The Forest Resources of Rural Householders in Dent County, Missouri

ALEX B. COLE AND RICHARD C. SMITH

SUMMARY

One of the major problems in Missouri is the high percentage of rural householders with low income. Low income rural householders are found throughout the state but there are more in certain areas.

One such area in the southeastern Missouri Ozark region coincides approximately with the most heavily forested region of the state. In the summer of 1957 a survey was made of one county, Dent County, in this region to determine the contribution of forests to the rural economy. The major results and conclusions are:

1. Of 158 houses in the sample 18 were vacant, 71 were nonfarm households, and 69 were farm households.

2. The total land holdings of farm households averaged 234 acres and nonfarm households averaged 70 acres. Approximately 50 percent of the land holdings of rural householders was forested.

3. In 1956, forest land provided an average income of 36 cents per acre for farm households, 14 cents per acre for nonfarm households, or 31 cents per acre for all households. Although fuelwood was the product most often cut, sawtimber made the greatest contribution to income. Fuelwood made the smallest contribution. Forests contributed more income as the size of total land holdings increased.

4. Most householders have a passive attitude toward protecting woodlands from fire. A minor group actively engages in annual burning of woodlands. Householders believe that investment in forestry practices such as timber improvement will not earn a satisfactory rate of return. Consequently, they did not express a need for credit secured by timber or timberland collateral.

5. The level of forest stocking ranges from poor to well-stocked. In general, the forests are well-stocked but the species composition and quality are undesirable. Seventy-one percent of the gross volume is in trees that will not make logs of sufficiently high quality to meet the minimum specifications for standard lumber logs. Of the trees that would make standard lumber logs, 21 percent of the volume is in grade three logs, 7 percent is in grade two logs, and only one percent is in grade one logs.

6. A number of sawmills offer a continuing active market for sawtimber, but opportunities for selling other forest products are limited.

7. Gross volume averages about five cords of pole-sized material and 1520 board feet of sawtimber per acre. More than one-fourth of this volume is cull material.

8. An average of approximately 400 board feet per acre of sawtimber stumpage worth about $4.00 is available for immediate income. Removal of this would leave about 650 board feet of higher-quality growing stock.

9. Approximately 94 board feet and 0.043 cords per acre of growth should be available annually for future income. At current market prices this would be worth 94 cents. This estimate is based on data from inadequately stocked stands that have experienced little, if any, improvement as a result of management practices. Managed, vigorous stands can be expected to yield greater returns.

10. Before any substantial increase in income can be expected it is imperative that *desirable* timber growing stock be built up by 400 percent or more. Desirable growing stock consists of species that grow rapidly, that have few defects, and are readily sold.

11. Improvement in timber quality offers the best prospect of increasing returns to the landowner. The greatest aid to improving timber quality is the development of markets for wood that is not now merchantable. Then, at least a portion of the undesirable trees could be removed at reduced cost or possibly at no cost to the owner.

12. The owner should exercise more control over his sales of timber, even under the sawlog economy now existing. He should mark trees for sale that need to be cut to improve the average quality of the stand retained and he should offer timber to several potential bidders to insure that he receives the highest possible bid. An excellent means of controlling timber sales, one landowners frequently do not take advantage of, is to get the advice of a Farm Forester. His knowledge of timber and of market conditions can provide a sound sale arrangement and this service is furnished at no cost to the owner.

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INTRODUCTION

One of the major problems in Missouri is the high percentage of rural householders with low incomes. The 1950 U.S. Census of Agriculture showed that 35 percent of rural Missouri farm families had cash incomes of less than $1000. Although incomes may be higher now, economic distress may be just as great because of higher costs of goods and services.

Rural householders with low incomes are found throughout the state but certain areas have more of them. One such area of 10 counties located in the southeastern Missouri Ozark region, designated in the census as Economic Area Eight, was described by the United States Department of Agriculture (1955) in its publication *Development of Agriculture's Human Resources* as being one of the serious problem areas in the United States. More than 50 percent of the commercial farms in this area had a gross income of less than $2500 annually, and the level-of-living index is among the lowest one-fifth in the nation.

The economic distress in this area is further illustrated by data showing that 29 percent of all rural families had incomes of less than $1000 in 1955. These incomes include all payments in money and kind made to every member of the household, plus the net income from the farm and other business, and the value of all products used in the home.

Farm families obtained only 22 percent of their income from farming. Wage work on other farms contributed another 2 percent. Nonemployment sources, such as old age pensions, yielded 31 percent and nonfarm employment yielded 45 percent. Nonfarm households obtained most of their income from nonemployment sources, with only 18 percent coming from nonfarm work and 7 percent from farm wage-work. Yet 80 percent of these nonfarm households had land holdings of more than three acres, but they were not classed as farms because they did not produce at least $150 annually from crops, livestock, poultry or timber.

The apparent reasons for low incomes were the small size of the farm business and the limited ability of the family heads to work because of age, ill health, or both. The major economic problem, according to Bird, Miller and Turner (1958) is not with employment of the younger and most active members of the labor force but rather with finding increased income for older and less active people.

Economic Area Eight coincides approximately with the most heavily forested region in Missouri. In this area the percentage of total land area in forest by counties varies from 54 percent to 85 percent (Figure 1) with an average of 76 percent for the ten counties, (King, Roberts and Winters, 1949). But Bird, Miller and Turner (1958) reported that forest industries provide only 8 percent of the nonfarm employment income for nonfarm households, and 11 percent for farm households. The contribution of forests to incomes in the form of products for home consumption is unknown. The contribution of forest product sales to income is 3 percent for farm households, and is unknown for nonfarm households. It is evident that forest resources and industries in this area are not con-

Fig. 1—Percentage of land in forests by county in Economic Area Eight. Dent County, located in the northwest corner, is 70 percent forested.

tributing their full share to the welfare of the local people. Much of the forested land is in the hands of local residents and sales of forest products could increase their income.

This study concerns Dent County in Economic Area Eight. Our objective is to provide information on the timber resource and past income from forests, to indicate how forests might be made to yield more income.

Factors that influence immediate income obtainable from forest land are species composition, level of stocking, volume per acre, tree size and quality, and available markets for primary forest products. These same factors with the addition of tree vigor, rate of growth, future markets, and the landowners' objectives and attitudes influence future income.

To obtain information on these factors, a random sample of open-county householders was interviewed. They were householders located outside incorporated towns and unincorporated places that had an estimated population of 100 or more persons or a density of more than 100 persons per square mile.

Past sales of timber were recorded and each householder was questioned about his woodland practices, his need for bank credit, attitude towards and frequency of woodsfires, and the desirability of doing timber stand improvement work. His attitudes concerning these matters may indicate in part why timber income is so small.

A timber inventory on land belonging to each householder was made to determine forested area, timber volume and quality, and rate of tree growth. Inventories were implemented by the use of aerial photographs followed by a check cruise on the ground. In addition, existing markets were investigated on a case-study basis to determine the type of products purchased, price paid and market location.

The collection and analysis of data are described in the Appendix.

RESOURCES RELATED TO LAND-USE

Location

Dent County is in the southeastern Ozark region. The county seat and largest town, Salem, near the center of the county, is approximately 125 miles southwest of St. Louis and 95 miles south-southeast of Jefferson City. The county contains 756 square miles of land area, of which approximately three-fifths is in farms.

Geography

Highways provide the primary means of transportation. Four state highways connect Salem with other parts of the state. They are hard-surfaced, allowing

rapid movement of traffic, but are crooked because of adverse topography. Several secondary roads are also hard-surfaced. Roads of gravel and graded-dirt leading to farms are often rough but most of them are passable under all weather conditions. A spur line of the St. Louis and San Francisco Railroad provides freight transportation into Salem. In general, transportation facilities are adequate for movement of even the most perishable farm commodities.

A humid continental climate characterized by warm summers and cool winters prevails. Much of the average annual rainfall of approximately 43 inches is received during the spring. Wide variations in daily, monthly, seasonal and annual rainfall and temperature are experienced. Although these variations are usually of short duration their effects are important. In many years the lack of soil moisture is critical for vegetation in July and August (Decker, 1955). The growing season, averaging approximately 180 days from mid-April to mid-October, is adequate for growing most small grains and legumes.

If cleared of forests, the topography in much of Dent County is not so rough as to prohibit cultivation or grazing of the land if careful management practices are followed. Figure 2 indicates the general topographic range in the county, which varies from gently rolling land to rugged hills. The central and northwestern parts of the county are rolling prairie. This is not as rough as the eastern and southern sections, where narrow creek bottoms bordered by steep hills are found.

