

mer temperatures (25-33C) (Table 1). These results indicate that even if dormancy is overcome to some extent by other factors during the summer, maximum germination will not occur until there has been a lowering of the average daily temperature to a range of approximately 22-26C.

The combined effects of alternate wetting and drying, time, and low temperature upon termination of dormancy cannot be separated from their effects upon germination. The role of these factors considered separately is not understood, but that the three combined affect germination was clearly shown by this investigation. The effect of each isolated factor upon the breaking of dormancy and upon germination was apparent but never as effective as the combination of the three.

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THE PULP AND PAPER INDUSTRY IN TENNESSEE

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ABSTRACT

Using the normative method, numerous aspects concerning the development and growth of the pulp and paper industry in Tennessee were analyzed. Paper companies were visited to ascertain the various methods of processing raw materials and marketing of the finished product.

There are six wood-pulp and paper mills in Tennessee. Their combined capacity has enabled Tennessee to join other southern states in a tremendous expansion of the pulp and paper industry. Two pulp mills in the state use hardwoods exclusively. Others utilize a combination of hardwoods and softwoods. At Calhoun, Tennessee, Bowaters Southern Paper Corporation pulps pine and hardwoods to turn out more newsprint each year than any other mill in the United States.

In addition to the present pulp mills, there are other good pulp mill sites along the Tennessee River and its tributaries. These sites will perhaps be developed in the future and a greater amount of hardwoods will be utilized.

INTRODUCTION

The tremendous growth in pulpwood cutting is undoubtedly the most noteworthy forestry development in Tennessee within the past several years. Tennessee's five primary pulp mills presently account for 11 percent of the total mill capacity in the seven Mid South states. Manufacturing capacity of the average mill is about 908 tons per day. Individual mill capacity ranges from 140 tons to 1,300 tons daily. Due to the fact that these

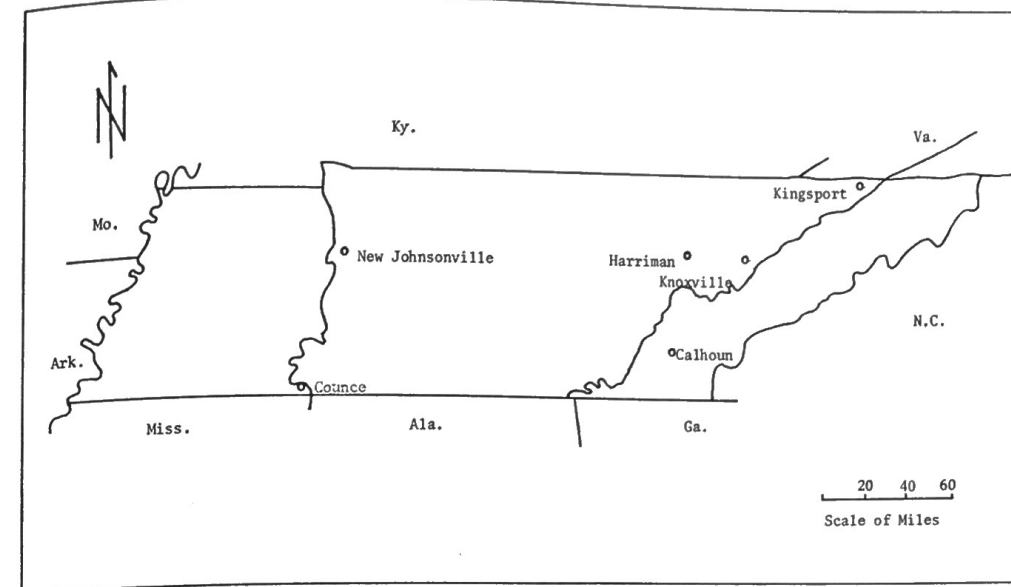
mills are an important part of the economy of the state, each plant will be discussed individually for the purpose of analyzing the growth and development of the pulp and paper industry in Tennessee.

Spatial Distribution of Pulp and Paper Mills

Southern Extract Company. The oldest established pulp and paper factory in Tennessee is the Southern Extract Company of Knoxville which was formed in 1890. The major factor that induced the company to locate in Knoxville was the availability of raw materials on privately owned woodlands in the eastern United States. In addition, the site combined abundant supplies of water, adequate rail and barge transportation possibilities; available labor, markets, and a choice of several fuels. These locational factors are available in varying degrees by all mill sites in the state.

Approximately 100 workers are employed by the plant. Of these, 20 percent are classified as skilled labor, and all the labor forces originates within a 50 mile radius of Knoxville.

Presently, the company utilizes 30,000 cords of hardwood annually and the daily production totals 140 tons of .009 inch corrugated board of three different grades. The product is produced by a semi-chemical (sodium-



Wood-Pulp Mills in Tennessee - 1969

sulphite) process and shipped by rail and truck for further processing to customers in the southeast and Mid West.

The Mead Corporation. The Mead Corporation, with main offices in Dayton, Ohio, located near the South Fork of the Holston River at Kingsport in 1920. Raw materials and chemicals for the pulping process were the main factors that influenced the company to locate at the Kingsport site.

