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Utilization of Low-Quality Hardwoods for Firewood in Knoxville, Tennessee

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SUMMARY

Tennessee's forests are characterized as having a relatively high proportion of low-quality hardwood trees, the removal of which would enhance the productivity of this resource. This study was designed to explore the possibilities of developing or expanding markets for firewood as a means of utilizing low-quality hardwoods.

Firewood users were found to have higher incomes, newer dwellings, larger dwellings, and an occupational distribution more heavily weighted by the professional, technical, managerial, and proprietary occupations, than did nonusers of the fireplace or substitute product users.

Quantity of firewood consumed per household was found to be a relatively stable characteristic, being little affected by level of income, number of fireplaces, or price of firewood.

Firewood consumers studied were found to exhibit definite preferences concerning the firewood product, especially with regard to availability of various sizes of purchase quantities, degree of seasoning, and size of firewood stick, and were found to burn firewood primarily for its aesthetic value. Only 18 out of 189 firewood users had ever used a substitute product in their fireplace, and among these coal predominated, being used more as a supplement than a substitute.

The predominant purchase quantity in the Knoxville area was found to be the delivered cord size lot of firewood with 91% of the consumers obtaining this quantity per purchase. Although the study indicated that the average truck load of firewood was equal to only three-fourths the volume of a fireplace cord or rick of firewood, no significant difference in price existed between these three units of measure for delivered lots of firewood. Door-to-door selling and "word-of-mouth" were the primary means by which a consumer-retailer relationship was established, with 55% and 20%, respectively, of the consumers indicating these means of contact.

A survey of retailers showed that among three farmer retailers, four part-time retailers, and six established retailers, firewood retailing was the sole source of income for only one retailer, being a supplementary endeavor for the others.

The survey of retailers showed that 64% of their supply of firewood came from within the city of Knoxville, and that one-half of the firewood was supplied by building contractors, with only 29% of the supply coming from commercial woodland. Also revealed was the fact that one-fourth of the total volume handled by retailers was acquired for the cost of cutting and removing the wood.

Retailers harvested, cut to length and split 94%, and they delivered and stacked about 85% of the firewood they marketed.

Cost estimates indicated that, although the average price of delivered firewood moved to the consumer through established retail outlets could only cover costs at very low wage rates, the average price of firewood delivered directly to the consumer from the point of production probably provides a reasonable labor return as well as a residual for stumpage which should provide woodland owners with some incentive to harvest and market low-quality hardwoods as firewood.

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by

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INTRODUCTION

Forest land constitutes one of Tennessee's most extensive natural resources. In 1961 forests occupied 52% of the total land area in Tennessee.[1] This 52% includes approximately 13.4 million acres of commercial forests of which 5.9 million acres were classified as farmer owned, 5.4 million acres as miscellaneous privately owned, and 946 thousand acres as forest industry owned.[2] The estimated total value of timber products harvested in Tennessee in 1958 was $55 million, with nearly half of the value being represented by saw logs, veneer logs, and pulpwood; slightly more than half of the value came from all other timber products (cooperage logs, fuelwood, poles and piling, fence posts, mine timbers, etc.).[3]

Although the quantity of Tennessee's forest resources indicates something about their importance to the economy, an assessment of the quality is necessary for a more complete evaluation of their potential contributions. Table 1 presents an inventory of the quality of Tennessee's forest resources. A review of this table suggests several important implications. First, a high proportion of the state's commercial forest acreage contains 70% or more of undesirable trees. Second, 80.7% of the total commercial forest acreage, stocked with less than 40% desirable trees, will not be improved by natural regeneration. Rather, this acreage needs to be replanted or seeded, in which case removal of large

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[1]U. S. Department of Agriculture, **Tennessee Forests,** Forest Survey Release 86 (New Orleans: Southern Forest Experiment Station, 1962), p. 3.

[2]**Ibid.,** p. 19.

[3]U. S. Department of Agriculture, **The Economic Importance of Timber in the United States,** Miscellaneous Publication 941 (Washington: Government Printing Office, 1963), p. 35.

