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FOREST RESOURCES

of the

NORTH ARKANSAS DELTA

A Progress Report

by

THE SOUTHERN FOREST SURVEY

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FOREWORD

The nation-wide Forest Survey, being made by the United States Forest Service, was authorized by the McSweeney-McNary Forest Research Act of 1928. Its five-fold object is: (1) to make an inventory of the present supply of timber and other forest products, (2) to ascertain the rate at which this supply is being increased through growth, (3) to determine the rate at which this supply is being diminished through industrial and local use, windfall, fire, and disease, (4) to determine the present requirement and the probable future trend in the requirement for timber and other forest products, and (5) to correlate these findings with existing and anticipated economic conditions, in order that policies can be formulated for the effective use of land suitable for forest production.

In the South, the Forest Survey functions as an activity of the Southern Forest Experiment Station with headquarters at New Orleans, La.

This release, which should be regarded only as a progress report, is based on a field survey made during November and December 1934 and January 1935. It contains Forest Survey data that will be included in complete reports to be published later, and that, although considered reliable, are subject to correction or amplification as the work of computation proceeds; while item 4 above, which is being studied on a national basis, is not discussed in this report.

In the presentation of these survey data, it is to be noted that owing to the sampling method used in collecting them, the greater the number of samples in any given classification the more accurate are the data for that classification. Hence classes that are of infrequent occurrence and relatively small in quantity generally cannot be determined with as high a degree of accuracy as classes that occur more frequently and in substantially greater quantities. Small tabular items are to be taken as showing, not the exact magnitude of the classes involved, but their relative magnitude in comparison with those of other classes.

Staff Assignment

Preparation of Report	- R. K. Winters, Forester
In Charge of Field Work	- J. A. Putnam, Associate Forest Economist
In Charge of Computations	- P. R. Wheeler, Associate Forest Economist

FOREST RESOURCES OF THE NORTH ARKANSAS DELTA

Location and General Description

The North Arkansas Delta survey unit includes the flood plains of the Mississippi River and its principal tributaries between Helena, Arkansas, and Cape Girardeau, Missouri, with boundaries as shown in figure 1. Although chiefly in Arkansas, it includes portions of Missouri, Tennessee, and Kentucky. A conspicuous topographic feature is Crowley's Ridge, a narrow elevation rising some 200 feet above the general level of the surrounding plain and extending about 180 miles from Helena, Ark., to the vicinity of Advance, Mo. Elsewhere the relief is remarkably uniform, seldom varying locally more than 20 feet, with drainage generally to the southward.

The soils are in general of alluvial origin and when cleared and drained are often of high agricultural worth. Practically the entire land area supported originally a stand of hardwood timber, although nearly 60 percent of the land area is now in some form of agricultural use. Cotton is the principal crop in the Arkansas portion of the unit, but farther north it gradually gives way to more diversified farm crops. The area is largely peopled by rural dwellers; while small villages abound, only two towns, Blytheville and Jonesboro, Ark., have populations of more than 10,000 persons. The negro population, which is largest in the counties adjacent to the Mississippi River, diminishes rapidly from east to west and gradually northward.

Table 1 shows the relative importance of the principal kinds of land use in the unit.

Table 1. - Land area classified according to major uses, 1935

Land use	Total land area	
	Acres	Percent
Forest	2,613,200	38.9
Agricultural:		
In cultivation:		
Old cropland	3,394,100	50.5
New cropland	164,900	2.5
Out of cultivation:		
Idle	134,900	2.0
Abandoned	67,000	1.0
Improved pasture	185,400	2.8
Total agricultural	3,946,300	58.8
Other: Marsh, waterways, towns and villages, roads, railroads, etc.	156,200	2.3
Total land area	6,715,700	100.0

Land taxes are generally high. In addition to a high ad-valorem tax, caused by a relatively high valuation of agricultural land, many areas bear an additional tax to pay for drainage improvements. In 1933 when approximately 2.7 million acres of land in the unit were in organized drainage districts, an average drainage tax of 58¢ per acre was assessed against the land in this area. Since then many drainage districts have been refinanced with loans from the Reconstruction Finance Corporation, with a resulting reduction in the current drainage tax. An additional area in organized drainage districts in the Missouri portion of the unit bears a similar tax. Furthermore, some portions bear an annual levee tax as great as 25¢ per acre. In certain extreme instances the total tax, including state and county taxes, may be more than $2 per acre per year. Forest land in many parts of this unit has a relatively high value because of its speculative worth as agricultural land. On account of this high value and high annual tax, cut-over forest land is used for agriculture if its quality permits and if economic conditions justify its use for this purpose.

Forest Description

Although most of this area was originally covered with a dense virgin hardwood forest, its proximity to the northern markets consuming hardwoods and its excellent timber stand made it one of the first areas of the Mississippi River Delta to be logged commercially. This cutting, begun certainly prior to 1880, carried on over a relatively long period, and followed as it often was by agricultural development, has resulted in a relatively small residual forest area. On the front lands along the Mississippi River in Arkansas, and in the Missouri portion of the unit, extensive areas occur in which the forest occupies no more than 10 to 15 percent of the land area. Certain areas less suited for agriculture, such as Crowley's Ridge and areas of very poor drainage, are now largely forested and can be expected to remain so. A considerable part of the present forest area, however, is potential agricultural land, and may become so if economic conditions warrant its use for this purpose. The situation in regard to the forest area is shown in greater detail in table 2, where this area is classified into 9 forest types on the basis of the species found there and into 5 forest conditions on the basis of the character of the timber stand. The general distribution of the forest types is also shown in figure 1, although the types shown here are somewhat more generalized than those given in table 2. The red gum-water oak, overcup oak-bitter pecan, cottonwood-willow, and hackberry-elm-ash types of table 2 have been combined in figure 1 into the red gum-mixed hardwood type, which, like the cypress-tupelo gum type, is commonly found on the bottoms. The mixed oak-mixed hardwood and the scrub oak-scrub hardwood types, characteristic of the terraces, have been combined in figure 1 to give the oak-mixed hardwood type. The water oak type of table 2, which occurs on both bottoms and terraces, has been included in figure 1 with the red gum-mixed hardwoods when it occurs on the bottoms, and with the oak-mixed hardwoods when it occurs on the terraces. The upland hardwood type is found on Crowley's Ridge and on the Commerce Hills south of Cape Girardeau, Mo.