The company utilizes hardwoods in all of its plants in Tennessee. About 95,000 cords are used at the company's soda mill at Kingsport in the production of high quality white paper for printing purposes. With a daily production of 550 tons, the finished product reaches customers as far as the Pacific Coast by truck or rail and some is exported.

Since World War Two, a continuous modernization program has resulted in greater production. For example, the plant has the first computer controlled machine that rolls 2,000 tons of uncoated paper daily.

In 1929 the Harriman Division of the Mead Corporation located on the Emory River, a tributary of the Tennessee River. Once again, raw materials were a major factor in the location of the plant.

The company's product, corrugating medium, is produced by a semi-chemical process, utilizing 35,000 cords of hardwood annually. Daily production amounts to approximately 190 tons, the second smallest output among the pulp and paper mills in Tennessee.

The Kingsport plant employs 1,500 people; whereas, the Harriman plant employs only 139. Of the combined labor force, 60.5 percent is classified as skilled labor.

The Bowaters Southern Paper Corporation. The Bowaters Corporation is located near the Hiwassee River at Calhoun, Tennessee. The Calhoun plant, headquarters for Bowaters United States Corporation, is one of three Bowaters plants located in North America. With main offices at The Bowaters House, Knightsbridge, London, England, the plant at Calhoun is only a small part of a world-wide organization manufacturing pulp, paper, packing and building products.

Labor was a very important factor in explaining why the company located at Calhoun. For example, the company received some 70,000 employment applications prior to production in 1954. Presently, the mill employs 1,300 people and 300 are employed in harvesting raw materials.

Raw materials arrive at Calhoun by truck, barge, and rail from 101 counties in the states of Tennessee, Kentucky, Georgia, Alabama, Mississippi, and North Carolina. The company obtains 85 percent of its pulpwood from private landowners and the remainder originates on Bowater's tree farms. All in all, the company pulps 524,000 cords of pine and 52,000 cords of hardwood to turn out more newsprint each year than any other mill in the United States.

Daily production amounts to about 1,300 tons of newsprint and byproducts include turpentine and tall oil.* The newsprint is a controlled blend of about 75 percent ground wood pulp and 25 percent chemical pulp. The mechanical, sulfate and soda processes are utilized in various stages of production.

* Tall oil is a resinous by-product from the manufacture of chemical wood pulp. Occasionally it is used in making soap, etc.

Bowaters supplies high quality newsprint and specialty paper to more than 700 customers as far south as Florida and as far west as Texas and Nebraska. Also, the company provides sulfate pulp sheets in bale form to other paper mills.

Tennessee River Pulp and Paper Company. The Tennessee River Pulp and Paper Company at Counce, Tennessee is an example of the fact that market is frequently an overriding factor in site selection of a new industrial plant. The mill is served by the Corinth and Counce Railroad Company, which connects with three railway systems at Corinth, Mississippi, and also various truck and river transportation systems. These systems allow the company to market its products, kraft linerboard, to container box companies throughout the South and Midwest.

In March 1961, the company began production and presently the daily output is 650 tons of linerboard, plus by-product tall oil and turpentine. In producing these products, the company's sulphate mill annually uses about 30,000 cords of hardwoods in a blend with some 300,000 cords of pine.

About 1,100 cords of pulpwood, required daily to operate the mill, are transported to the plant by rail and truck. Approximately 10 trucks deliver pulpwood from nearby forests and farm woodlands; whereas, pulpwood from outlying acres is transported to the mill by rail. The wood originates in private, public, and company owned forests of Tennessee, Alabama, and as far away as Central Mississippi.

The plant uses TVA power. In addition, the bark of the trees, since it cannot be used for pulping, is collected and burned in the power boiler to make steam. Another economic step undertaken by the plant is the recovery and reuse of the chemicals used to cook the wood chips in the digestors.

There are 500 employees on the mill payroll. Also, the mill provides work for about 2,000 persons who grow, cut, and haul pulpwood to the mill.

The Inland Container Corporation. The Inland Container Corporation, with headquarters in Indianapolis, Indiana, is constructing a plant at New Johnsonville, Tennessee. As the site is near the New Johnsonville, steam plant, the company will use TVA power and will be equipped with anti-air and water pollution systems when it begins production in 1970.

Utilizing the neutral sulfite ammonium process, the daily output will be approximately 300 tons of corrugating medium. In addition to all species of hardwood, waste paper, sawdust, and chips will be utilized as raw materials.

All in all, Inland Container expects to employ 150 people and inject about seven million dollars annually into the economy of Tennessee.