Table 1. Selected quality characteristics of Tennessee forests, 1960-1961[1]

Percent of total commercial forest acreage stocked with less than 30% desirable trees[2]	76.9
Percent of total commercial forest acreage stocked with less than 40% of desirable trees and with inadequate seed source and/or seedbed unfavorable to natural regeneration	80.7
Percent cull trees are of total volume of growing stock	20.7
Percent cull trees are of total roundwood products output	3.0
Percent of total commercial forest acreage which is comprised of 50% or more of hardwood species (excepting stands having 25% or more of cedar)	79.5
Percent hardwood culls are of total number of cull trees	97.3
Percent sound culls are of total volume of growing stock	11.5

[1]Source: U. S. Department of Agriculture, **Tennessee Forests,** Forest Survey Release 86 (New Orleans: Southern Forest Experiment Station, 1962), pp. 19-29.

[2]Desirable trees are defined as growing-stock trees that have no serious defects to limit present or prospective use, are of relatively high vigor, and contain no pathogens that may result in death or serious deterioration before rotation age.

quantities of low-quality hardwoods will be required in order to increase productivity. Third, 20.7% or approximately one-fifth of the total volume of growing stock is composed of cull trees, and only 11.5% of the total volume is made up of sound culls. Fourth, nearly 80% of Tennessee's commercial forest acreage can be classified as hardwood forests, and this high proportion of total acreage contains 97.3% of the cull trees and nearly 99% of the sound cull trees. Lastly, although sound cull trees make up 11.5% of the total volume of growing stock, they contribute only 3.0% to the total output of roundwood products, indicating that a relatively large volume of cull trees remain in the forests.

A brief statement regarding the present status of Tennessee's forest resources would stress "adequate quantity" and "poor quality." Expansion of Tennessee's timber based economic activity requires an adequate source of high quality wood which can only be attained through the wide application of better forest management practices. Although the application of these practices will benefit the state's economy in the long run, unless they offer some short run economic incentives to individual woodland owners, their acceptance is likely to be limited.

The Problem

The extent of low-quality hardwoods in Tennessee forests suggests the need for either the removal of or the deadening of cull hardwoods. The presence of low-quality hardwoods growing on softwood sites requires the removal of the hardwood growth. In hardwood stands where composition of the existing growth is undesirable, removal or deadening of the undesirable species is required if the productivity of the stand is to be improved.

Although there are several types of chemical materials available which will effectively eliminate and control undesirable growth in timber stands, wide acceptance of this method of timber stand improvement has failed to materialize.[4] Girdling of cull trees has also failed to gain widespread acceptance. The failure of these two methods of timber stand improvement to be widely accepted is believed to be partly due to the fact that the increased returns from these methods appear in the form of small annual increments of growth on individual trees rather than in the form of annual cash receipts.

An alternative approach by which the application of timber stand improvement measures can be stimulated is the development of market outlets for low-quality hardwoods. The market outlet approach to improvement in forest productivity may also offer possibilities for expanding employment and stimulating local economic activity.

Objectives of the Study

The objective of this study was to obtain information which would provide a basis for evaluating the possibilities of expanding existing firewood markets and/or of developing new markets. The specific objectives were: 1) to determine the present pattern of fireplace use in an urban residential area and to determine how firewood consumers differ from those not using firewood; 2) to determine firewood consumers' preferences and consumption habits and evaluate possibilities for market expansion and development; and 3) to determine the characteristics of the marketing system for firewood in order to obtain an evaluation of market efficiency and potentials for development.

[4]Joe A. Martin and Billy Gene Hicks, **The Economics of Using Low-Quality Hardwoods for Producing Charcoal in Tennessee**, Bulletin No. 375 (University of Tennessee, Agricultural Experiment Station, February, 1964), p. 5.