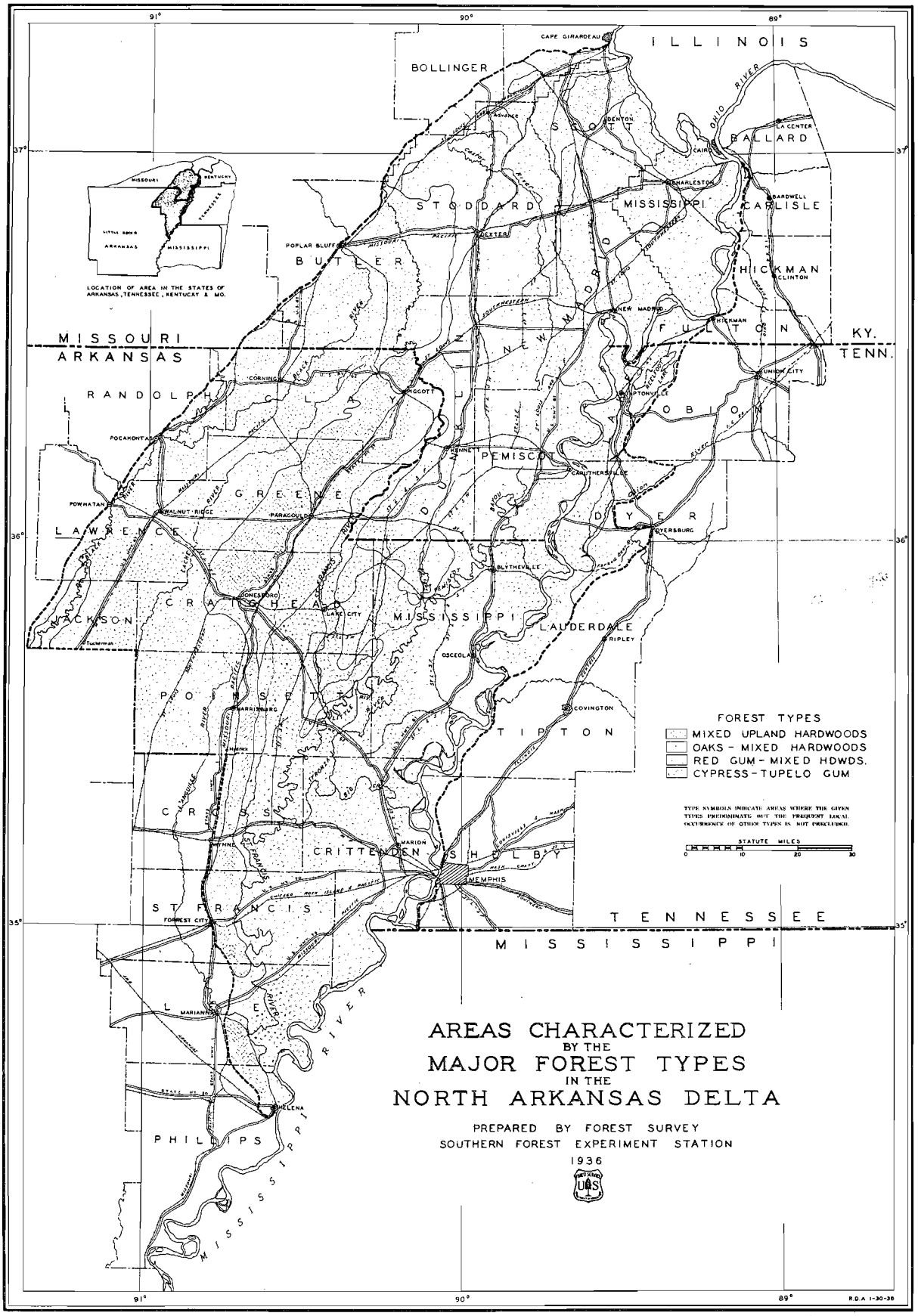
AREAS CHARACTERIZED
BY THE
MAJOR FOREST TYPES
IN THE
NORTH ARKANSAS DELTA
PREPARED BY FOREST SURVEY
SOUTHERN FOREST EXPERIMENT STATION
1936
FOREST TYPES
MIXED UPLAND HARDWOODS
OAKS - MIXED HARDWOODS
RED GUM - MIXED HDWDS.
CYPRESS - TUPELO GUM
TYPE SYMBOLS INDICATE AREAS WHERE THE GIVEN TYPES PREDOMINATE BUT THE FREQUENT LOCAL OCCURRENCE OF OTHER TYPES IS NOT PRECLUDED.
STATUTE MILES
LOCATION OF AREA IN THE STATES OF ARKANSAS, TENNESSEE, KENTUCKY & MO.
ILLINOIS
MISSOURI
ARKANSAS
KY.
TENN.
MISSISSIPPI
TENNESSEE
BOLLINGER
STODDARD
BUTLER
RANDOLPH
CLAY
GREENE
LAWRENCE
JACKSON
CRAIGHEAD
POINSETT
CROSS
ST FRANCIS
PHILLIPS
MISSISSIPPI
DUNKLIN
NEW MADRID
PEMISCOT
DYER
LAUDERDALE
TIPTON
CRITTENDEN
SHELBY
FULTON
HICKMAN
CARLISLE
BALLARD
OBION
WEAKLEY
LAKE
CAPE GIRARDEAU
POPLAR BLUFF
POCAHONTAS
POWHATAN
WALNUT RIDGE
PARAGOULD
JONESBORO
LAKE CITY
BLYTHEVILLE
OSCEOLA
HARRISBURG
MARION
MEMPHIS
FORREST CITY
MARIANNA
HELENA
CORNING
DEXTER
CHARLESTON
CAIRO
BENTON
LA CENTER
BARDWELL
NEW MADRID
HICKMAN
CLINTON
UNION CITY
OBION
TIPTONVILLE
RUTHERSVILLE
DYERSBURG
COVINGTON
RIPLEY
OHIO RIVER
MISSISSIPPI RIVER
R.D.A. 1-30-36

Figure 1.

Table 2. - Distribution of total forest area in the various forest types and forest conditions, 1935

Forest type	Old growth		Second-growth sawlog size		Second-growth under sawlog size, reproduction, and clear-cut	All conditions	
	Uncut	Partly cut	Uncut	Partly cut			
	Acres						Percent
Red gum-water oak	33,100	26,000	77,300	74,100	227,200	437,700	16.7
Hackberry-elm-ash	15,000	50,500	115,200	101,700	190,100	472,500	18.1
Overcup oak-bitter pecan	9,500	27,600	29,200	37,100	62,200	165,600	6.3
Cottonwood-willow	-	-	82,000	26,800	153,900	262,700	10.1
Cypress-tupelo gum	1/	38,600	63,900	75,700	86,900	270,600	10.4
Water oak	1/	14,200	49,700	86,000	115,100	266,600	10.2
Mixed oak-mixed hardwood	1/	24,500	68,600	100,200	208,200	405,400	15.5
Upland hardwood 2/	1/	24,500	37,900	38,700	116,600	219,300	8.4
Scrub oak-scrub hardwood	-	6,300	6,300	13,400	86,800	112,800	4.3
Total all types	70,200	212,200	530,100	553,700	1,247,000	2,613,200	100.0
Percent of total	2.7	8.1	20.3	21.2	3/47.7	100.0	

1/ Although the Survey data show an area in this type and condition, it is too small to indicate accurately even the relative magnitude of the individual item. The area estimated, however, is carried in the total for the type and condition.

2/ Includes a small area of pine-hardwood type.

3/ Of this total area, only about 2 percent can be classed as "clear-cut."

