for a fiscal policy.

Ability to Pay As a Basis For Support of Reforestation

When benefits are diffuse, indistinct, or remote, the usual dependence in tax policy is on ability to pay. Many of the policies and programs of the state are of an excessively long time nature. This is particularly true in the case of forestry where many benefits will not accrue until the period of the harvest which may be delayed in many cases
as many as fifty or more years. The state arrogates to itself the privilege of collecting taxes regardless of benefits and upon the assumption that for the long time support of the state and for the general benefits that accrue therefrom, the citizen owes in proportion to his ability to pay. It would appear, therefore, that this particular criterion of taxation would be the basis upon which to finance much of the reforestation program. It is the public rather than the private owner that benefits chiefly from efforts at flood control. It is the public also, rather than most present day private property owners, that will benefit from the long-delayed returns from forest restoration. A clear case of this kind resides in any program to bring tax delinquent lands under public control for purposes of forest restoration. There are millions of acres of such lands in Missouri. Some programs must be found for them. They are, on the whole, the least productive, most denuded of all lands as indeed their tax delinquent status indicates. Private individuals apparently have not found it worth their while to regenerate tree growth upon them. If, as the authors of this report believe, a public program is advisable, the cost of it should be financed upon some such basis as ability to pay or upon the basis of the general tax program of the state: that is, by appropriations from general revenue.

**Taxation of Publicly Created Values**

The last criteria of taxation, that of appropriating for public purposes publicly created values and incomes, is vigorously advocated by a small minority of the population and is as theoretically defensible as any other basis but has gained little foothold in Missouri. It is the program of the land value taxationists, or single taxers, and is based upon the idea that land owes a great part of its value to its site. That is, it is the presence of people and the demand created by them that gives land its value and it is to the public, therefore, that these values belong. Until there is a wider acceptance of this principle of taxation, however, little is to be gained by indicating the dependence upon it that a reforestation program might have.

**No Special Problems of Tax Morality Involved**

The conclusions to be drawn from these considerations are that a fiscal program for forest restoration in Missouri, while it may upon occasion have reason to resort to the benefit theory, should rest in the main upon much the same criteria of taxation as that employed for the general fiscal program of the State. That is, no special problems of tax morality of the community are involved. If the tax morality of the
community is bad, that is rather a special problem in its own right without any direct bearing upon conservation programs.

**Specific Taxes and Special Fund Arrangements**

Among the devices not uncommonly used for fiscal purposes in the financing of reforestation programs in various states are the use of specific taxes and the provision for special funds. Almost any new public program attempts in its initial stages to put itself in a favored position by courting legislative enactments to give it certain specific and assured sources of revenue.

**Advantages and Disadvantages of Specific Taxes**

Such specific tax and special fund programs have their limitations. It may be worthwhile to take up directly the proposal to levy, as an illustration, a tax of five cents per one hundred dollars of valuation on general property as a means of providing money for the purposes of the forest restoration program. Such a tax would provide annually more than a million and a half dollars of revenue upon the basis of the present assessed valuation of property in Missouri. The revenues would be designated to reforestation and would not need appropriation each biennium.

The advantages of the establishment of such a fund are the security that it would provide for the program and particularly the possibility of long range planning of administration that is so necessary where forests and lands are concerned.

These are formidable advantages but there are quite as formidable disadvantages. In the first place, the rigidity of such a specific tax is undesirable. To forecast just what the people of Missouri will wish to expend upon reforestation and conservation generally, particularly at the inception of the program, is quite impossible. The public in some states has moved forward rapidly in conservation matters. In other states it has held back. Second, it is not easy to measure progress in conservation. In the case of the road program, financed with specific taxes and funds, the lengthening mileage of graded, drained, and surfaced highways are obvious measures of the effect of the expenditures of road funds. The effects of reforestation are, in the first instance, much more localized than is highway building, and in the second place, will be for years to come in the intangible form of unmarketable timber growth. The use of specific taxes is safest where progress is easily measured. The third objection is that a fixed levy of the kind suggested above would tend to provide too great a revenue to be expended efficiently at the onset of the program and probably too little
revenue at later stages after the program has reached administrative maturity. Changing the rates to provide flexibility, that is, to provide smaller amounts at first and larger amounts later, would essentially thrust the program back into the hands of the legislature since the legislature only can decide what the proper rate and the proper changes should be.