Method of Study

The present study was divided into two parts: 1) the study of firewood consumption, and 2) the study of firewood marketing. Data for both parts were secured by personal interview. The analysis of firewood consumption was based on a sample of 353 dwelling units containing fireplaces. These dwellings were located in blocks which were randomly selected from residential traffic zones in the Knoxville urban area. The four traffic zones from which the sample was selected represented median income levels of $3,000-4,999, $5,000-6,999, $7,000-9,999, and $10,000 and over. The traffic zone representing each income level, with the exception of the single traffic zone having a median income level of $10,000 and over, was randomly selected from the four traffic zones having the highest residential density, this density being determined by the ratio of "place of residence of labor force" to "place of employment of labor force."[5] The population chosen for study was assumed to be representative of the firewood consumers in the area.

The analysis of firewood marketing was based on 13 personal interviews with individuals who had marketed firewood in the Knoxville urban area during the 18-month period preceding the retailer survey, which was conducted in March, 1966. An attempt was made to obtain a complete list of retailers from consumers interviewed, but the attempt was unsuccessful due to the fact that a large proportion of consumers bought firewood from door-to-door peddlers, for whom names and addresses could not be obtained.

The study of firewood consumption revealed that 46.4% of the households having a fireplace either did not use the fireplace or used it for products other than firewood, such as coal and electric logs. Throughout the remainder of this report the term "nonusers" will be used to refer to households making no use of their fireplace and the term "substitute users" will refer to households using their fireplace but not using firewood. An analysis of significant differences was used to reveal the differences for selected variables between firewood consumers and households not using firewood. The same type of analysis was used to show significant differences in quantity of firewood consumed by fire-

[5]Metropolitan Planning Commission. Knoxville and Knox County, Tennessee, **Knoxville-Knox County Comprehensive Transportation Study** (Knoxville: Knoxville and Knox County Planning Commission, June 1963).

wood users. Simple data enumeration was used to reveal firewood consumer preferences and consumption habits; and to reveal the characteristics of the marketing system for firewood in the Knoxville urban area.

FACTORS AFFECTING FIREPLACE USE IN KNOXVILLE

The consumption of firewood is generally restricted to those homes equipped with a fireplace, but all homes equipped with a fireplace do not consume firewood.

The data collected from households in the Knoxville urbanized area showed that three types of households existed with regard to the use of their fireplaces. The largest group, accounting for slightly over 50%, consisted of those who burned firewood in the fireplace. The second largest group, about one-third, made no use of their fireplace. The third and smallest group, making up 13% of the households, consisted of substitute users who used primarily electric logs and coal in their fireplaces (Table 2). The differences between these three groups with regard to family income, age of dwelling, number of fireplaces, and occupational distribution were assumed to be important variables from the standpoint of evaluating the potential growth of the firewood market.

Table 2. Distribution of 353 dwellings according to use of fireplace and percent each use group is of the total sample, Knoxville, Tennessee, 1965-66

Use of fireplace	Number of dwellings	Percent of sample
Nonuse of fireplace	118	33.4
Use of fireplace for substitute products only	46	13.0
Use of fireplace for roundwood firewood consumption	189	53.6
Total	353	100.0

Income

The income distribution for the three groups is shown in Table 3. The data indicated that for firewood users the percent

Table 3. Average income for each type of 353 fireplace users and percent of each group in the various income ranges, Knoxville, Tennessee, 1965-66

Fireplace use Group	n	Average Income	Income Ranges $3,000-4,999	$5,000-6,999	$7,000-9,999	$10,000 and over
			Percent			
Nonusers	118	$5118*	23.7	24.6	23.7	28.0
Substitute users	46	5434*	32.6	32.6	15.2	19.6
Firewood users	189	7667**	9.0	11.1	17.5	62.4
Sample	353	6858	17.0	18.4	19.3	45.3

*Significant at the 95% level.
**Significant at the 97.5% level.

of consumers in the income range over $10,000 was greater than for the other two use groups, 62% as compared with 28% for nonusers and about 20% for substitute users. The average income level for firewood consumers was approximately 50% above nonusers and about 40% higher than substitute product users.

Results of the tests of significance led to the acceptance of the hypothesis that fireplace use is associated with the level of income. Given increased levels of real income and the corresponding changes in tastes and preferences of consumers which are usually associated with the income changes, the use of fireplaces for the consumption of firewood would be expected to increase. The amount of increase in demand for firewood associated with an increase in real income would, of course, be a function of the income elasticity of demand for firewood.