95% in Ark.-Plume - metered from type map 208,300

The total forest area has been further subdivided into commercial and noncommercial areas. By a "commercial" forest area is meant one that supports a stand of adequate quality and volume per acre to warrant operation under normal conditions for such high-grade products as industrial lumber, cooperage stock, or veneer. Since practically all of the forest area in this unit is accessible for truck logging during some season of the year, industrial operators generally find it feasible to log areas bearing 1,000 board feet or more per acre of high-grade material; throughout this report such forest areas are considered to be commercial. "Noncommercial" areas include all forest lands that do not meet these qualifications. These areas frequently bear stands suitable for cross ties, structural timbers, and lumber for domestic use.

High-grade material is contained specifically in (1) lumber-mill and veneer-mill logs and (2) other high-quality logs suitable chiefly for the manufacture of cooperage and small-dimension stock. Lumber-mill logs are those at least 14 inches (12 inches in ash, yellow poplar, and black walnut) in diameter that can be expected to yield 30 percent or more of their lumber volume in grades No. 1 common and better. Logs in this class average about 60 percent of their volume in these grades of lumber. Cooperage and small-dimension logs are at least 10 inches in diameter and of the same general quality as lumber-mill logs, but they cannot be so classified because of their small diameter or excessive sweep. These small, high-grade logs are suitable for industrial uses that require bolts or blocks rather than logs. High-grade material in cypress and pine includes the contents of all individual trees which will cut a minimum of 80 to 90 percent of their lumber volume in grades No. 2 common and better, and which, in addition, will produce more than 5 percent in firsts and seconds or B and better. Low-grade logs of all species are those that do not meet the above qualifications. In all partly cut sawlog-size forest conditions, the high-grade volume is largely made up either of species that did not at the time of the last cutting have a well-established market, or of small logs suitable only for cooperage and small-dimension stock.

Of the total forest area, only 200,000 acres, or less than 10 percent, supports sufficient high-quality timber (1,000 board feet or more per acre) to be classified as commercial. Of this commercial area, approximately 27 percent is in the old-growth uncut condition, 24 percent in the old-growth partly cut condition, 32 percent in the second-growth sawlog-size uncut condition, and 17 percent in the second-growth sawlog-size partly cut condition. Approximately one-third of the commercial forest area was in the red gum-water oak type.

Timber Inventory

The volume estimate has been broken down into sawtimber volume (expressed in board feet, Doyle log scale) and into cordwood volume. The sawtimber volume includes the net volume of all usable logs in good trees of sawlog size, regardless of log grades. Such trees are at least 13.0

inches d.b.h.[1/] (9.0 inches in pine) and contain at least one 12-foot usable log (i.e., one 10 inches or more in diameter at the small end in hardwood, and 6 inches or more in pine); and at least 50 percent of their volume in material suitable for the manufacture of lumber of commercial grade, low-grade structural material, low-grade box material, or railroad cross ties. The sawtimber volume, however, includes neither the volume of sound cull and rotten cull trees, nor the cull volume in good trees.

The cordwood volume of trees under sawlog size (5.0 - 12.9 inches d.b.h. in hardwood and cypress, and 5.0 - 8.9 in pine) includes the wood and bark of the main stem to a usable top, the minimum allowable top being never less than 4 inches and seldom more than 8. The cordwood volume is also net, that is, the volume of cull material that normally would be left in the woods as waste has not been included.

Board-foot volume

The total net board-foot volume, as shown in section A of table 3, is 3.0 billion board feet, according to the Doyle log rule. Of this total, approximately 21 percent is in old-growth uncut stands; 20 percent is in the old-growth partly cut; 32 percent in the second-growth sawlog-size uncut; 22 percent in second-growth sawlog-size partly cut stands, and 5 percent on the remaining second-growth and clear-cut areas. Considering the total board-foot volume from another point of view, 41 percent (or 1.2 billion board feet) is on commercial areas; approximately half of this is high-grade material suitable for industrial lumber, veneers, and cooperage. On noncommercial forest areas approximately 12 percent of the total board-foot volume is high-grade material.

Although these are the total volumes, a sharper picture of the timber stands in the unit perhaps can be obtained best from a statement of the total stand per average acre, high-grade and low-grade material combined, in the various forest conditions.

Forest condition	Average number of board feet per acre (Doyle log scale)
Old growth:	
Uncut	9,066
Partly cut	2,798
Second growth:	
Sawlog size:	
Uncut	1,852
Partly cut	1,196
Under sawlog size, reproduction, and clear-cut areas	112
Weighted average, all conditions	1,153

1/ "d.b.h." is the abbreviation for "diameter at breast height," which is the tree diameter at 4½ feet above ground. The Survey uses 2-inch diameter-classes; thus for example, the lower and upper limits of the 14-inch diameter-class are 13.0 and 14.9 inches, respectively.

Table 3.— Total net volume of good trees on forest areas, classified according to forest condition and species-group, 1935

A. BY FOREST CONDITION

Forest condition and species-group	Volume on commercial areas			Volume on noncommercial areas			Total volume	
	Sawtimber (Doyle)		Cordwood[1]	Sawtimber (Doyle)		Cordwood[1]	Sawtimber (Doyle)	Cordwood[1]
	In high-grade logs	In low-grade logs		In high-grade logs	In low-grade logs			
	M bd.ft.	M bd.ft.	Cords	M bd.ft.	M bd.ft.	Cords	M bd.ft.	Cords
Old growth:								
Uncut	328,100	242,500	145,500	10,900	54,900	54,500	636,400	200,000
Partly cut	133,100	126,500	155,200	24,600	309,500	515,900	593,700	671,100
Second growth:								
Sawlog size:								
Uncut	131,900	143,700	323,900	118,900	587,400	2,372,700	981,900	2,696,600
Partly cut	50,300	68,100	166,700	54,400	489,600	2,163,300	662,400	2,330,000
Under sawlog size	-	-	-	11,300	124,200	4,056,600	135,500	4,056,600
Reproduction	-	-	-	-	1,700	12,300	1,700	12,300
Clear-cut	-	-	-	-	2,200	12,400	2,200	12,400
Total	643,400	580,800	791,300	220,100	1,569,500	9,187,700	3,013,800	9,979,000

B. BY SPECIES-GROUP

Red gum	225,000	123,500	54,800	10,800	81,700	511,200	441,000	566,000
Water oaks	22,100	29,100	57,000	15,900	291,500	1,470,400	358,600	1,527,400
Red oaks	33,200	26,500	47,000	19,700	100,400	871,400	179,800	918,400
White oaks	11,900	18,700	27,800	8,700	49,500	350,100	88,800	377,900
Overcup oak[2]	15,300	70,200	30,100	7,200	177,900	952,800	270,600	982,900
Ash	45,500	27,700	59,100	11,400	33,000	453,100	117,600	512,200
Cottonwood	57,000	68,000	20,300	11,600	95,500	344,600	232,100	364,900
Willow	8,600	8,400	12,700	13,500	75,100	580,500	105,600	593,200
Elms[3]	57,000	62,600	118,500	25,300	200,900	876,100	345,800	994,600
Tupelo gum[4]	11,600	17,000	36,600	12,900	45,600	410,700	87,100	447,300
Cypress	63,600	12,100	55,300	31,500	120,100	730,800	227,300	786,100
Bitter pecan	1,100	4,700	11,000	500	23,000	71,900	29,300	82,900
Hickory[5]	7,600	10,400	46,400	7,700	62,100	467,700	87,800	514,100
Hackberry	11,100	14,200	104,700	11,400	57,500	322,800	94,200	427,500
Miscellaneous[6]	72,800	87,700	110,000	32,000	155,700	773,600	348,200	883,600
Total	643,400	580,800	791,300	220,100	1,569,500	9,187,700	3,013,800	9,979,000

1/ Cordwood volume of trees under sawlog size including the wood and bark of the main stem to a usable top, the minimum allowable top never being less than 4 inches and seldom more than 8. Cordwood volume was calculated on a basis of 80 cubic feet per cord for hardwood species and 90 cubic feet for pine and cypress. Only woods cull was deducted from the cordwood volume.