Elevations range from a minimum of 879 feet near Sligo in the central-northeast to a maximum of 1376 feet at Bunker in the extreme southeast. For the county the average elevation is 1100 feet. From east to west through the center of the county a major ridge divides the six forks of the Meramec River draining the northern part of the county and the four forks of the Current River draining the southern part of the county. Several large flowing springs are found, including Montauk Spring in the southwestern corner. It is the source of the Current River, one of the most scenic rivers in Missouri.

Topography affects farming practices. Cultivation is confined principally to valley bottoms and ridge tops. In the more gently rolling sections a larger proportion of the land is in field crops. Steep hillsides in some cases have been cleared for pasture, but primarily they have remained in forest cover.

As shown in Figure 3, four soils predominate in Dent County, (Miller and Krusekopf, 1929). Only two, the Clarksville gravelly loam and the Huntington loam, will support a fairly prosperous agriculture. All four soils are derived from a cherty limestone parent material. Except for the Huntington loam all have been thoroughly leached so that most of the lime, fine silt and clay have been removed from the surface layers, leaving a soil mass consisting to a great extent of chert fragments of all sizes. The high chert and stone content makes them low in water-holding capacity. In addition, all four soils are low in nitrogen, phosphorous and organic matter. Huntington loam is alluvial or colluvial
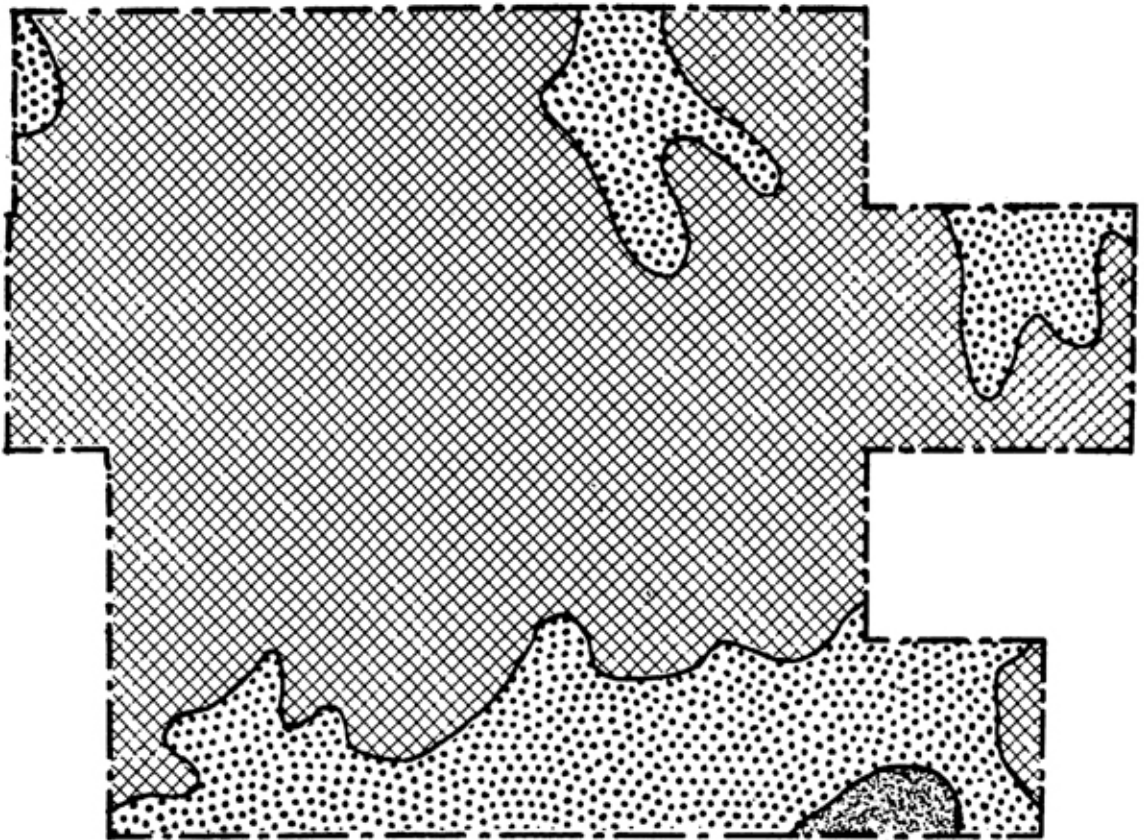
SLOPE PERCENT

▨	0 to 10
⦂	10 to 20
▦	Over 20

Fig. 2—Extent of three slope percent categories in Dent County. Most land with a slope of less than 10 percent can be cultivated successfully.

Clarksville Stony Loam

Clarksville Gravelly Loam

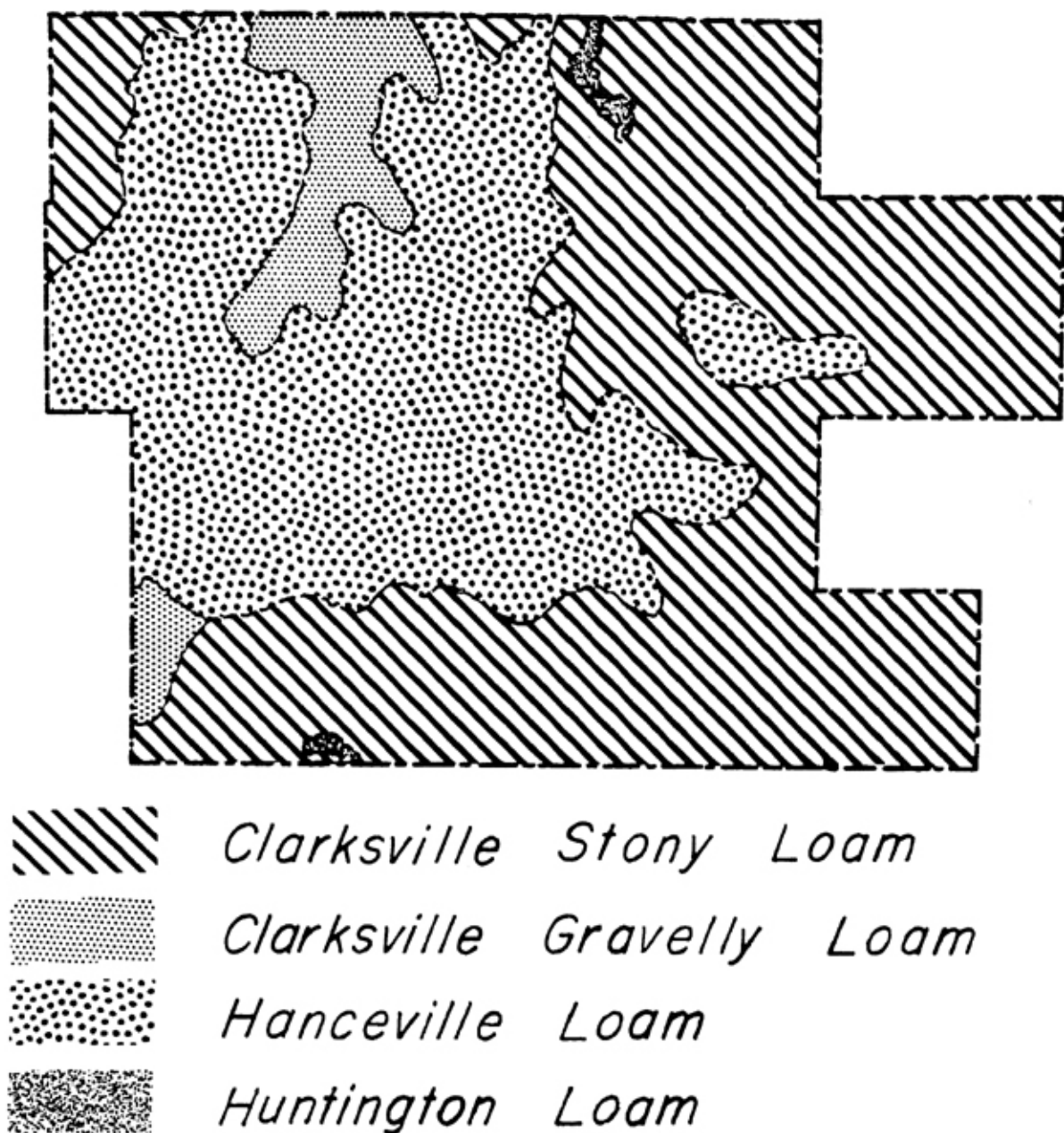Hanceville Loam

Huntington Loam

Fig. 3—Extent of four soils in Dent County. Over one-half the area is of the Clarksville type.

in origin and is found along the major streams. Its fertility is sufficiently high to produce excellent crop yields but its extent is too limited to be of very great importance.