Age of Dwelling

Observations made while obtaining the survey data led to the hypothesis that the age of dwelling is a relevant variable in determining whether a fireplace will or will not be used for firewood. The reasons for not using the fireplace, or using it only for firewood substitutes, were not obtained from consumers. However, a number of consumers indicated that they did not use their fireplace, or did not burn firewood in it because they felt that the fireplace was unsafe for any type of open-flame fuel, or unsatisfactory because of improper draft control, due to failure to have a damper installed.

The average age of dwelling for firewood users was about 13 years, nonusers about 18 years, and substitutes users about 23 years (Table 4). Results of the tests of differences in the average ages of dwellings showed that substitute product users had an average age of dwelling significantly higher than the population, while firewood users had an average age of dwelling significantly lower than the population and significantly lower than the average age of dwelling for both nonusers and substitute product users. This suggests that there is a potential for expansion of firewood consumption as new homes are built with functional fireplaces.

Table 4. Average age of 336 dwellings for nonusers, substitute product users, and firewood users, Knoxville, Tennessee, 1965-66

Fireplace use group	n	Average Age of dwelling	Range
		(years)	(years)
Nonusers	110	18.3	3-41
Substitute users	44	23.3*	5-70
Firewood users	182	13.3**	1-110
Sample	336[1]	16.2	1-110

[1]17 did not know the age of their house.
*Significant at the 95% level.
**Significant at the 97.5% level.

Fireplaces Per Dwelling

The study revealed that firewood users had a greater average number of fireplaces per dwelling than did substitute users and nonusers. The data showed that about 92% of the nonusers lived in dwellings with one fireplace, 8% lived in dwellings with two fireplaces, and less than 1% lived in dwellings with three or more fireplaces; while about 75% of the firewood users lived in dwellings with one fireplace, 22% lived in dwellings with two fireplaces, and nearly 4% lived in dwellings with three or more fireplaces (Table 5). The difference in the number of fireplaces per dwelling for firewood users and nonusers suggests that firewood use is not likely to be influenced by this factor.

Occupational Distribution

The occupational distributions of the head of household were different for the three fireplace use groups. The most outstanding differences in occupational distribution was the percent of firewood users in the professional and technical occupational

Table 5. Average number of fireplaces per dwelling for each use group, and percent of each use group having one, two, and three or more fireplaces, Knoxville, Tennessee, 1965-66

Fireplace use group	n	Average Number of fireplaces per dwelling	Fireplaces per dwelling		
			1	2	3 or more
			Percent		
Nonusers	118	1.1*	91.5	7.6	0.9
Substitute users	46	1.3	78.1	19.6	2.3
Firewood users	189	1.3**	74.6	21.7	3.7
Sample	353	1.2	80.7	16.7	2.6

*Significant at the 95% level.
**Significant at the 97.5% level.

group; 47% of the users were in this group while among nonusers and substitute users only 14% and 9%, respectively, were in the professional and technical group (Table 6). These findings suggest that with increasing levels of formal education and larger proportions of the labor force being engaged in the professional and technical occupations, an increase in the use of fireplaces for firewood consumption is likely to follow. However, any noticeable change in the occupational distribution of a population would normally be expected to be a long-run phenomenon.

Table 6. Occupational distribution of 353 heads of household for the total sample, nonusers, substitute users, and firewood users, Knoxville, Tennessee, 1965-66

Occupational group	Total sample (n=353)	Nonusers** (n=118)	Substitute users** (n=46)	Firewood users* (n=189)
		Percent		
Retired	10.8	11.9	30.4	5.3
Professional and technical	30.9	13.5	8.7	47.1
Managers, officials, and proprietors	15.9	12.7	17.4	17.5
Clerical and kindred	4.8	5.1	6.5	4.2
Sales workers	11.6	12.7	15.2	10.0
Craftsmen and foremen	9.6	11.9	13.1	7.4
Operative and kindred	5.7	10.2	6.5	2.6
Private household, excluding service workers	2.0	4.2	—	1.1
Service workers, including private household	4.8	8.5	2.2	3.2
Laborers	2.0	5.1	—	0.5
Occupation not reported	1.9	4.2	—	1.1
Total	100.0	100.0	100.0	100.0

*Significant at the 95% level.
**Significant at the 97.5% level.