2/ Approximately 32 percent of this volume is "hill" post oak.

3/ Approximately 80 percent of this volume is white elm.

4/ Approximately 34 percent of this volume is black gum.

5/ Approximately 40 percent of this volume is sweet pecan.

6/ Includes a small volume of pine (approximately 11 million board feet and 17,000 cords).

Thus it is seen that the under-sawlog-size, reproduction, and clear-cut conditions, which make up nearly 48 percent of the forest area (see table 2), support an average stand of only 112 board feet per acre, and the weighted average for the total forest area is only 1,153 board feet per acre. It is apparent that in general the forests of this unit are understocked in trees of sawlog size. In addition to this board-foot volume, the average acre bears approximately 3.8 cords of stem wood in trees under sawlog size. Converting the board-foot volume of sawlog-size trees to cords for purposes of comparison, we get 4.0 cords of sawtimber on the average acre. Almost half the volume in stems of good trees, expressed in cords, is therefore in trees under sawlog size.

Although the Doyle log rule is the legal rule of Arkansas and is in general use for timber estimates in the South, its application to stands made up mainly of small trees results in a considerable understatement of the actual volume recoverable in lumber. The board-foot volume in this survey unit, according to the International $\frac{1}{4}$-inch log rule, which closely approximates green lumber tally, is 4.1 billion board feet; and according to the Scribner log rule, the official log rule of the U. S. Forest Service, it is 3.7 billion board feet. The average stand per acre, using the International $\frac{1}{4}$-inch rule, is 1,577 board feet instead of the 1,153 feet found with the Doyle rule.

Cordwood volume

In addition to the sawtimber volume, and the volume in sound trees under sawlog size, already shown in table 3, there is, as determined by a very rough estimate, 11.7 million standard (4 x 4 x 8 feet) cords of sound wood, including bark, which is classified as follows:

	Cords
Tops and limbs of good trees of sawlog size	6,001,500
Sound wood from stems, tops, and limbs of cull trees	5,659,400
	11,660,900

In sawlog-size trees, this cordwood volume includes that portion of the main stem above the usable sawlog limit and also includes the volume of all hardwood and cypress limbwood over 4 inches in diameter. In cull trees, the volume includes the sound volume of all stemwood in trees at least 5.0 inches d.b.h., together with limbwood in sawlog-size trees.

Cubic-foot volume

The cubic-foot equivalent of the total sawtimber volume is 728 million cubic feet inside bark. The cubic volume of good trees under sawlog size but over 5 inches is 635 million cubic feet excluding bark. The total cubic volume, excluding cull trees and tops, is therefore 1.4 billion cubic feet (1935).

Timber Increment

Annual increment on an area is considered to be the difference between the net volume of live, good trees standing on the area at the beginning of any year and the corresponding volume at the end of the same year, assuming that no volume is removed by cutting in the meantime. It is, therefore, the increase over and above the volume lost through natural mortality, and is equivalent to the cut that can be made that year without reducing the volume of the original growing stock.

Board-foot increment is made up of (1) the growth on trees already sawlog size and (2) the total board-foot volume of trees becoming sawlog size during the year. This increment is expressed in net log scale, and is based on good trees only, from which all cull material is excluded. Similarly, cubic-foot increment represents (1) the growth on sound stemwood in good trees at least 5.0 inches in diameter, plus (2) the total volume of small trees growing up to, or exceeding, this diameter during the year.

Table 4 shows the annual increment per acre in the various forest conditions in terms of board feet and cubic feet, excluding bark. In these increments, deductions for natural mortality have been made; no deductions have been made, however, for material removed in timber-cutting operations. Increment in board-foot material is expressed in lumber tally as measured by the International $\frac{1}{4}$-inch rule. Cubic-foot increment includes material in trees of both sawlog and under sawlog sizes.

Table 4. - Annual increment 1/ on the average acre of commercial and noncommercial forest, by forest conditions, 1935

Forest condition	Annual increment	
	Board feet (Int. $\frac{1}{4}$-inch rule)	Cubic feet (i.b.)
Commercial area:		
Old growth, uncut	102	18
Old growth, partly cut	106	22
Second growth, sawlog size	200	34
Noncommercial area:		
Old growth, uncut	96	18
Old growth, partly cut	79	20
Second growth, sawlog size	128	27
Second growth, under sawlog size	48	29
Clear-cut and reproduction	2/ -7	2/ -5
All conditions	85	25

1/ Figures in this table do not include increment resulting from the change of noncommercial areas to commercial areas (see footnote 3, table 5).

2/ Negative increments occur when the volume lost to the stand through natural mortality of residual trees is greater than the increase in volume in good trees.

Table 5 shows the total net volume of wood added to the inventory of good trees on the whole forest area during 1935, expressed in board feet (International $\frac{1}{4}$-inch rule) for sawlog-size material and in standard cords of 4 x 4 x 8 feet for material under sawlog size. In arriving at these estimates, deductions were made for natural mortality but not for cuttings. The total increment for all conditions is about 223 million board feet of sawtimber material and 574,000 cords in the stems of good trees under sawlog size. Conversion of the board-foot increment to cords, on the basis of 2 cords per thousand board feet, gives nearly 450,000 cords. Considerably more than half the increment, therefore, is on trees under sawlog size. Of the board-foot increment, nearly two-thirds is in trees below the 20-inch diameter-class. Also, employing the same conversion factor as before (2 cords per M bd. ft.) we find (from table 5) that nearly 75 percent of the total increment expressed in cords is on noncommercial areas. Thus we see that the increment is predominately in trees below the 20-inch diameter-class and on noncommercial areas, and consequently of low immediate value from the viewpoint of the industrial lumber operator. Because the increment is largely on the smaller trees and in understocked stands, however, one should not conclude that the increment per acre is necessarily small. Converting the board-foot increment to cordwood volume (including bark), the total annual increment per acre in the second-growth sawlog-size and under-sawlog-size conditions, which make up 87 percent of the forest area, is between 0.4 and 0.5 cord.