Thus, while there are certain difficulties in divorcing the program from a calculable revenue, the advantage appears to be on the side of permitting the legislature to exercise its judgment from biennium to biennium upon the basis of (1) the performance of the administrative agencies under which reforestation is carried on, and (2) the state or stage of public opinion with respect to forest restoration.

A Tax Reversion Law

While the discussion above has indicated only broadly the nature of the fiscal plan for the support of conservation, there are certain aspects of the plan that call for much more specific treatment.

The first of these is the need for a reversion law relating to tax delinquent lands. As noted in a previous section, there are great acreages of such lands in Missouri, particularly in central Ozark counties. Owners have ceased to pay taxes on them, often for as many as five years. An analysis of the disposal of such lands at periodical public tax sales indicates that they fail to sell for enough to bring in any net revenue.

These tax delinquent lands are also those upon which private initiative has failed most dismally to provide a satisfactory use. Other states troubled with the same malady have turned to state administration of these lands for state forest purposes. Missouri could well do likewise. One of the best means for acquiring a body of land for state forests would be through State acquisition of tax delinquent lands under a carefully prepared reversion law. Such a law should provide that the delinquent lands, after allowing a sufficient period to permit owners to take suitable steps to protect their interests, should revert to the state. Other states have laws of this kind.

While there are a number of difficulties standing in the way of writing a suitable reversion law for Missouri, the task is not impossible. Enactment of a suitable reversion law, will, it is true, provide no immediate revenue, but it will make such revenue as is provided go further for purposes of land acquisition. Furthermore, in order for a state to qualify for Federal help under the so-called Fulmer Act (H. R. 6914) a tax reversion law must have been passed by June 30, 1942.

1. See, for instance, Chapter VIII, "Land Use in Northern Minnesota," Jesness and Nowell.
A second matter for special consideration in preparation of a fiscal plan is a provision for subsidies to local governments in areas where land acquisition for purposes of reforestation further depletes the already low volume of taxable wealth per capita. As noted heretofore (See Section V, "Problems of Local Governmental Maintenance During the Transitional Period") per capita taxable wealth in Ozark counties, where most tax delinquent lands lie and where most public acquisition of lands for reforestation purposes will take place, are those in which per capita taxable wealth is already lowest. It would be unfair for the State or National Government to acquire land and thus deplete further the low level of per capita taxable wealth in these counties unless some provision is made at the same time to reimburse local governments for their loss in fiscal wealth.

One of the parts of the fiscal plan must be, therefore, to provide for such a subsidy. Under the Wisconsin Forest Crop Law a subsidy of this kind is in part provided though under somewhat different circumstances. The report on Forest Land Use in Wisconsin prepared by a special committee appointed by Governor La Follette includes the following relevant statement, "The towns (the principal local governments in the Wisconsin cut-over area) are the direct and principal beneficiaries of Forest Crop Law. They receive in lieu of the property tax that would be levied on the acreage entered (under the law) ten cents per acre from the state and ten cents from the owner. When title is taken to delinquent tax lands by the counties, these lands are removed from the assessment roll. If they are entered under the Forest Crop Law, though the county pays no acreage share, the state pays ten cents an acre to the towns."

Missouri has no similar forest crop law but needs to take special steps to provide for the maintenance of the weakened local governments that will result from any extensive program by state or federal governments.