CONSUMPTION OF FIREWOOD PER HOUSEHOLD

An analysis of the quantity of firewood consumed was made to reveal differences, if any, between firewood consumers which might significantly affect the demand for firewood. The general hypothesis that consumption per household would be significantly different for various levels of income, number of fireplaces per dwelling, and price of firewood was tested. Consumption was measured in terms of quarter-cord units of a fireplace cord of firewood. A fireplace cord was defined as a stack of firewood 8 feet long, 4 feet high, and with the length of the stick being of variable dimensions. Hereafter the term "fireplace cord" shall be referred to simply as a "cord."

Income Effect

Based on the general premise that, within given ranges of income, the quantity consumed of most commodities will increase with an increase in income, other things being equal, the consumption of firewood was expected to be significantly greater for higher levels of income. The analysis showed that the average consumption was not significantly different for various income levels, at the 5% level of probability (Table 7). This indicates that although income may be a significant variable in determining use of a fireplace, it has little influence on the quantity of firewood consumed per household.

Table 7. Distribution of 187 firewood users by income, average consumption and range of consumption, Knoxville, Tennessee, 1965-66

Level of income	Number of consumers	Average consumption	Range of consumption
		Quarter-cords	
$3,000-4,999	17	7.8	36
$5,000-6,999	21	4.6	24
$7,000-9,999	33	4.5	12
$10,000-over	116	5.5	40

Number of Fireplaces

The data obtained regarding the relationship between number of fireplaces per dwelling and quantity consumed showed that dwellings with one fireplace had an average consumption of 5.3

quarter-cords while those with two or more fireplaces had an average consumption of 6.0 quarter-cords (Table 8). These differences, however, were not significant at the 5% level.

Table 8. Distribution of 87 firewood users by number of fireplaces, average consumption and range of consumption, Knoxville, Tennessee, 1965-66

Number of fireplaces	Number of consumers	Average consumption	Range of consumption
		Quarter-cords	
1 fireplace	40	5.3	40
2 or more fireplaces	47	6.0	24

Prices Paid for Firewood

Generally, the lower the price of a "good" the more of it will be taken by consumers. It was expected that firewood consumption would tend to follow this general pattern. Although no significant differences in consumption existed between households paying a low, medium, and high range of prices, the average consumption of consumers paying the medium range of prices, $10 to $12 per delivered cord, was significantly greater than the average consumption of all consumers—about eight quarter-cords as compared to about five quarter-cords (Table 9). There is reason to doubt the effectiveness of price in determining the quantity consumed, as evidenced by the more than three-fourths of the consumers who stated that price of firewood did not determine the quantity consumed.

Table 9. Distribution of 77 firewood users by price paid for firewood, average consumption and range of consumption, Knoxville, Tennessee, 1965-66

Price paid for firewood	Number of consumers	Average consumption	Range of consumption
		Quarter-cords	
Less than $10 per cord	10	6.9	18
$10 to $12 per cord	55	8.0*	40
More than $12 per cord	12	5.5	14

*Significant at the 95% level.

Generalization of the Findings

A review of the results of the analysis of differences in average consumption, as affected by income, number of fireplaces,

and price paid for firewood, indicate that given the fact that a household uses firewood, the quantity consumed in a given period is a relatively stable characteristic. Assuming this to be so, increased demand for firewood is likely to come primarily from increasing the number of consumers rather than the amount used per household.

FIREWOOD CONSUMPTION PATTERNS IN KNOXVILLE

The following description of the characteristics of firewood consumption in Knoxville may provide useful information to those interested in marketing firewood. Such information on general consumption patterns is a necessary prerequisite to the establishment of new firewood markets and the expansion of existing markets.