Some Conservation Measures Associated With Paper Production

Pollution. The Tennessee Stream Pollution Control Board has adopted certain minimum criteria for all streams receiving wastes. For example, the receiving streams must show not turbidity or color that produces an objectionable appearance; no distinctly visible solids, scum, foam, or oil slick; no substances that would prevent the production of potable water by modern water treatment processes or create offensive odors; no toxic substances that may affect man, animal, or aquatic life; and no other pollutants in quantities that may be detrimental to public health, aquatic life, recreation, or other reasonable and necessary uses of the waters. These criteria are applied after the wastes are mixed with the receiving waters at a reasonable distance below

EXISTING WOOD-PULP MILLS IN TENNESSEE-1969

Corporation	Pulp Mill Location	Process	Daily Capacity *	Principal Products
Bowaters Southern Paper Corporation	Calhoun, Tennessee	Groundwood Sulphate Soda	1300	Newsprint, kraft pulp
Mead Corporation	Kingsport, Tennessee	Soda	550	Book, magazine, eggshell tablet, envelope, offset, and other papers
Mead Corporation	Harriman, Tennessee	Semi-chem.	190	Corrugating board
Southern Extract Company	Knoxville, Tennessee	Semi-chem.	140	Corrugating board
Tennessee River Pulp and Paper Company	Counce, Tennessee	Sulphate	650	Kraft pulp, liner board
Inland Container ** Corporation	New Johnsonville, Tennessee	Neutral sulfite ammonium	300	Corrugating board

* in tons
** To be completed in 1970.

the mixing zone. Determinations are made under conditions of minimum stream flows and maximum water temperatures.

No waste may be discharged to a stream in Tennessee without a permit. Pertinent data concerning the proposed discharge, together with preliminary plans for waste treatment facilities, are submitted to the Tennessee Department of Public Health. No construction may be started until approval has been obtained. All permits are revocable and subject to modification as indicated by operating records, investigations, or conditions in the receiving stream.

All of the mills discussed in this paper have complied with state regulations concerning anti-water pollution, and four mills have anti-air pollution.

Forest Management. One of the outstanding conservation features of two paper companies, Bowaters Southern Paper Corporation and Tennessee River Pulp and Paper Company, is the program of forest management. For example, the Wood and Land Division of Tennessee River Pulp and Paper Company is working with nature to improve the quality and growth of the forest. Through a progressive program of forest management, company foresters are working to grow crops of trees over and over again on the same tree farm land.

Tree planting, pine stand maintenance, forest fire prevention and control, and research and development of better forests are among the scientific forestry practices applied to company-owned woodlands. Equally important in the forestry program is assistance to land owner and pulpwood producers. Conservation foresters are trained to provide free technical services and demonstrations to encourage the wise use of forest resources.

Another example of sound forest management is the "multiple use" concept in practice by Bowaters. Their forest lands are open to the public for such recreation as hunting, fishing, hiking, camping, and other recreational activities.

A New Raw Material. Pulp and paper mills, in cooperation with local and state agencies, are engaged in reforestation to have a continuous supply of young pulp-

wood. However, as the demand for paper increases and more mills develop, it may become almost impossible to supply the needed pulpwood from local sources. The answer may rest with a promising substitute called Kenaf. Conclusive tests are not yet available, but it is believed that the pulping properties of Kenaf will equal those of softwoods and will be superior to hardwoods.

The Future of Pulp and Paper in Tennessee

Pulpwood demands by the year 2000, a time when the population of the United States is expected to reach 328 million, is anticipated to be three times that of today, in view of the growing needs for newsprint, towels, clothing, food containers and other disposables. Industry and various governmental agencies have indicated that the South will probably provide most of the additional timber growth to meet the increased demand.

Along with softwood, Tennessee grows a large amount of hardwood timber on its 14 million acres of forest land. Much of this hardwood is suitable for pulping and the growth exceeds harvest by substantial amounts. Also, better markets for the lower grade hardwoods would accelerate their harvest and thus improve the capacity of forest stands to grow more and better pulpwood.

Training of manpower for forest industry employment is rapidly expanding. Many technical, vocational and high schools offer forest industry-related courses. By the year 2000, it is estimated that an additional 50,000 trained workers will be required.

Tennessee now ranks third in the Southeast as a manufacturing center. However, development of the additional hardwood pulping capacity would create the needed market, and at the same time, increase employment and improve the general economic climate.

The next growth phase of the pulp and paper industry in the state will probably involve greater hardwood utilization. Due to many factors, some of which have been discussed in this paper, an extensive hardwood pulping base could be adequately supported in the state.

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PETROGRAPHY OF A BASEMENT GRANITE FROM CENTRAL TENNESSEE

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ABSTRACT

Recent drilling in Davidson County penetrated basement. No description of basement rock in Central Tennessee has previously been published. The rock encountered is a massive, medium-grained pink granite consisting mainly of albite, perthitic microcline, quartz, and biotite. Accessories include magnetite, apatite, rutile, zircon, and epidote. Although alteration is not excessive,

it is pervasive. Alteration species are chlorite, hematite, clay, sericite, calcite, and possibly some magnetite.

In 1969 a diamond drill hole penetrated the basement in Davidson County near Nashville, Tennessee.* Gran-

* Dupont No. 1 Monitoring Well (Old Hickory). Carter Coordinate location SW NW Sec. 16, 3S-35E.