Table 5.-- Total annual increment,[1] classified according to forest condition, 1935

Forest condition	Increment[2] in trees under sawlog size			Increment in sawlog-size trees						
				Diameter-classes 14 - 18 inches		Diameter-classes 20 inches and over		All sawlog-size trees		
	Commercial area [3]	Noncommercial area	Total	Commercial area [3]	Noncommercial area	Commercial area [3]	Noncommercial area	Commercial area [3]	Noncommercial area	Total
	Cords			M board feet (Int. ¼-inch rule)						
Old growth:										
Uncut	3,400	900	4,300	600	300	5,000	1,200	5,600	1,500	7,100
Partly cut	6,700	21,900	28,600	1,700	5,900	3,600	6,900	5,300	12,800	18,100
Second growth:										
Sawlog size	94,300	30,700	125,000	23,800	59,100	43,400	20,000	67,200	79,100	146,300
Under sawlog size	7,000	414,700	421,700	100	53,700	1,300	[3]-2,700	1,400	51,000	52,400
Reproduction and clear-cut	-	[4]-5,700	[4]-5,700	-	[3]-1,100	-	100	-	[3]-1,000	[3]-1,000
Total all conditions	111,400	462,500	573,900	26,200	117,900	53,300	25,500	79,500	143,400	222,900

1/ Increment figures are based on the assumption that no cutting takes place.

2/ This increment includes the annual growth on trees at least 5.0 inches d.b.h. that remain under sawlog size throughout the year, plus the volume in trees that during the year move into the 6-inch diameter-class.

3/ The annual increment on commercial forest areas includes not only the increment on areas that were commercial forest at the beginning of the year, but also the total timber volume added through movement of areas from the noncommercial to the commercial class as a result of one year's growth. Negative board-foot increment on noncommercial forest areas indicates (1) that the volumes on areas moving from the noncommercial to the commercial class were greater than the increment on areas remaining in the noncommercial class, and (2) that the mortality in residual stands is heavy.

4/ Negative annual increments of trees under sawlog size means that the volume of trees changing from under sawlog size to sawlog size is greater than the increment of the trees that were under sawlog size at the end of the year (see footnote 2).

Forest-Products Industries

In 1936, the North Arkansas Delta (which, as previously stated, includes portions of Missouri, Tennessee, and Kentucky) supported within its boundaries 273 primary wood-using plants (figure 2), of which 237 were sawmills and 36 were nonlumber plants.

Lumber industry

The sawmills of this unit are of two distinct classes: (1) those that cut industrial lumber of standard grades, used largely in the manufacture of furniture, fixtures, vehicles, flooring, mill work, and implements; and (2) those that produce (a) heavy structural material for such uses as cross ties, car stock, dock and bridge material, and (b) light structural material for local building. Industrial lumber mills in general have a daily capacity of at least 20,000 board feet. Usually band mills, equipped to cut well-manufactured, air-dried, rough lumber for factory consumption, they require a large proportion of high-grade logs. Hardwood mills producing structural material usually are small mills, often with a circular saw and lacking facilities for the proper edging, trimming, and yarding of their output. They can operate generally on a lower average quality of timber than can the industrial lumber mills.

Table 6 shows that 122 million board feet of lumber was manufactured in the sawmills of the unit in 1936. From this table it can be seen also that although the sawmill industry is characterized by small mills, which chiefly cut heavy structural material and material for local building, these small mills produced only about 39 percent of the lumber cut in this unit. Furthermore, although the mills in the unit produced 122 million board feet of lumber, 168 million board feet was cut from the stands of the unit, indicating that a considerable volume in sawlogs was shipped out to mills located elsewhere. A large part of this volume was shipped to Memphis, Tennessee, an important hardwood industrial center just across the Mississippi River from this unit.

Table 6. - Production and employment data in the lumber industry, 1936[1/]

Daily mill capacity	Mills	Produced by mills in the unit	Mill employment	Produced from forests of the unit	Woods employment
M bd.ft.	Number	M bd.ft.	Man-days	M bd.ft.	Man-days
Under 10	200	25,500	34,400	25,300	35,400
10 - 19	25	22,100	32,900	24,000	27,300
20 - 39	7	22,900	52,300	48,500	88,800
40 - 79	3	25,900	60,800	59,900	81,500
80 and over	2	25,700	35,900	10,500	13,600
Total	237	122,100	216,300	168,200	246,600

1/ Based on a 10-hour operating day and net log scale (International $\frac{1}{4}$-inch log rule).

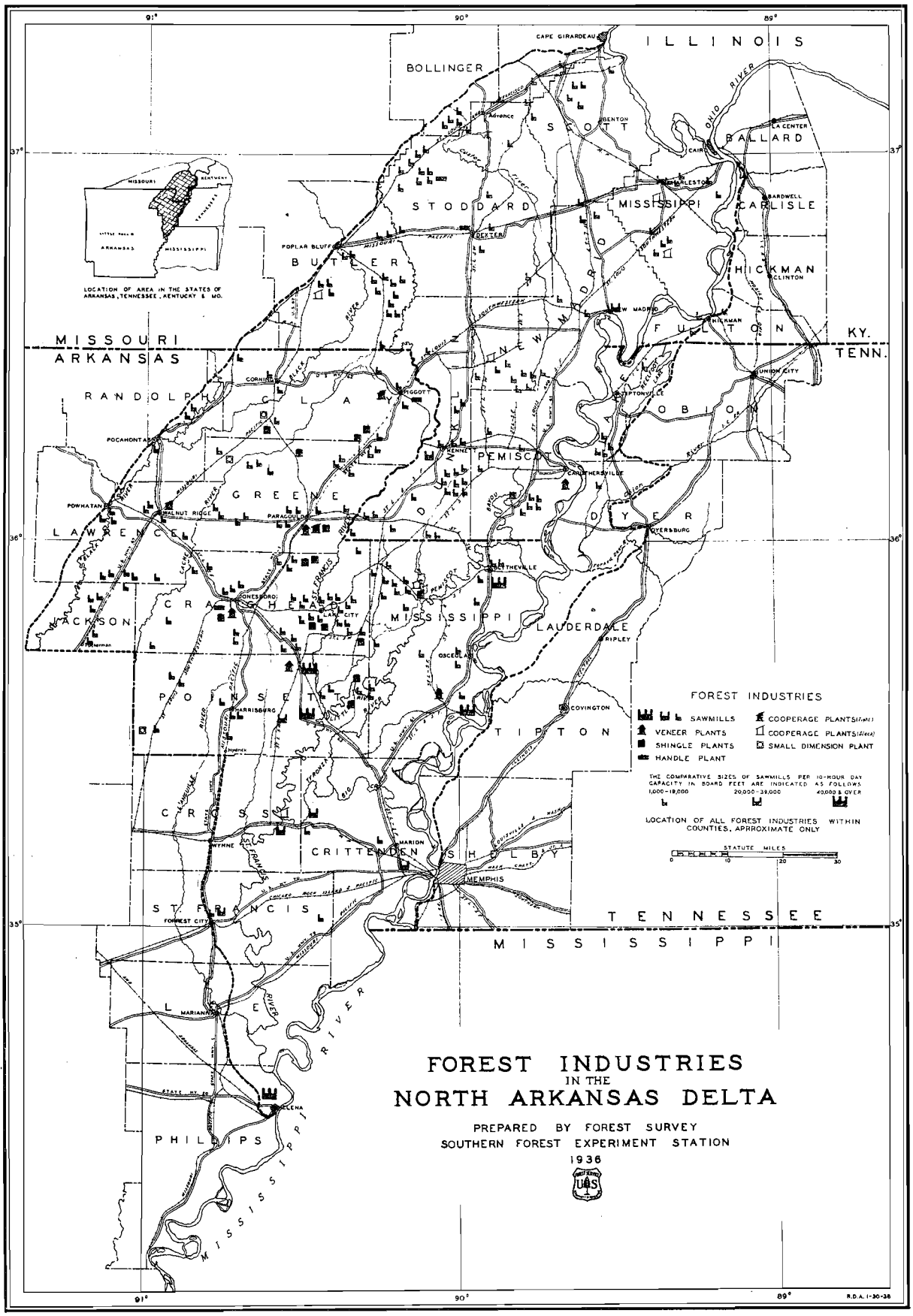
FOREST INDUSTRIES
IN THE
NORTH ARKANSAS DELTA
PREPARED BY FOREST SURVEY
SOUTHERN FOREST EXPERIMENT STATION
1936
FOREST INDUSTRIES
SAWMILLS
VENEER PLANTS
SHINGLE PLANTS
HANDLE PLANT
COOPERAGE PLANTS(Stock)
COOPERAGE PLANTS(Stock)
SMALL DIMENSION PLANT
THE COMPARATIVE SIZES OF SAWMILLS PER 10-HOUR DAY CAPACITY IN BOARD FEET ARE INDICATED AS FOLLOWS
1,000-19,000
20,000-39,000
40,000 & OVER
LOCATION OF ALL FOREST INDUSTRIES WITHIN COUNTIES, APPROXIMATE ONLY
STATUTE MILES
LOCATION OF AREA IN THE STATES OF ARKANSAS, TENNESSEE, KENTUCKY & MO.
ILLINOIS
MISSOURI
ARKANSAS
KY.
TENN.
MISSISSIPPI
TENNESSEE
BOLLINGER
SCOTT
STODDARD
BUTLER
RANDOLPH
CLAY
GREENE
LAWRENCE
CRAIGHEAD
POINSETT
CROSS
CRITTENDEN
ST. FRANCIS
LEE
PHILLIPS
MISSISSIPPI
NEW MADRID
PEMISCOT
DUNKLIN
OBION
DYER
LAUDERDALE
TIPTON
SHELBY
FULTON
HICKMAN
CARLISLE
BALLARD
JACKSON
CAPE GIRARDEAU
POPLAR BLUFF
DEXTER
CORNING
PIGGOTT
POCAHONTAS
WALNUT RIDGE
PARAGOULD
JONESBORO
LAKE CITY
OSCEOLA
HARRISBURG
WYNNE
MARION
FORREST CITY
MARIANNA
HELENA
MEMPHIS
COVINGTON
RIPLEY
UNION CITY
DYERSBURG
CAMDEN
KENNETT
CARUTHERSVILLE
HICKMAN
CLINTON
FULTON
CAIRO
R.D.A. 1-30-38