**Financing of Fire Control**

A further item needing special consideration in a fiscal plan is the provision for fire control districts and their financing. Only if the state steps in to meet the obligations of the public (which, as noted heretofore, benefits as well as the private owner from a fire control program) will it be possible to inaugurate a coordinated and directed
fire control system. Provision for fire control districts is a supplement-ary rather than an integral part of a fiscal plan but the financing of fire control is of direct concern.

Perhaps in this instance because of the extraordinarily great impor-tance of the fire control program and because of the ease with which it can be planned for a great period in advance it would be possible to depart from the dictum laid down above that the program not ask for specific taxes and special fund arrangements. It appears in other words, worthwhile to suggest that a small, perhaps one-half cent or one-fourth cent, levy upon general property in the state be made to finance the state's portion of the fire control program. There would be abun-dant use for such funds immediately in the construction of fire towers and telephone lines before the State acquired any appreciable amount of land and before owners had organized fire control districts. The money thus received would not, therefore, lie idle awaiting develop-ments of other parts of the program.

The Opportunity to Use Relief Labor

Planning for the judicious use of federal and state monies spent locally for relief on community projects either directly or indirectly related to forest restoration is a fourth specific item for special con-sideration in the preparation of a fiscal plan. The prospects that expenditures for relief will be of some magnitude over a considerable period is rather generally accepted. Furthermore, relief loads has not only been heaviest in the Ozark areas where forest restoration is of greatest importance but it is in these very areas also that the necessity for relief expenditures is likely to continue for the longest time.¹

The relevance of this fact to the forest restoration program occurs because the problem of reforestation is greatest in the very areas in which relief payments are likely to be continued longest. Judicious long time plans to make use of relief labor on conservation and refor-estation works might, therefore, be able to accomplish much in the suc-ceeding decades in Missouri. Again while such a plan perhaps does not provide specific monies, it accomplishes much the same thing by giving the administration of the reforestation program an opportunity to tap resources about as good as those obtained from direct monetary receipts.

¹. See "The Farmer and the Cost of Local Rural Government in Missouri," Missouri Agricultural Experiment Station Bulletin, No. 385, pp. 48-55.
Planning and Research as a Basis For Soliciting Support

As a final item for special consideration there is needed, both before and during any program of acquisition, an adequate body of research and survey work to establish even more closely than the present report has attempted to do, the location, area, and character of the lands to be purchased for reforestation. The experience of other states shows almost universally that they have regarded such research as a vital preliminary to their programs.

In New York State, for instance, there was introduced in January, 1927, into the Senate of that state a bill proposing the creation of a debt of $100,000,000 for a reforestation program. Perhaps the proposal carrying so huge a sum was not introduced with the serious thought that it would carry immediately but rather that it would stimulate interest in the reforestation program. This it clearly did since in the following year the legislature passed a law creating a Reforestation Commission, later appointed by the then Governor, Alfred E. Smith. The Commission presented its report which was published in 1932 and in that report are contained the following important paragraphs relevant to the need for research to underlie a reforestation program.

"The first work of the Commission was a survey of the idle lands of the state. It was known that New York State farms were reported to have been abandoned at the rate of about 40,000 acres per year from 1880 to 1920. . . . .

"The Commission decided to determine, first, the location and extent of additional farm lands that could be obtained in areas of 500 acres or more for reforestation purposes, and that could probably be purchased at a price that would justify their being reforested. . . . .

"In addition to the survey of idle lands, the Commission held public hearings from time to time at which representatives attended from practically every state organization interested in forest conservation, fish and game, as well as agricultural economists, lumbermen, Chambers of Commerce, and other public organizations, and the representatives of these organizations gave their views, which were found by the Commission to be very beneficial in its work."  