Because of the unsuitability of these soils to agriculture without heavy applications of organic matter, lime, and other fertilizer, much of the land has never been cleared or if cleared has been allowed to revert to forest cover. Forests cover 340,000 acres in Dent County, 70 percent of the total land area of 484,000 acres.

Land Ownership Characteristics

The National Forest Reservation Commission (1952) reported that the Forest Service, United States Department of Agriculture, administers 61,500 acres or 18 percent of the total forested area. Another 14,013 acres or four percent of the total forested area is controlled by the State of Missouri. Montauk State Park includes 758 acres. The remainder, 13,255 acres, is in the Indian Trail Forest and Refuge. The area not controlled by state or federal governments is largely in small private ownerships.

In Dent County in 1954 the U. S. Bureau of the Census (1956) listed 1423 farms occupying 285,485 acres. They had an average per-acre value of $33. Only 595 of these farms were classed as commercial farms and for 433 of these, the total gross value of products sold was less than $2500 per farm.

Tenancy does not seem to be a problem in this county. In 1956, 88 percent of the farm and 76 percent of the nonfarm residences in the Ozark region of Missouri were owned by their current occupants. This is a higher percentage than that for the United States as a whole. However, unstable land tenure is a problem. In 1956, in Economic Area Eight, 35 percent of the farm and 60 percent of the nonfarm householders had lived in their current residences for less than 10 years (Bird, Miller and Turner, 1958). In a similar 12-county area in southwestern Missouri, Smith (1957) reported that one-half of approximately 60,000 acres sampled during a taxation study was held in the same ownership for the 10-year period of the study. The other one-half changed hands from one to nine times.

Taxes on forest land are not a deterrent to holding small ownerships in production, although they are anything but uniform. Assessed valuation and taxes paid vary widely within and among counties. In Dent County in 1953 forest land had an average per-acre assessed value of $5.48 with an average per-acre tax rate of ten cents. In the same year, agricultural land had an average per-acre assessed value of $10.91 with an average per-acre tax rate of 18.2 cents. Forest land is assessed higher on the average in relation to market value than farm or urban property.

Dent County is one of 15 counties in southeastern Missouri grouped together as a homogeneous Rural Social Area by Gregory (1958). In comparison

to the rest of Missouri, the economic resources in this Rural Social Area are low. The area is characterized by a surplus population above that required to maintain a stable level. Levels of education, living and farm machinery use are below those reported for other regions in the state. Roads are of lower quality and the value of land and buildings is lower than in other areas. Many of the residents of this area are former timber workers or their descendents from the days of heavy logging of the original stands.

The Changing Economy

The major cause for the long persistence of a frontier or pseudo-frontier way of life, concluded Kersten (1958), has been the meagerness of natural resources, and, perhaps to a lesser extent, isolation. The quickly exhausted resources have forced people to shift occupations or combine several activities. After decades of backwardness, agriculture and forestry promise to reach a position of permanent productivity. The concepts of conservation and the need for sound management of natural resources is finding increasing acceptance in the region. Manufacturing and recreation, the newest activities to achieve significance, may be keys to future prosperity as population in each succeeding year becomes more concentrated in urban areas.

RESULTS

There were 158 houses indicated in the sample segments. Of these, 18 were vacant or were weekend and summer cottages. An additional 21 householders were not interviewed but were included in the sample, 15 because they were on lots less than an acre in size and six because they had no forested land. In the sample there were 140 households. Of this number 71 were nonfarm households and 69 were farm households. Of the farm households only 33 were on commercial farms and 36 were on part-time or residential farms.

For farm households it was found that in 1957 the average size of land holding was 234 acres. This is 33.4 acres larger than the average reported for 1954 by the Census of Agriculture. Part of this difference can be explained by possible differences in the classification as to farm or nonfarm and by consolidation of farm units during the intervening years. Nonfarm households in the sample had an average land area of 69.9 acres. The average land area for all rural households was 150.8 acres. A little over half the holdings of rural householders was forested. This varies little between farm and nonfarm, and among farms grouped into several size classes.

Past Income

The principal product cut from forests by householders was fuelwood for home use. Seventy-eight percent of the farm and 30 percent of the nonfarm

households or 54 percent of all rural households cut fuelwood. The average cutting was seven cords per year per household. Only 11 percent of all households cut other forest products. About three times more farm households than nonfarm households cut other forest products. Both the cutting of fuelwood and the cutting of other forest products increased as the total size of holdings increased.

Although fuelwood was cut by the greatest number of households, it ranked last, at 2.4 cents, in its per-acre contribution to past income obtained from forests. Sawlogs were first with 20 cents per acre. Stave bolts were second with 5.1 cents per acre and fence posts third with 3.4 cents. Thus, forested land contributed a total of 30.9 cents per acre per year to rural householders (Figure 4). The annual per-acre contribution of forest land to incomes was about 5 cents higher than the average for farm households and 17 cents lower for nonfarm households. The contribution of forests to incomes of households increased as the total size of land holdings increased.

Apparent Attitudes

Most rural householders in Dent County are indifferent to their forest holdings. A minority are practicing an extensive type of management or are actively
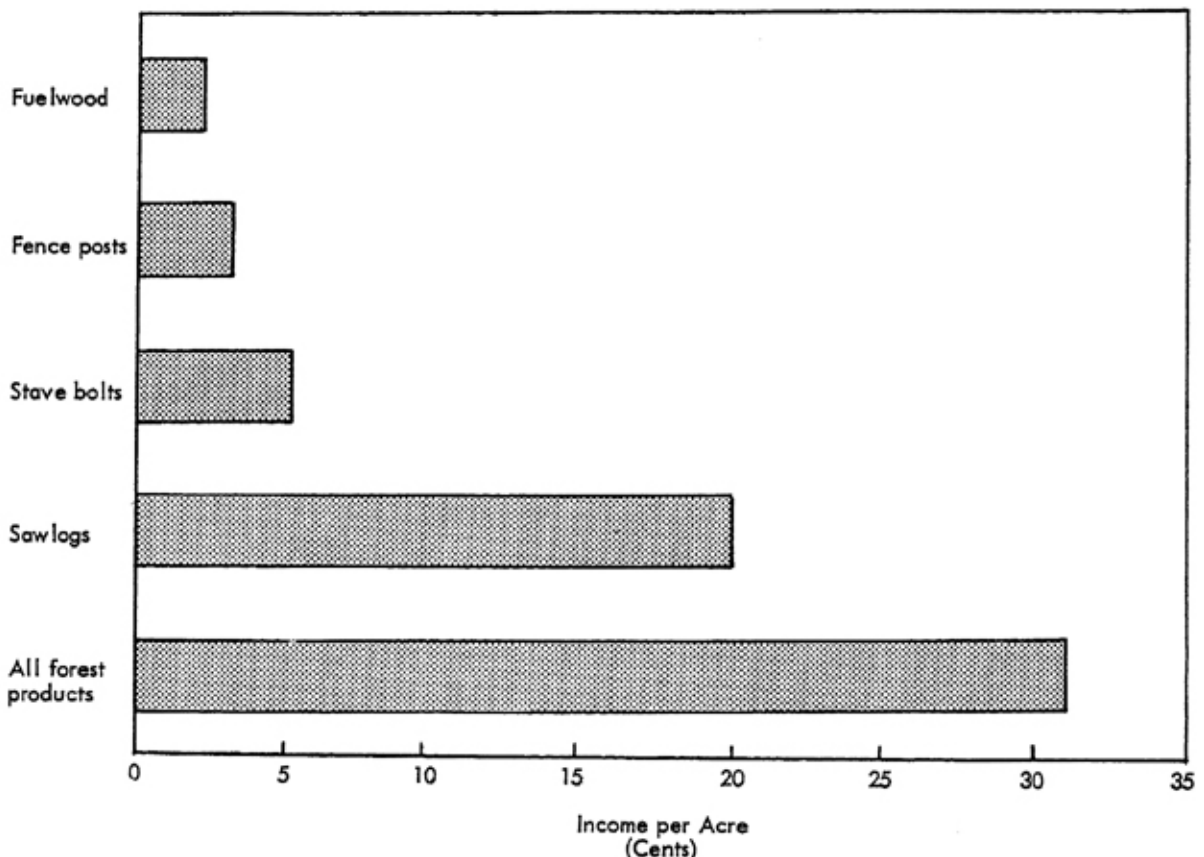

Fig. 4—Average income from sales of forest products, 1956.

clearing forest land for agriculture. The majority does nothing. As soon as a stand reaches small sawtimber size, most householders sell everything merchantable. Cutting the annual fuelwood supply, often on a clearcut basis, is the only other forest activity.