Figure 2.

Nonlumber industries

In general the manufacture of veneer, tight and slack cooperage stock, poles and piles, and such miscellaneous products as small dimension stock, handles, and vehicle stock, requires a large proportion of high-grade logs or bolts. These nonlumber industries, however, can draw ordinarily on the high-grade material in the second-growth stands and partly cut stands left after logging for industrial lumber mills. The industries producing cross ties, shingles, and chemical wood, which do not require high-grade material, can operate effectively on the kind of timber most abundant in partly cut and second-growth stands.

Table 7 shows the 36 nonlumber wood-using plants in the unit. These plants, together with the many small sawmills cutting structural material, play an important part in the utilization of the forest and have to a considerable extent adjusted themselves to a forest growing stock characterized by low average volumes per acre and a relatively small proportion of high-grade timber.

Table 7. - Production and employment data in the nonlumber industries, 1936 1/

Commodity	Plants in unit	Produced by plants in the unit	Plant employment	Produced from forests of the unit	Woods employment
	Number	Cords	Man-days	Cords	Man-days
Tight cooperage material 2/	3	11,600	42,000	11,800	12,000
Slack cooperage material 3/	6	21,000	30,500	28,000	29,100
Chemical wood	-	-	-	4,100	5,200
Handles	4	4,300	12,000	8,400	16,000
		M bd.ft.		M bd.ft.	
Veneer	5	11,900	27,900	29,600	47,300
Shingles	15	1,500	4,200	1,500	4,200
Small dimension stock	3	400	2,300	2,600	8,500
		Pieces		Pieces	
Cross ties	-	-	-	319,000	32,200
Poles and piles	-	-	-	19,000	5,200
Total	36	-	118,900	-	159,700

1/ Cordwood volume is expressed in standard (4 x 4 x 8 feet) cords, including bark. Board-foot volumes are in terms of the International $\frac{1}{4}$-inch log rule. Man-days are based on a 10-hour day.

2/ Both staves and heading.

3/ Only staves.

Employment

The total forest industrial employment in the unit in 1936 was 741,500 man-days (see tables 6 and 7), of which 462,900, or 62 percent, were expended in the sawmill industry and the remainder in the nonlumber industries. In addition, it is probable that the labor involved in cutting about a million cords of fuelwood and miscellaneous material used on farms, as well as the 5,750,000 fence posts used in the unit, amounted to approximately 1,300,000 man-days. Although only a small portion of this employment — probably no more than 10 percent — was for cash wages, it represents an important employment item in the life of the people. The material thus produced, without cash outlay and usually without interference in normal gainful employment, is a substitute for material that would otherwise have to be purchased.

Forest Drain

The total volume of wood removed from the good trees of the unit in 1936 for use in industry and for domestic purposes has been expressed in table 8, in terms of drain against the growing stock of good trees. As used here, forest drain means the total volume of usable material removed from the stands by cutting, including the full volume of the trees felled; it does not include losses due to mortality, which are taken into account in calculating the increment. Neither does it include material cut from cull and dead trees or from limbs. Thus, drain in board feet in the first column of figures in table 8 includes the volume actually used (from tables 6 and 7), plus the volume left in the woods as waste because, although it met the Survey specifications for usable logs, it did not meet the requirements of the particular user. Drain in the last column of table 8 includes the cubic-foot contents of the sawlog portion of sawlog-size trees, plus the cubic-foot contents of the main stem of good trees at least 5.0 inches d.b.h. but under sawlog size.

Table 8. - Net volume of timber drain from good trees, 1936

Commodity	From sawlog-size trees	From all trees 5 inches d.b.h. and larger
	M bd.ft.[1]	M cu.ft.[2]
Lumber	189,100	28,860
Veneer	33,400	4,810
Tight cooperage material	8,400	1,230
Slack cooperage material	18,200	2,940
Handles	3,900	1,000
Shingles	1,600	330
Small dimension stock	3,000	570
Poles and piles	2,000	370
Cross ties	19,200	2,940
Material cut in clearing land	19,400	8,840
Chemical wood	100	280
Material cut for fuelwood, farm fence posts, and other domestic uses	80,600	27,170
Total	[3]378,900	[4]79,340

1/ According to the International $\frac{1}{4}$-inch log rule.