PLATE X.—Fire protection and other good management practices have produced the dense stand of shortleaf pine shown in the upper picture. Whether land adequately stocked with trees will provide enough forage to sustain grazing livestock (as in lower picture) still is a problem for further investigation. (Photos by courtesy U. S. Forest Service.)
The work of this Commission helped to advance the program of forest restoration now being carried on in New York. It is significant also that the research work upon which the New York program is based has been carried on continuously ever since. For the latest bulletin, published in connection with this program, see Cornell University Agricultural Experiment Station Bulletin, No. 654, "An Economic Study of Land Utilization in Chenango County, New York," prepared by H. S. Tyler under the direction of Professor T. E. Lamont.

Other states began their programs even before that of New York, The Michigan Land Economic Survey having begun in the early 1920's. Similar work has been done also in Wisconsin where a whole series of studies were made. Typical of these studies is that entitled, "Making the Most of Washburn County Land," published as a special circular of the Extension Service of the College of Agriculture of the University of Wisconsin in October, 1932. An equally significant study for the same state published in 1929 related particularly to Bayfield County. The Province of Manitoba also inaugurated and carried on a survey of its unused lands in 1926. In Minnesota a number of surveys have been made starting first with the inventory of the lands owned by the state, the results of which were published in a report submitted to the Legislature in 1928. The report was made under the direction of the Conservation Commission. Still later in this same state a comprehensive study of a typical county (Hubbard County) in the cut-over region was made. This report, presented as Minnesota Agricultural Experiment Station Bulletin, No. 317, is significant in connection with the advanced conservation policies of that state.

Since the area of lands needing reforestation is about as large and the forest problems of Missouri as complex as in Minnesota, Wisconsin, Michigan, or New York, the need for similar and continuing research upon which to base the program in this state is quite as great as it has been in those that have been mentioned.
AN ADMINISTRATIVE PLAN

By E. Murray Bruner
United States Forest Service

An earlier section ("Needed administrative agencies") calls attention to the existing facilities which by proper development can provide for an effective state forestry program and suggests in a general way the nature of the administrative organization that should be developed. Details of such a plan are outlined in the following paragraphs. The chart which follows is meant merely to suggest a logical organization set-up.
State Forests

As may be seen by reference to its reports, the Missouri State Planning Board has pointed out the desirability and economic and social necessity for a very large aggregate acreage of forest and wildlands being acquired and administered as State forests and game refuges. A number of State-owned areas are already being handled as State forests and game refuges. Each of these can be used as a nucleus for the establishment of a State forest unit of whatever size may prove to be economically and administratively desirable.

In anticipation of funds being made available under the Fulmer Act (see Federal Aids in Forest Restoration and Maintenance) a number of areas in addition to the existing State forest units have already been designated as desirable for purchase by the Federal Government as Fulmer State Forests. Thus it is hoped to establish in a reasonably short time a definite, carefully planned system of State forests by direct acquisition of lands by the State and through the operation of the Fulmer Act which authorizes purchases of lands by the Federal Government for State forests.

As indicated in the organization chart the following kinds of work of major importance should be carried on in connection with the administration of the system of State Forests:

**Administration.**—Selection, employment and training of personnel for specific job specifications, fiscal and financial control, and general supervision of personnel and work projects.

**Acquisition.**—Examination, appraisal and option of lands to be acquired for State forests, examination of title, etc.

**Research.**—Silvicultural, grazing and forest products utilization studies in cooperation with other State and Federal agencies. (See “A Forest Research Program” by W. M. Baker).

**Water Conservation.**—Stream and lake improvement, small dams, prevention of pollution of streams and springs.

**Erosion Control.**—By establishment and maintenance of forest cover and regulation of grazing.

**Recreation.**—Provide picnic and camping facilities, scenic trails, etc.

**Improvements.**—Construction of roads, trails and structural improvements needed on State forests.

**Forest Development.**—Forest tree nurseries and planting, timber stand improvement by thinnings, liberation and weeding and marketing of mature timber.
Private Forestry

The broad land-use plan as outlined by the State Planning Board calls for the eventual acquisition of several million acres of forest and wild land for national and state forests, parks, game refuges, etc. The national forest program is definitely under way with encouraging initial progress already made, and it is of course anticipated that definite state forests, park and game refuge programs will be speedily set up under the Conservation Commission. But even though the most optimistic view is taken toward the attainment of the goal set by the State Planning Board, it must be realized, nevertheless, that because of its tremendous aggregate area the bulk of the forest and wild land within the borders of the State must necessarily remain in private ownership for at least many years, and that doubtless the greater part will so remain permanently.