Most householders have this same passive attitude toward protecting timber lands from fire and grazing. Some actively engage in annual burning of woodlands. The majority either actively pasture their woodlands with livestock or do nothing to prevent it.

Most farm householders in this area borrow very little money according to Bird, Miller and Turner (1958). Almost all householders believe that investment in such forestry activities as timber stand improvement will not earn a satisfactory rate of return. Consequently, they did not express a need for credit secured by timber or timberland.

Present Size and Stocking Classes

Two-thirds of the forest land in Dent County belonging to rural householders supports pole-sized stands at present (Figure 5). About 60 percent of
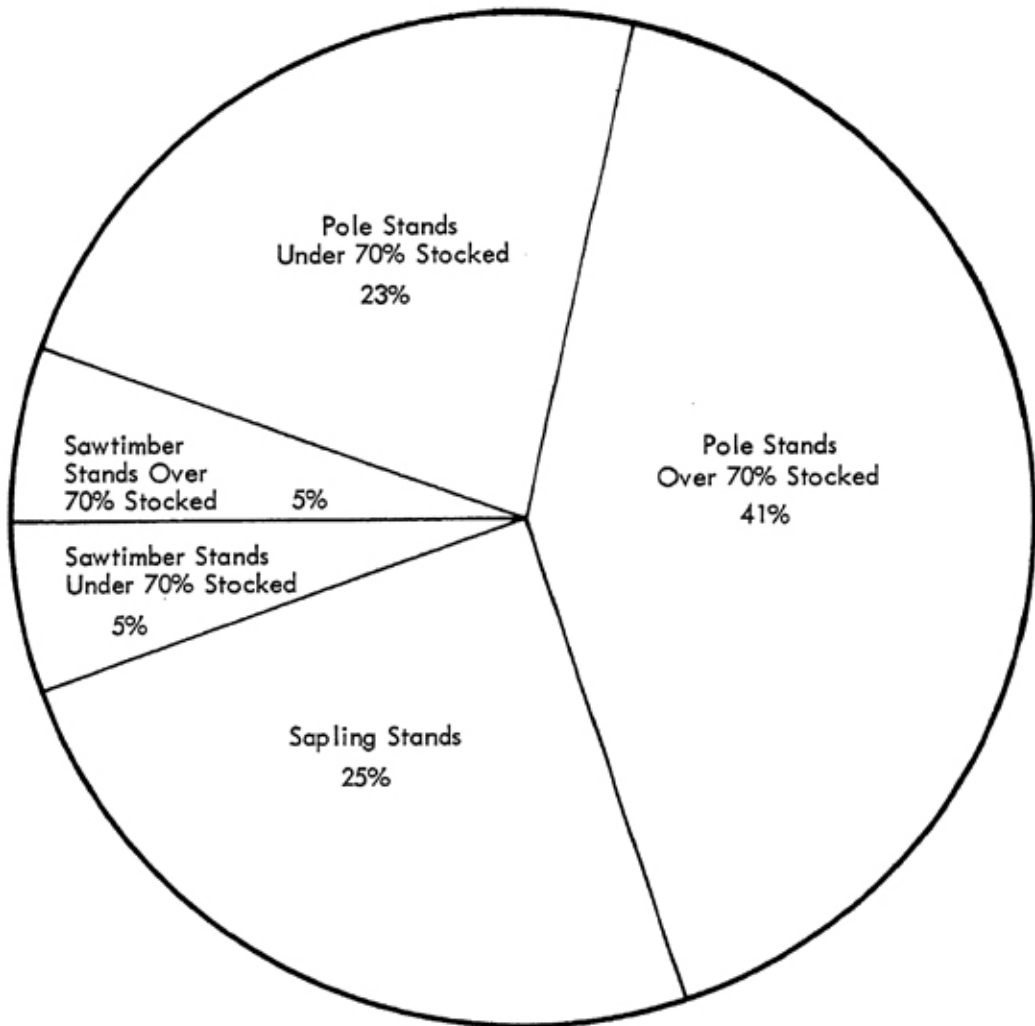

Fig. 5—Stand-size and density-class distribution of forest land, 1957. Only 10 percent of the forest land is in sawtimber stands.

these pole-sized stands are more than 70 percent stocked. Small sawtimber stands occupy another one-tenth of the land area in forests. This area is divided about equally between stands under 70 percent stocked and those over 70 percent stocked. The remaining one-quarter of the land area is occupied by fully-stocked sapling stands.

The level of tree stocking in the county ranges from poor to well stocked. One measure of stocking, basal area, averages 46.5 square feet per acre in trees above five inches in diameter at breast height. A well-stocked stand should have approximately 60 square feet of basal area per acre. In general, the level of stocking is sufficiently high to produce an average growth of above 60 cubic feet or 100 board feet per acre annually.

Quality of Existing Timber

The species composition and quality of trees in Dent County are generally undesirable. In the average stand about 40 percent of the trees are of the less desirable species such as blackjack oak, post oak and hickory. Almost one-quarter of the gross board-foot sawtimber volume is contained in trees that are not merchantable (cull) because of decay and other defects (Figure 6). Another one-third of the sawtimber volume is contained in merchantable trees that should be removed from the stand because of poor vigor and low quality.

The grades of logs that trees will yield are a good indication of the value of the timber and lumber that can be sawed from the trees. In Dent County, hardwood trees contain low-grade logs. About 71 percent of the total gross hardwood volume is contained in logs that are below the specifications for standard lumber logs. Almost one-third of this volume, or 22 percent of the gross volume, is in cull logs. Two-thirds, or 49 percent of the gross volume, is in tie and timber (grade four) logs. This leaves 29 percent of the total gross volume in logs that meet the specifications for standard lumber logs. Three-quarters of this volume is in grade three logs and one-quarter is divided between grade one and two logs. Only 1 percent of the total gross volume of sawlog timber will make grade one logs.

Pine sawtimber is of better quality. Using softwood log grades, 38 percent of the total gross softwood volume is in grade two logs and the remaining 62 percent is in grade three logs.

The distribution of volume between log grades varies with species. A much higher percentage of the volume of post and blackjack oaks, as contrasted to other white and black oaks, is in grade four and cull logs. Thirty-eight percent of the post and blackjack oak, 13 percent of the other black oaks and 12 percent of the other white oak volume is in cull logs. Almost equal percentages of the volume of each of these tree species groups are in grade four logs. But in grades one, two and three there are larger percentages of the other white and other black oak volumes than there is of the post and blackjack oak volume.
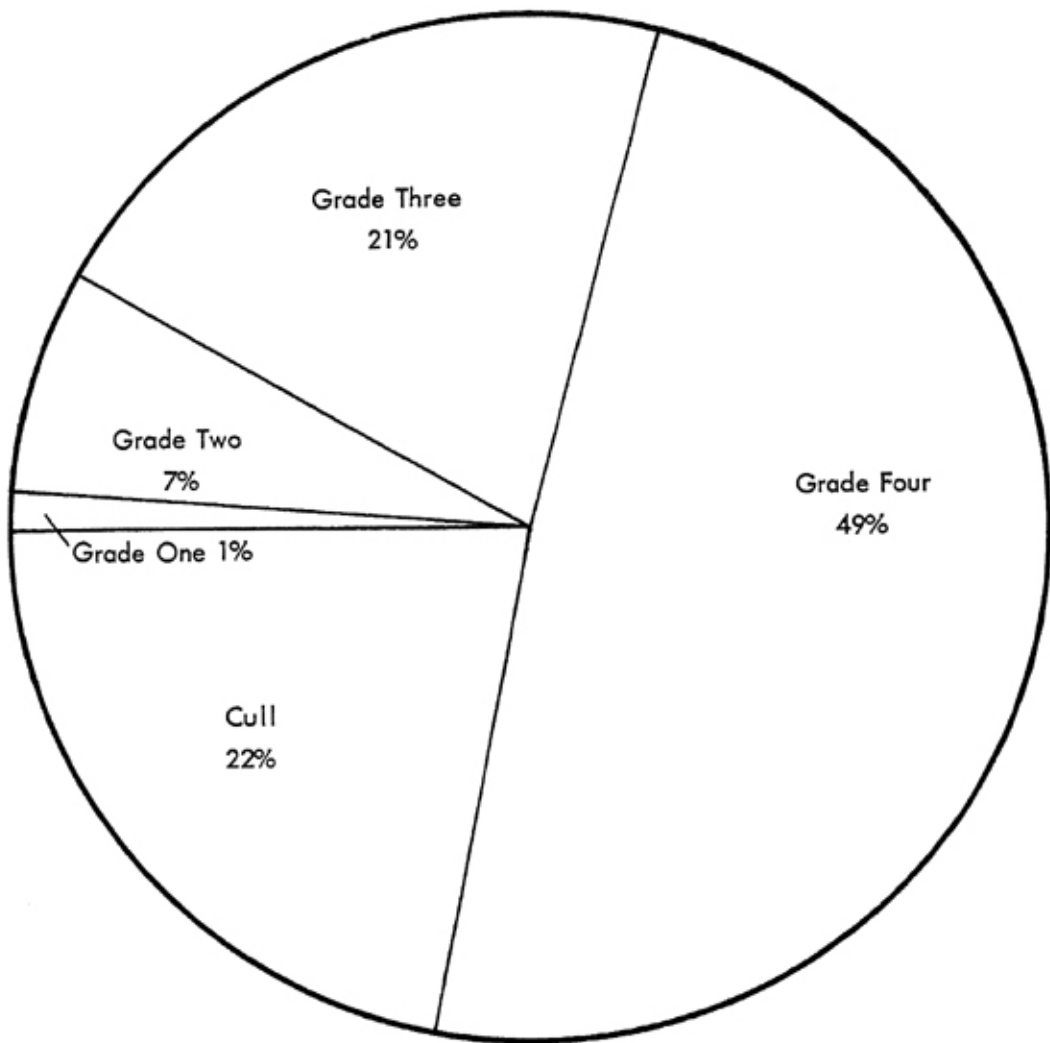
Fig. 6—Distribution of hardwood sawtimber volume among log grades.