2/ Inside bark.

3/ 5,200,000 board feet, or approximately 1.4 percent, is pine; the remainder is hardwood and cypress.

4/ 940,000 cubic feet, or approximately 1.2 percent is pine; the remainder is hardwood and cypress.

The total 1936 drain from sawlog-size trees was 378.9 million board feet, of which 5.2 million is pine; in 1935 the drain from sawlog-size trees was 354.5 million board feet. Approximately half of this drain comes from commercial areas, which furnish a high proportion of the cut for lumber, veneer, and cooperage material. Noncommercial areas, on the other hand, furnish the greater part of the board-foot drain occasioned by land clearing, for fuelwood, and for other domestic use, since the sawlog material cut for these purposes is usually unsuited for high-grade industrial uses.

Comparison of Increment and Drain

The total net growing stock in the forests of the unit on January 1, 1935, was 4,122 million board feet, green lumber tally. The board-foot drain in that year exceeded the increment on noncommercial areas as well as on commercial. Furthermore, the total cubic-foot drain exceeded the total cubic-foot increment. It is evident that the sawmills and nonlumber industrial plants and other cutting operations are depleting their forest capital. At the end of 1935, the growing stock had been reduced to 3,974 million board

feet, a net reduction of forest capital of 148 million board feet. In 1936 the drain increased over that of 1935, resulting in a further reduction in growing stock. The comparison of growth and drain and the state of the growing stock for 1936 are shown in table 9.

These facts indicate that this unit is suffering from a chronic case of over-cutting. It is close to the agricultural and industrial centers of the Midwest, to which freight rates on industrial lumber from the unit are generally favorable. Furthermore, local markets are available for the relatively low grades of lumber and other wood products. Because of these advantages over competing hardwood-producing regions more distant from the principal consuming centers, it is to be expected that commercial cuttings in the Arkansas Delta are feasible on areas that would be impracticable to log in the hardwood regions farther south. Furthermore, during recent years relatively large areas of cut-over forest land have been cleared for agricultural uses. This trend in land clearing probably will continue, thus reducing the forest acreage still further and possibly resulting in still greater excesses of drain over growth. In addition, the rural population within the unit is increasing, and there is a corresponding increase in its wood-utilization requirements.

Table 9. - Comparison of increment with drain, 1936

Item	Total forest area	
	M bd.ft. 1/	M cu.ft. 2/
Net growing stock, Jan. 1, 1936	3,974,300	1,350,970
Increment, 1936 3/	202,500	63,090
Utilization drain, 1936	378,900	79,340
Net change in growing stock, 1936	-176,400	-16,250
Net growing stock, Jan. 1, 1937	3,797,900	1,334,720

1/ According to the International $\frac{1}{4}$-inch rule.
2/ Exclusive of bark.
3/ Increment figures are based on the assumption that cutting took place.

Outlook for the Future

In general, this unit is an agricultural region and can be expected to become even more so. The area east of Crowley's Ridge, especially in the northern portion of the unit is now very largely agricultural, with forest areas restricted to small scattered blocks of woodland evidently unable to meet adequately the domestic needs of the present farming population. Here the primary function of the forest area is to supply the needs of an agricultural people for fuelwood, fence posts, other domestic uses, and forest pasture. In much of the remainder of the unit, the forest is also an adjunct to farming, but the supply of wood is in excess of that needed for domestic use. Here farmers can expect to increase their cash income through the production of logs for sawmills and other primary forest industries. A relatively small percentage of the forest area is owned by industrial timber operators,

who are, in general, selling their cut-over lands to farmers as rapidly as possible. Certain areas, however, principally on the "batture" (i.e., the land between the levee and the river), probably will continue to be held for timber production by industrial operators.

It is therefore apparent that this unit is primarily not an industrial timber-growing region, and that the timber that is produced for industrial use can be expected to come in large part from farm woodlands and batture land. Furthermore, the woodland area is steadily decreasing through conversion to cultivated land. The present excess of drain over increment, occasioned by the increasing demand for wood and the shrinkage in forest area, can be expected to continue for some time; but with the application of the few relatively simple forest-management practices mentioned below, the forest growing stock can in time be built up to produce a much greater increment of a higher quality than that now being obtained. The owner of permanent forest land should consequently wish to improve the quality of his forest increment so that he may be able to supplement his cash farm income by the sale of industrial wood products in addition to producing wood for his domestic needs.

In general, the forests of this unit are at present badly run down; both the average volume per acre and the relative proportion of high-grade material suitable for industrial use are low. As can be seen from a comparison of figures 3A and 3B, there is on the average forest acre a dearth in the proportion of trees in the larger diameter-classes (12 inches and over). In the actual forest, the 12-inch diameter-class shows the largest basal area,[2/] whereas in a well-managed forest, designed to give optimum continuous production, the maximum basal area is in the 18- and 20- inch diameter-classes. In the noncommercial forest areas (more than 90 percent of the whole) the prevailing cutting practices are tending to increase the present maladjustment of size-classes; the general lack of larger trees is forcing the cutting of medium-sized trees, which should be left to grow into the larger size-classes.

Unless remedial measures are adopted, it is very apparent that sooner or later the production of the more valuable forest products from this area will be reduced materially because of a lack of suitable standing timber of the proper kind and quality. In other words, the present tendency is inevitably towards progressively confining the future output of the forests to smaller trees of low value. To increase the value of the forest growth, larger trees of higher quality must be grown. This will require the general adoption of a longer rotation, that is, trees that are to constitute the final harvest must be left to grow until they are 20 inches in diameter or larger. At the same time the forest growing stock must be built up; in general, the present run-down stands average only one-fourth to one-third of the board-foot volume the sites are capable of sustaining. It is obvious that stands cannot be built up as long as the annual drain from individual areas, and also from the unit as a whole, is greater than the annual increment. During the several decades needed to rehabilitate the forest stands, a reduction in the cut of industrial timber would be necessary.

2/ The basal area is the sum of the areas of the cross sections of the trees at breast height.