It will be the function of the Section of Private Forestry to sponsor and promote the conservation and development of all privately owned forest and wild land. Broadly, such lands may be grouped into two main divisions or classes. First, lands in relatively large ownerships, including timbered tracts, cut-over forest and more or less abandoned wild lands in ownerships or blocks of 1,000 acres and over. Second, small forest and woodland areas, especially farm woodlands and non-agricultural lands included in farm holdings which should be considered potential forest land.

In its program for promoting the practice of forestry and multiple land-use on the larger timber and cut-over areas, the Section of Private Forestry will no doubt find it desirable and practicable to develop to the fullest extent possible cooperation of appropriate Federal and other State agencies, including the national forest organizations, University of Missouri, and other sections of the Conservation Commission.

In the vitally important field of farm forestry the primary function of the Section of Private Forestry would seem to lie in giving all possible assistance to the Extension Service of the College of Agriculture which is charged with the responsibility for educational and demonstrational work in forestry on farms. All trees for planting in farms can be produced in the State Forest Tree Nursery under the administration of the Division of Forestry. As already pointed out (Federal Aids in Forest Restoration and Maintenance), the Federal Government cooperates with the States under Section 4 of the Clarke-McNary Law in the production and distribution of forest tree planting stock to farmers.
Likewise the Extension Service receives Federal Government cooperation under Section 5 of the Clarke-McNary Law in educational and demonstration work in farm forestry.

Forest Fire Control

The functions of the Forest Fire Control Section have been fully set forth in "The Problems of Protection—Fire Control," to which reference is made.

Land Use Planning

Broadly, it is the aim of land-use planning to determine the logical and desirable division of forest and wildland ownership (exclusive of farm woodlands and small scattered areas) between private holdings, State (and County) and Federal agencies with due attention to the ability of each to manage such lands in the public interest. Important factors to be taken into consideration include multiple-use of land, forest practice rules, forest zoning, forest fire and forest taxation laws.

Unquestionably, the Division or Department of Forestry will be called upon to play an important part in the field of land-use planning in cooperation with other appropriate State and Federal agencies.

In order to decentralize the actual field administration of the various essential conservation activities to the greatest practical degree and to insure the largest possible measure of coordination in planning and conduct of the entire field of work the type of field administration organization shown on the opposite page is suggested for consideration.

Under this suggested kind of an organization set-up the central office staff would function primarily as a policy making body and as a general supervisory and inspection force. The goal sought is to get actual administration of the field projects handled by the man on the ground. With this purpose in view administrative duties are delegated to the field force to the fullest extent practicable.

The successful working out of a field organization of this type is contingent first of all upon the selection of thoroughly qualified and competent men as regional or area directors or supervisors. Since he must be in fact the administrative representative of the Director of Conservation and the Commission within his region or area, the regional area director or supervisor must necessarily be a man who has a comprehensive grasp of the entire field of conservation. He must possess outstanding administrative and public relations ability, and must be able properly and effectively to coordinate the great variety of activities which go to make up a well rounded conservation program.
With the proper type of man selected as regional or area director or supervisor, the next essential step is to provide him with such administrative and technical assistants as may be required effectively to direct and supervise the various district organizations which actually carry out on the ground the many activities which go to make up the complex conservation program of work.

Obviously, it is necessary also that the district supervisor be a man thoroughly grounded in the various phases of conservation, and that he, like the regional director or supervisor, be possessed of a high degree of administrative ability, since he is directly responsible for the actual conduct of every conservation activity under the jurisdiction of the Commission within his district.