Low timber quality and poor species composition is the result of several factors. One factor that materially reduces timber quality is wood fires that open avenues for attack by insects and disease. Woodfires have too often burned over the same area annually. Another factor is low stocking. Large limbs are formed on trees and are retained rather than eliminated by natural pruning commonly encountered in dense stands. Another factor is the continued removal for sale of the better quality and more desirable trees without removal of the poorer ones. This practice is caused in part by the lack of markets for low-quality material and trees of small size.

Existing Markets

The major primary wood product market in Dent County is for oak saw-logs. There are three semi-permanent sawmills near Salem and one at Bunker, in the southeastern corner of the county, that buy oak sawlogs from a number of

independent loggers (Figures 7 and 8). Also located at Salem is a sawmill with a molder for cutting wood to pattern. It buys sawlogs of primarily pine, syca-more, elm, gum and oak. In addition, there are a number of small portable sawmills in the county that buy either stumpage, logs or both.

White oak of stave quality can be sold to independent stave bolt producers. One stave mill is at Van Buren, 75 miles southeast of Salem outside the county. Although it is economical to haul stave bolts to Van Buren, the long haul in-creases production costs and places the stave bolt producer in a poor bargaining position with the stave mill. This combination of factors reduces substantially the returns to both landowner and producer from stave stumpage.

The market for hardwood material below sawlog size is confined to limited seasonal sales of fuelwood and sales to charcoal manufacturers. One manu-facturer operating a 30-cord kiln is located just east of Salem. Another much larger charcoal manufacturer is located five miles south of Salem (Figure 9). In-dependent charcoal-wood producers supply almost completely the requirements of both plants from clearing operations for agricultural land. In most cases the stumpage is given to the producer in exchange for clearing the land. The price paid for charcoal wood barely covers production costs and leaves nothing for stumpage.

Pine below sawlog size can be sold for fence posts and small poles within the range of pine in the county. This market is quite active with independent post cutters, barking plants and treating plants as possible buyers. Although the barking and treating plants are outside the county they are within economical hauling distance.

Existing Marketing Practices

Timber marketing practices range from lump-sum sales of stumpage to operations where the owner cuts, logs, mills and sells the lumber. All variations between these extremes are found. The most common marketing practice is a lump-sum sale to an independent logger with the seller poorly informed as to the volume and quality of the timber he sells and the prevailing price for such timber. Under another frequently encountered arrangement the seller receives a share of the income received by the logger from the mill. The size of the share depends on the seller's bargaining position, knowledge of prices and markets, and his contribution, if any, of labor, equipment or both to the logging opera-tion.