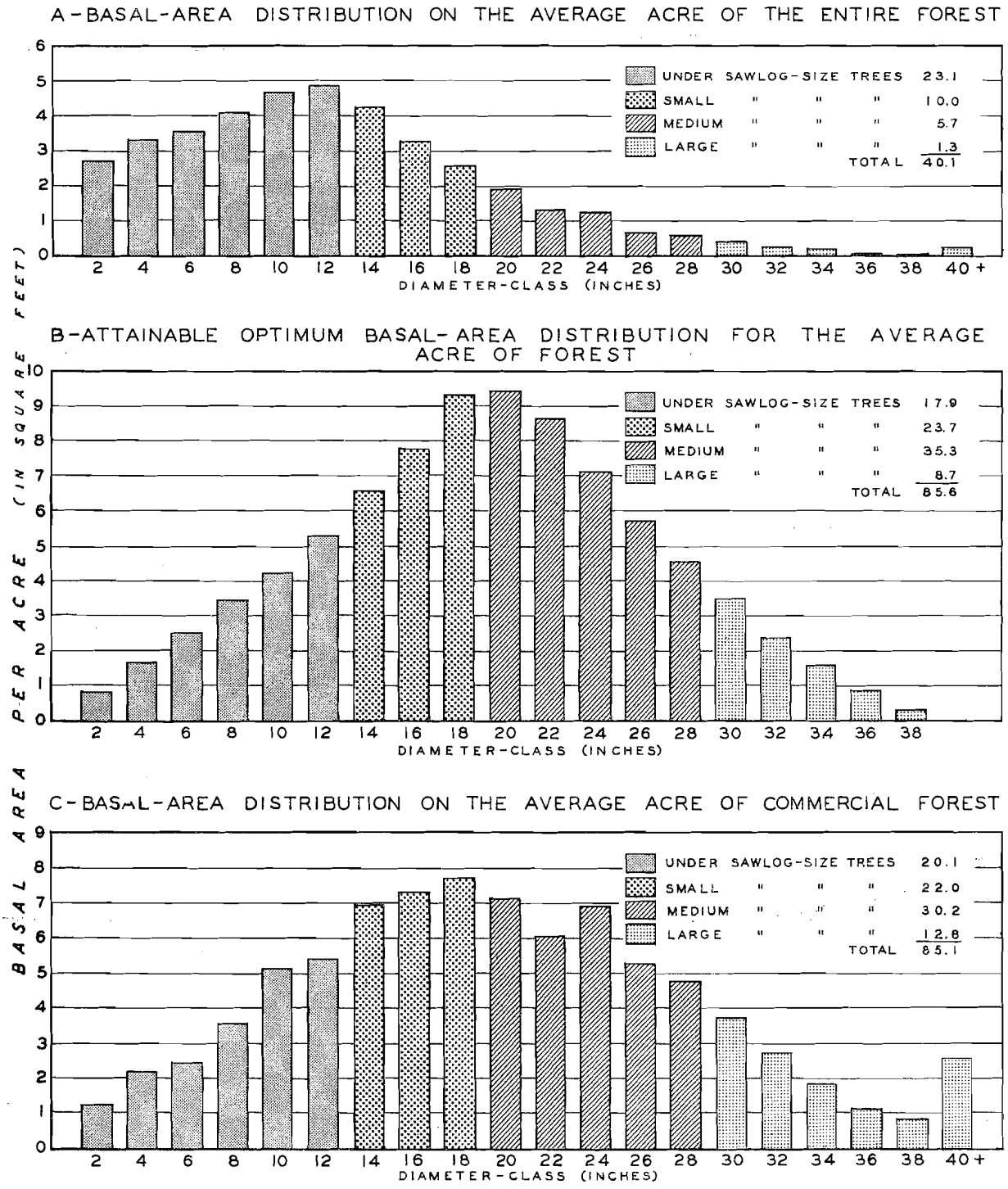
A-BASAL-AREA DISTRIBUTION ON THE AVERAGE ACRE OF THE ENTIRE FOREST
UNDER SAWLOG-SIZE TREES 23.1
SMALL " " " 10.0
MEDIUM " " " 5.7
LARGE " " " 1.3
TOTAL 40.1
BASAL AREA PER ACRE (IN SQUARE FEET)
DIAMETER-CLASS (INCHES)
B-ATTAINABLE OPTIMUM BASAL-AREA DISTRIBUTION FOR THE AVERAGE ACRE OF FOREST
UNDER SAWLOG-SIZE TREES 17.9
SMALL " " " 23.7
MEDIUM " " " 35.3
LARGE " " " 8.7
TOTAL 85.6
BASAL AREA PER ACRE (IN SQUARE FEET)
DIAMETER-CLASS (INCHES)
C-BASAL-AREA DISTRIBUTION ON THE AVERAGE ACRE OF COMMERCIAL FOREST
UNDER SAWLOG-SIZE TREES 20.1
SMALL " " " 22.0
MEDIUM " " " 30.2
LARGE " " " 12.8
TOTAL 85.1
BASAL AREA PER ACRE (IN SQUARE FEET)
DIAMETER-CLASS (INCHES)

Figure 3.

Growth possibilities in this unit are inherently great. In spite of the present understocked condition of the second-growth stands, the annual increment is between 0.4 and 0.5 of a cord per acre on 87 percent of the total forest area. This increment could be increased substantially through the application of the following basic measures of timberland management: (1) increasing the timber volume on the average acre by cutting less than the annual increment and encouraging an increase in the number of stems, since it is obvious that a forest with a stand of 2,500 board feet per acre will lay on more wood per annum at a given increment rate than will a stand of only 1,500 board feet; (2) retaining in the stand for a few more years the most rapidly growing trees (i.e., trees 16 to 20 inches d.b.h.) instead of cutting them while they are still growing at their most rapid rate, thus tending to increase the volume per acre and to take full advantage of the rapid-growth period of the individual trees; (3) removing the relatively slow-growing and low-quality trees for fuelwood and other domestic uses, thus releasing the rapid-growing young trees from competition; and (4) reducing to a practicable minimum the timber loss through natural causes, by effectively preventing forest fires and removing cull trees and trees destined to die before they reach maturity.

Although these simple measures can be applied by almost anyone interested in making his woodland contribute most to his needs, there is need for extension workers to "sell the idea" of "timber culture" to an agricultural people and to demonstrate that in this area there is a definite place for both "timber culture" and agriculture. Because of the peculiar soil and drainage conditions found here, there is a considerable area of land that will remain forested for many years to come. Timber cropping on this land should be a desirable adjunct to agriculture, since it provides both material for domestic use and off-season woods employment to farm labor, and also adds to the farm or plantation income through the sale of wood products.

Because an intimate relationship exists between farm and forest, because markets for high-grade lumber in industrial and agricultural centers are relatively near, and because there is already a local demand for low-quality material, it is to be expected that most of the woodlands in this unit will continue in private ownership. On the other hand, high land taxes, especially within the boundaries of organized drainage districts, are (and will continue to be) a handicap to private timber growing. Wherever practicable, areas of low agricultural value should be given preferential treatment in the drainage tax schedule and should be dedicated to timber production. Also efforts should be made to establish a reasonable, uniform, and stable taxing policy for lands suitable chiefly for timber production, since such a policy would greatly stimulate the continuous use of this land for this purpose.

Summary and conclusions

In brief, the outlook for the future in this unit comprises (a) a shrinking forest area as a result of conversion to agriculture, (b) a continuing excess of forest drain over increment, and (c) a decrease in the volume of production of high-grade industrial forest commodities. This paints a depressing picture for forestry, but the superior claim of agriculture to the fertile soils of this favorably located section of the Delta must be recognized. Nevertheless, successful agriculture here will always need woodlots and their products. Furthermore, there are certain areas of high forest values in all parts of the unit that will be neither readily converted nor soon needed for agricultural crops. On some of these areas, notably on batture land and on Crowley's Ridge, the growing of timber as an activity in itself may be feasible. Owners of such lands should be aided through tax relief, extension work in forestry, and cooperative fire-protection service, to develop the forest possibilities of these areas to the full capacity of their sites. In this way will these forest lands best serve their owners and the communities in which they occur.