Existing Timber Volume

The existing gross volumes per acre averaged about five cords of pole-size material and 1520 board feet of sawtimber material. Deductions for cull material contained in trees reduce these figures to approximately 4.7 cords and 1195 board feet. Of the volume of 1195 board feet, approximately 145 board feet are in trees
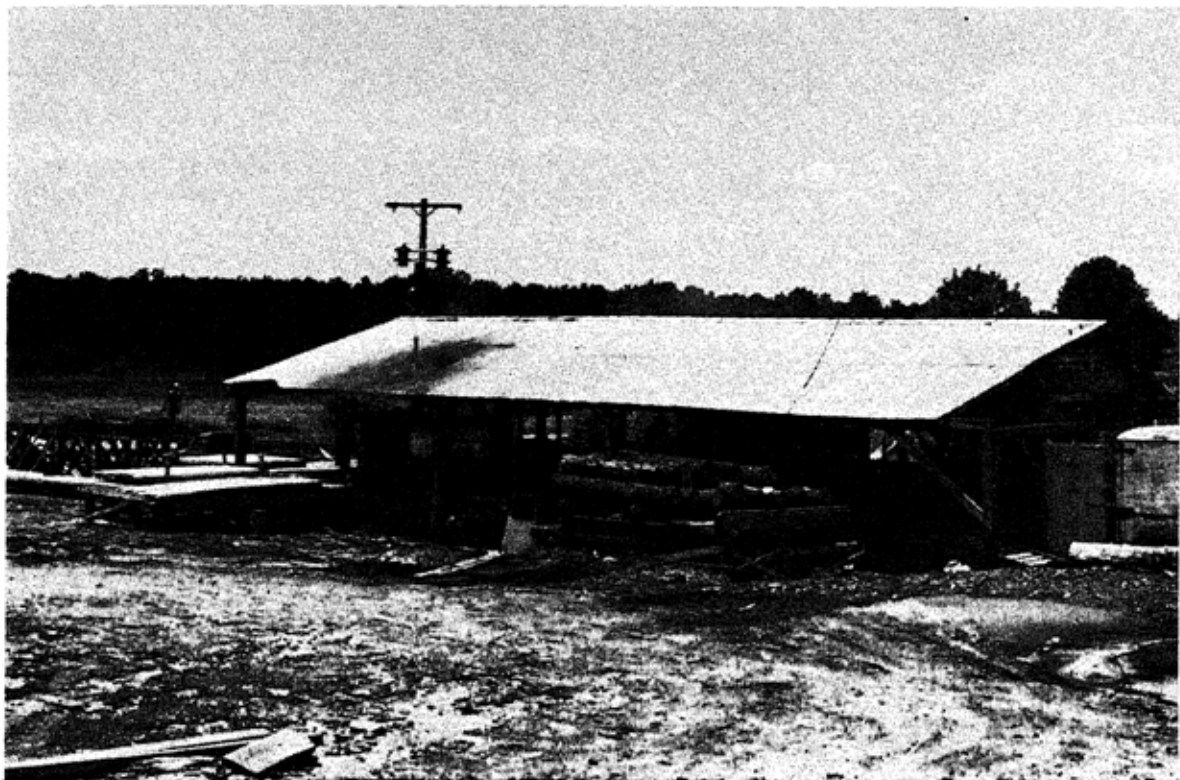
Fig. 7—One of the sawmills at Salem producing approximately 10,000 board feet of oak lumber per day and operating about 200 days per year. Mills of this type are the major primary forest products market.
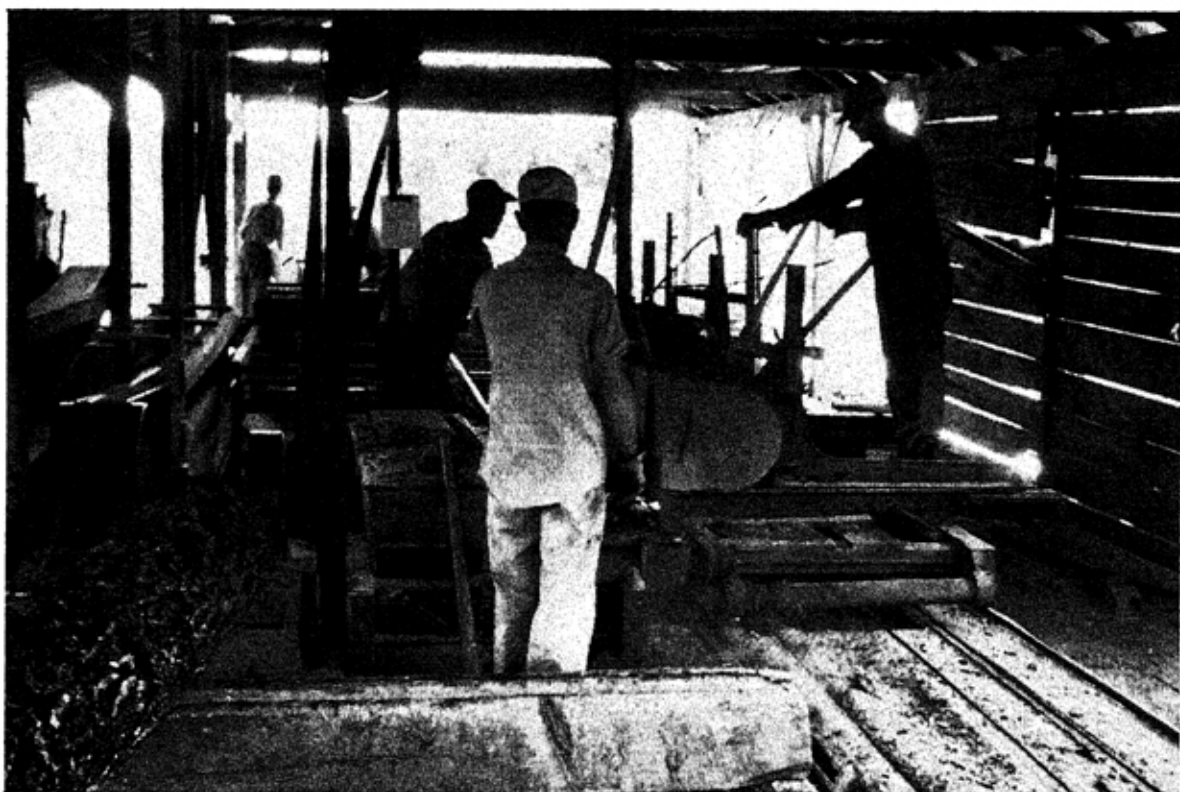
Fig. 8—Interior view.
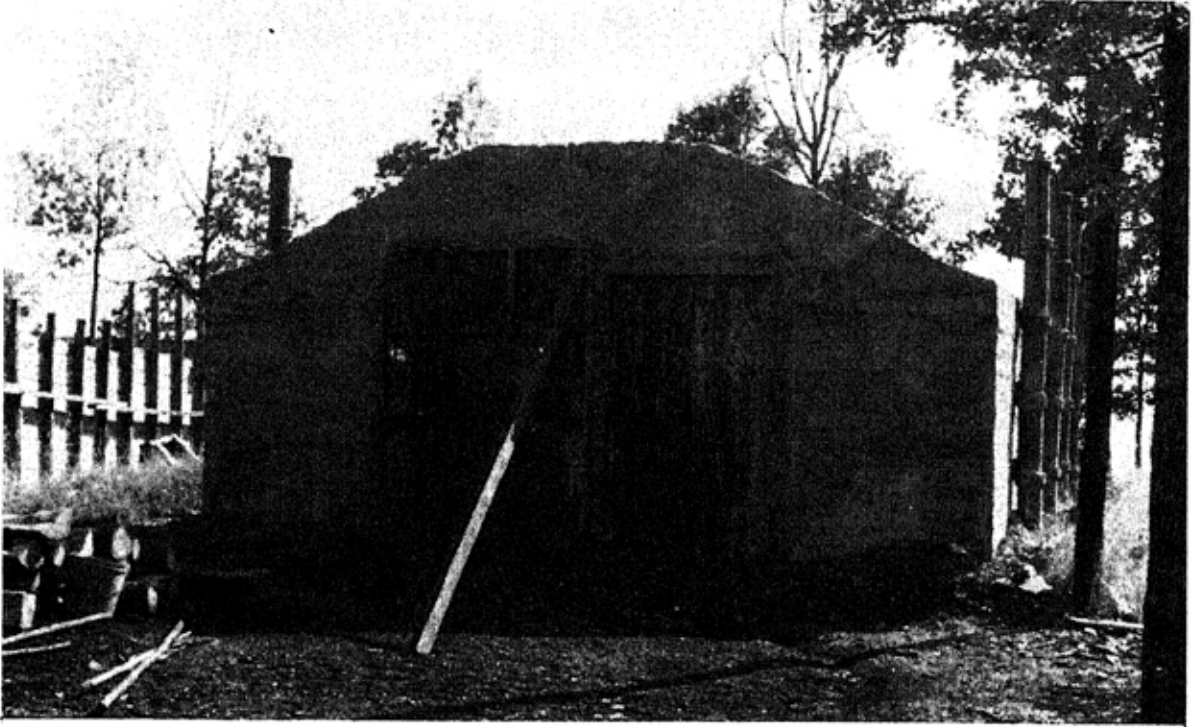
Fig. 9—Charcoal kiln of 30-cord capacity. Charcoal manufacturers using kilns of this size and type provide only a limited market for charcoal wood.

that are unmerchantable because of decay or poor form, another 410 board feet are in trees that should be cut and sold because of low vigor and poor quality, and 640 board feet are in high-quality trees that should be left as growing stock. Of the net volume of 4.7 cords, 1.1 cords should be removed because of low vigor and poor quality, with the remainder left as high-quality growing stock.

For most households, gross per-acre volumes range from approximately 980 to 1930 board feet and 2.8 to 7 cords.

Opportunities for Immediate Income

Under existing marketing conditions households averaged 409 board feet net of material that should be removed because of poor vigor and quality and that can be sold. For many farms the range is from 246 board feet to 466 board feet. Assuming an average stumpage price of $10.00 per thousand, 409 board feet would be worth $4.09. Certainly not all householders could realize this amount from each acre of forest. Some have no sawtimber. Sawtimber for others is too scattered to be profitably logged. Operators cannot cut less than about 300 board feet per acre profitably, especially if the tree quality is low. With these limitations forests could be expected to yield approximately $4.00 per acre of immediate income and still leave about 650 board feet of higher-quality growing stock.

If a cut of merchantable timber were made, approximately another 325

board feet gross of material in cull sawtimber trees would be left per acre. This is equivalent to two trees of average height, 16 to 18 inches in diameter. These trees should be removed from the stand by cutting, girdling or poisoning.

In addition, about 1.4 cords gross in undesirable trees below sawtimber size should be removed. This material is not readily marketable under existing conditions but much of it would be suitable for fuelwood, charcoal or pulpwood. Many of these trees will die and drop out of the stand in a few years because of competition from more vigorous trees. Their immediate removal would increase the growth of high-quality material in the stand.

Costs for timber stand improvement work vary from practically nothing where the material removed is taken out as fuelwood by the owner to approximately $10.00 per acre when the labor is hired. In similar stands in western Tennessee, Barraclough and Pleasonton (1957), found that approximately one-half man-day of labor and one-half gallon of chemical were needed to treat one acre. In North-Central Mississippi, Sternitzke (1959), reported a range of cost for stand improvement of $1.00 to $8.00 per acre and an average cost of $5.00, if work is done by experienced crews.

Opportunities for Future Income

Future income from forests depends on the rate of tree growth, quality of timber produced, available markets and efficiency of the marketing process as well as protection of the forests from the ravages of fires, insects and diseases.

During the last 10 years, including several years of severe drought, total annual growth per acre for Dent County has averaged 122.8 board feet of sawtimber and 0.089 cords of pole material. This varies from a low of 70.8 board feet and 0.051 cords per acre to a high of 168.1 board feet and 0.122 cords, depending on the volume of growing stock.

The volume of annual growth reported for pole-sized material is conservative because it does not include an allowance for smaller trees growing into this size class, but trees growing out of this class were deducted.

Not all of the annual growth could be sold. Of the total gross volume of 122.8 board feet, 3.6 board feet are on cull trees. Another 6.4 board feet are on trees that should be cut for sale immediately. Growth on trees presently in the cut-unmerchantable class accounts for another 17.4 board feet leaving a volume of 95.4 board feet. This is further reduced because of defects to a net volume of 94 board feet per acre per year. In the same manner, the gross growth of 0.089 cords is reduced to a net of 0.043 cords.

At an average stumpage price of $10.00 per thousand board feet, 94 board feet would be worth 94 cents. Good forestry practices would increase this income by increasing the rate of growth and ultimately the quality. If the present prices, markets, and marketing practices continue in the future, 94 cents per acre per year is about the maximum contribution of forests to income that can be expected.

If income from forest land is to be increased substantially the growing stock must be built up to produce a much larger rate of growth. A depleted forest capital is no more able to add timber volume by growing than is a small savings bank account able to earn a large amount of interest. The saying that it takes money to earn money is indeed applicable to a forest.

The forests of Dent County must be rehabilitated and probably increased 400 percent in volume of *desirable* growing stock before owners can expect to earn a substantially greater income from timber.

Future Markets

The development of a market for pole-sized material, as would be provided by construction of a pulp mill in the area, probably would not add greatly to income from rural household forests at their present low level of stocking and growth. In Ohio, McCauley (1958) reported that stumpage for hardwood pulpwood ranges in price from 50 cents to $2.00 with the most frequent price being $1.00. With an average stumpage price of $1.00 per cord, 0.043 cords would be worth 4.3 cents. This would increase the potential per-acre income from 94 cents to 98 cents.

Improvement in timber quality would contribute the most toward increasing income from forests. The costs of logging and manufacturing are approximately equal for timber of high quality and for poor material. Only a small income can be expected from hardwood sawtimber stumpage when approximately 71 percent of the total gross volume is in trees that will not meet the minimum specifications for standard lumber logs. Improvement in quality that adds only $1.00 per thousand board feet to the stumpage price will increase the annual per-acre return by 9.4 cents.

The most significant aid to improving timber quality is the development of markets that would permit the profitable removal of low-quality material in trees of all sizes. This would enable land-holders to remove low-quality trees without cost. The process of repeated high grading, resulting in the existing low-quality stands, could be reversed. But unless markets develop for low-quality hardwoods of all sizes, little improvement in timber quality can be expected, particularly when the prevailing owner attitude toward improving his forest property is one of indifference.

Desirable Changes in the Marketing Process

The individual householder would receive the greatest return from his woods if he produced logs for sale, delivered at the mill. This requires a heavy investment of time and effort. In addition, some equipment and skill is required. Many have the necessary skill and most of the needed equipment. Age, ill health, and lack of time, are probably reasons why householders do not log their woods themselves even though this considerably decreases their rate of return.

Greater care and planning by the landowner in selling timber on the stump would help him realize the maximum return from his woodlands. Each lot of timber should be offered to several prospective buyers to obtain the highest bid. This would require relatively little more time and effort. Another technique to control the amount and quality of timber sold is to mark each tree offered for sale. It probably would not increase immediate returns but a continued effort to sell poorer quality trees that are saleable would improve the quality of the stand retained. A Farm Forester of the Missouri Conservation Commission can give valuable service to landowners in helping to decide when a sale of timber is desirable, in locating buyers and suggesting favorable sale arrangements. His services are furnished at no cost to the owner.

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APPENDIX

COLLECTION AND ANALYSIS OF DATA

Sampling Plan

To insure that each household in the county had an equal chance of being selected for interview, the Master Sample of the United States Department of Agriculture was used. The Master Sample divided the county into segments containing four to six rural homes as indicated by the 1954 Census of Agriculture. Each 19th segment was selected for this study, a total of 29 separate areas. Every householder within the segment was interviewed except those having holdings of less than one acre and those with no forested land. All forest land belonging to a householder was inventoried whether or not it was located within the segment.

The sample was the same as that used by Bird, Miller and Turner for their study on resources and levels of income of rural households.[2] Their completed interviews were used to supplement information collected for this study. In addition, their classification of households as to farm or nonfarm was used. It is essentially the same as that used in the 1954 Census of Agriculture. Households were classed a farm if the residence was on a farm. A place was considered a farm if it contained more than three acres and produced in 1955 at least $150 worth of crops, livestock, poultry or timber. A place of less than three acres was also considered a farm if sales totaled more than $150.

Interview With Householders

The primary objective of the interview with householders was to check the area and exact boundaries of the property and to obtain access permission. It also gave an opportunity to obtain information on type and value of products cut during previous years from the householder's wood and his attitudes toward growing timber as a crop, woodfires, timber stand improvement work and the need for credit with woodlands and timber as collateral.

A formal, written schedule of questions was not used, but no attempt was made to disguise the purpose of the visit. The interview was conducted informally but information obtained was recorded later on a data sheet for each household. Data on personal attitudes are subject to pronounced bias from the interviewer; therefore, quantitative interpretation was not attempted. Difficulty was encountered in obtaining exact quantitative values for wood volume removed and income received. Apparently this resulted from a lack of bookkeeping rather than a desire to withhold information.

Timber Inventory

From information provided by the householder and the legal land description obtained from county tax records, exact boundaries of each ownership were

[2]Bird, R., F. Miller, and S. C. Turner, *Resources and Levels of Income of Farm and Rural Nonfarm Households*, Missouri Agricultural Experiment Station, Research Bulletin 661, March, 1958.

plotted on a planimetric base map of the segment. Boundaries were then transferred to vertical aerial photographs. The forested area of each property was stand mapped from stereo-pairs of photographs according to crown size and crown density classes.

Areas with less than 20 percent crown density were not considered to be forest land. The minimum area recognized as a forest stand was four acres. Stand boundaries and size and density class designations were marked on the photographs. The total area of each stand type was determined by using a dot area-grid and the area was recorded on the individual household data sheet.

One-fifth-acre plots for detailed examination were selected and marked on the photograph for field inventory in areas considered by the interpreter to be most representative of the entire stand. "Detail" plots were picked at the approximate rate of one per 25 acres. They were distributed among stand classes in a manner to sample more intensively the areas with variable timber volume and high-value stands.

A selective sampling system of plot location does not allow statistical analysis to measure variation and sampling error, but experience has shown that such a sampling design, particularly where stand sizes are stratified by examination of aerial photographs, can give informative and acceptable results. It is believed that the disadvantage of the lack of a measure of variation and sampling error is offset by lower costs than would have been required by other designs.

Circular concentric plots with the radii adjusted for slope were used for the ground check. Sawtimber trees were measured on one-fifth-acre plots and pole-sized trees were measured on one-tenth-acre plots.

Plot description and growth data were recorded in the field on IBM mark-sense cards. For each sawtimber and polesized tree, the following was listed on an IBM mark-sense card: species, diameter at breast height, total height, percentage of cull, number of logs, log grades and disposal class. The latter refers to a decision made to cut or leave each tree on sample plots. It is described below.

Basal area and gross volume were recorded to provide a field estimation of stocking. Basal area was estimated by using a 3.03 diopter wedge-prism. Trees were placed in the following size classes:

TREE-SIZE-CLASS	HARDWOODS	SOFTWOOD
	----------- D.b.h. inches -----------	
Saplings	1 to 5	1 to 5
Poles	5 to 11	5 to 9
Sawtimber	11 and over	9 and over

On sample plots, ten times the number of trees counted in a given size class gave the basal area in that class. Ten times the number counted in all classes gave the total basal area of the stand.

Volume per acre in sawtimber trees in hundreds of board feet (International Rule, one-quarter-inch kerf) was estimated by multiplying the number of trees

in each merchantable length class by a volume factor[3] and summing the products. This estimate of gross volume provided a rough field check on informal ocular estimates. When requested by a householder, it provided a means of giving an immediate estimate of his sawtimber volume.

Estimation of Growth

To determine timber growth, the tree nearest the center of each plot, having a breast high diameter greater than four inches and a dominant or codominant crown, was sampled. Species, bark thickness and radial growth for the last ten years were recorded.

Growth was computed using the percent-movement method outlined by Wahlenberg.[4] To allow for mortality, the number of trees in the predicted stand was reduced by 5 percent.

Log Quality

To obtain an indication of quality, the number and grade of logs in each sawtimber tree were obtained during the field survey. Log grades developed by the Forest Products Laboratory, as modified for the forest survey of Iowa[5] were used. They are based on number, size, location and character of visible defects on the log as they will affect the grade of lumber the log will yield. All volumes in the same log grade were accumulated and each of these totals was divided by the total volume of sawtimber to obtain the percentage in each log grade.

Cutting Recommendations

A cut or leave evaluation was made for every tree found on sample plots. This evaluation placed trees into "disposal" classes that indicate which trees should be left in the stand for growing stock and which should be removed. For the ones that should be removed the disposal classes indicate whether or not they could be sold under either existing or future market conditions. The decision placing a tree into a disposal class was based primarily on the tree's vigor, crown condition and position, bole condition, size class and species. The existing markets and the marketable stand volume were also considered. Listed below are the classes used.

Leave	Trees not placed in one of the other categories.
Cut -- unmerchantable	Trees that will soon drop out of the stand because of competition and are of no value and have no

[3]Grosenbaugh, L. R., *Shortcuts for Cruisers and Scalers*, Southern Forest Experiment Station, Occasional Paper 126, March 1952.

[4]Wahlenberg, W. G., *Methods of Forecasting Growth in Irregular Stands*, U. S. Department of Agriculture, Technical Bulletin 796, 1941.

[5]Central States Forest Experiment Station, Forest Survey Field Instructions for Iowa. Unpublished. Forest Service, U. S. Department of Agriculture, 1953.

	prospects of living long enough to become valuable under present market conditions. These trees would be suitable for fuelwood or pulpwood if markets existed.
Cut -- merchantable	Trees that should be removed from the stand because of low vigor or poor condition or both and are salable under present market conditions.
Cull	Trees that should be removed from the stand because of low vigor or poor condition or both and that would probably never be salable under any future market conditions.

Table 1 shows the average volume per acre by disposal classes for farm economic class, nonfarm level of income and size of total land holdings. Table 2 shows mean annual growth by disposal classes for the same categories.

TABLE 1--EXISTING VOLUME PER ACRE BY DISPOSAL CLASSES FOR FARM ECONOMIC OR NONFARM LEVEL OF INCOME AND SIZE OF TOTAL LAND HOLDINGS CLASSES

	Leave				Unmerchantable		Merchantable		Cull		All			
	Cords[1]		Board Feet[2]		Cords		Board Feet		Board Feet		Cords		Board Feet	
	Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net
Farm Economic Classes														
I - IV[3]	3.8	3.8	589.0	579.9	1.4	1.2	442.8	382.0	300.3	133.1	5.2	5.0	1332.1	1095.0
V - VI[4]	3.4	3.4	814.7	695.0	1.3	1.0	495.9	427.8	355.9	155.8	4.7	4.4	1666.5	1278.6
Part Time	3.9	3.9	754.1	728.0	1.4	1.2	535.6	462.1	320.4	140.3	5.3	5.1	1610.1	1330.4
Residential	3.2	3.2	742.4	581.3	1.2	1.0	461.4	398.0	335.5	147.5	4.4	4.2	1539.3	1126.8
All Farm	3.6	3.6	719.4	648.3	1.4	1.1	483.2	416.9	327.1	143.8	5.0	4.7	1529.7	1209.0
Nonfarm Level of Income Classes														
Under $1,000	5.1	5.1	934.6	697.0	1.9	1.6	539.7	465.6	454.6	198.9	7.0	6.7	1928.9	1361.5
$1,000 to $2,000	3.9	3.9	769.1	721.9	1.5	1.2	497.9	429.6	355.5	157.9	5.4	5.1	1622.5	1309.4
Over $2,000	2.0	2.0	495.8	366.4	0.8	0.6	285.1	245.9	196.7	86.3	2.8	2.6	977.6	698.6
All Nonfarm	3.6	3.6	753.6	622.5	1.4	1.1	448.1	386.6	329.9	145.8	5.0	4.7	1531.6	1154.9
Size of Holdings Classes, acres														
0 - 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 - 41	3.5	3.4	861.2	576.9	1.2	1.1	458.8	395.8	347.7	152.7	4.7	4.5	1667.7	1125.4
42 - 119	3.7	3.7	777.7	578.6	1.4	1.1	463.4	399.8	324.5	142.7	5.1	4.8	1565.6	1121.1
120 - 229	3.7	3.7	799.9	737.8	1.3	1.1	491.0	423.6	306.2	135.8	5.0	4.8	1579.1	1297.2
230 - 1128	3.6	3.5	676.7	627.7	1.3	1.1	471.3	406.6	333.0	146.3	4.9	4.6	1481.0	1180.6
All Sizes	3.6	3.6	719.0	641.0	1.4	1.1	473.9	408.9	327.2	144.0	5.0	4.7	1520.5	1193.9

[1] Cord volumes are for trees below sawtimber in size.
[2] Board-foot volumes are for trees of sawtimber size.
[3] Farms that sold more than $2,500 worth of products in 1954.
[4] Farms that sold less than $2,500 worth of products in 1954.

| | Leave | | | | Unmerchantable | | | | Merchantable | | Cull | | All | | | |
| | Cords[1] | | Board Feet[2] | | Cords | | Board Feet | | Board Feet | | Board Feet | | Cords | | Board Feet | |
	Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net
Farm Economic Classes																
I - IV[3]	0.033	0.032	88.1	86.8	0.049	0.041	16.2	13.5	6.1	5.2	3.8	1.9	0.082	0.073	114.2	107.4
V - VI[4]	.044	.043	94.9	93.6	.044	.037	17.6	14.7	6.8	5.9	3.5	1.6	.088	.080	122.8	115.8
Part Time	.061	.060	117.2	115.6	.048	.041	18.8	16.8	7.3	6.3	3.4	1.6	.109	.101	146.7	140.3
Residential	.040	.040	85.6	84.6	.039	.033	16.6	13.8	6.1	5.2	3.3	1.6	.079	.073	111.6	105.2
All Farm	.044	.043	96.5	95.1	.046	.039	17.3	14.4	6.5	5.7	3.5	1.7	.090	.082	123.8	116.9
Nonfarm Level of Income Classes																
Under $1,000	.057	.055	130.5	128.6	.065	.054	24.7	20.6	7.6	6.6	5.3	2.3	.122	.109	168.1	158.1
$1,000 to $2,000	.045	.044	99.1	97.6	.046	.036	19.3	16.1	6.5	5.6	4.1	2.2	.091	.080	129.0	121.5
Over $2,000	.027	.027	54.0	53.2	.024	.020	10.4	8.7	4.1	3.5	2.3	1.1	.051	.047	70.8	66.5
All Nonfarm	.042	.041	92.4	91.0	.043	.036	17.8	14.9	6.1	5.2	3.8	1.9	.085	.077	120.1	113.0
Size of Holdings Classes, acres																
0 - 1	.000	.000	0.0	0.0	.000	.000	0.0	0.0	0.0	0.0	0.0	0.0	.000	.000	0.0	0.0
2 - 41	.039	.038	89.6	88.2	.044	.039	17.1	14.2	5.9	5.1	3.2	1.6	.083	.077	115.8	109.1
42 - 119	.040	.039	94.8	93.4	.045	.038	17.8	14.8	6.1	5.3	3.6	1.7	.085	.077	122.3	115.2
120 - 229	.047	.046	97.8	96.4	.044	.037	18.1	15.1	7.0	6.0	3.8	1.9	.091	.083	126.7	119.4
230 - 1128	.043	.042	95.1	93.7	.045	.038	17.1	14.3	6.4	5.5	3.6	1.7	.088	.080	122.2	115.2
All Sizes	.044	.043	95.4	94.0	.045	.037	17.4	14.5	6.4	5.6	3.6	1.7	.089	.080	122.8	115.8

[1] Cord volumes are for trees below sawtimber in size.
[2] Board-foot volumes are for trees of sawtimber size.
[3] Farms that sold more than $2,500 worth of products in 1954.
[4] Farms that sold less than $2,500 worth of products in 1954.

Computations

Using IBM procedures, stand, stock and basal area tables were constructed for each size and density class in the two timber types recognized, oak-hickory and oak-pine. Each table was constructed to show the portion of the stand that should be removed and the portion to be left. The portion to be removed was listed as merchantable or unmerchantable. Volumes were computed in both cords and board feet using composite volume tables[6] corrected for stem taper differences among species.

To obtain the total volume of wood in each cut or leave class for each farm, the area in each stand class was applied to the appropriate stock table.

Value of Timber Cut

To compute past income, only timber sales made by householders during 1956 were used. When the volume of timber sold for a given product was recorded, but no estimate of its value was obtainable, a prevailing average price was applied to obtain its value. The following stumpage prices were used:

PRODUCT	UNIT	OAKS	PINE	WALNUT	OTHER
Sawlogs	M. Bd. Ft.	$10.00	$20.00	$50.00	$6.00
Fence posts and poles	Each	0.05	0.05		
Stave bolts	Chord Ft.[7]	0.35			
Fuelwood	Cord[8]	0.50			

The total value of wood removed was computed by product. This value divided by the total acres of woods gave the per-acre income received.

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[6]Gevorkiantz, S. R., and L. P. Olsen, *Composite Volume Tables and their Application in the Lake States*, U.S. Department of Agriculture Technical Bulletin 1104, January, 1955.

[7]One foot along the chord of the heartwood viewed on the end of a stave bolt, measured from the inner edge of the sapwood on one side to the inner edge of the sapwood on the other side.

[8]A stack of wood measuring four feet by four feet by eight feet or having the equivalent volume.