Reasons for Consumption

Data obtained in this study showed that 62% of the consumers burned firewood because they "just liked a fire in the fireplace," and 19% burned firewood as a part of their holiday and social activities (Table 10). Although 9% of the consumers indicated that weather conditions was the primary reason for firewood consumption, this reason is apparently related to the aesthetic value of an open fire since none of these consumers used firewood as a major source of heat for the home.

Table 10. Primary reason given by 189 firewood users for consumption of firewood, number of respondents and percent of total sample, Knoxville, Tennessee, 1965-66

Reasons for consumption	Number of consumers	Percent of sample
Weather conditions	17	9.0
Holiday and social activities	35	18.5
Just like a fire in the fireplace	118	62.4
All above reasons	16	8.5
Other reasons	3	1.6
Total	189	100.0

Use of Substitutes

Although substitute products were used exclusively in 46 out of the 353 households interviewed, only 18 or about 10% of the firewood users also used some other type of product in their fireplace. Among substitute users, about 72% used electric logs and about 13% used coal; while among those firewood users who also used a substitute product, about 11% used electric logs and nearly 78% used coal (Table 11). These data suggest that coal was used more as a supplement than a substitute for firewood. Other substitutes encountered were gas logs, pressed wood, lumber scraps, and paper logs, all of which were used by only a small number of households utilizing their fireplace. The small use of other combustible products by firewood users suggests that firewood is a unique product in the minds of the consumers, and that the demand for firewood is not greatly influenced by the presence of other products which may be used in the fireplace.

Table 11. Number and percent of households using various other products in their fireplaces, Knoxville, Tennessee, 1965-66

Other products used in the fireplace	Households using substitute products only		Households using firewood and substitute products	
	No.	%	No.	%
Electric logs	33	71.7	2	11.1
Coal	6	13.1	14	77.8
Pressed wood	3	6.5	1	5.5
Gas logs	3	6.5	—	—
Others	1	2.2	1	5.6
Total	46	100.0	18	100.0

Types of Purchases

An analysis of the types of purchases made during an 18-month period provided information regarding both the purchase quantities obtained and the frequency of purchases. During this period, 60% of the consumers had made purchases, 35% had obtained no firewood at all, and 5% had used firewood obtained from their residential property or that of a friend.

Ninety-one percent of the purchases were delivered cord-size quantities while approximately 7% of the purchases were small carry-home type bundles. All of the carry-home type purchases were bought in bundles containing one dozen sticks of firewood.

Delivered purchase quantities were measured by: 1) the cord, 2) the rick which is equivalent in volume to the cord, and 3) the truckload with 86.5%, 10.1% and 3.4% of the purchases, respectively, being by these units of measure.

Prices Paid for Firewood

Prices paid for firewood were analyzed from the standpoint of price per unit of measure and seasonality of price. Small carry-home type bundles were all purchased at $1 per dozen sticks. Delivered cord size quantities purchased by the cord, the rick, and the truckload were purchased at an average price of $10.16, $10.50, and $11.67, respectively. Although these prices were found not to be significantly different at the 2.5% level of significance, information obtained from retailers in the area indicated that the average truckload (pick-up truck) of firewood was equivalent to only about three-fourths of the volume contained in a cord or rick.

Although nearly 86% of the consumers purchased firewood during the October-December quarter, the average price paid during the four quarters of the year was about the same. The data collected on seasonality of consumption revealed that only 17 of the 189 consumers used any firewood from April through September; and of these 17, 25% or less of their average annual consumption was used during this period.

Consumer-Market Relations

Since consumer satisfaction is the end to which all production and marketing processes must ultimately be directed, an evaluation of consumer-market relations is a necessary part of any attempt to improve marketing and expand consumer demand. The survey showed that over 50% of the buyers had made purchases from only one retailer in an 18-month period. Only 18% of the consumers were able to provide the name and/or specific location of a retail firewood source. This was believed to be due to the means by which consumers located their firewood source. Approximately 55% of the firewood consumers indicated that they were contacted by the retailer at their residence, while about 20% indicated they learned the location of their firewood source by "word-of-mouth." An overall evaluation of the effectiveness of the market in providing consumer satisfaction showed that about 88% of the users were satisfied with the purchase quantities available, but that nearly 1 out of 5 households found it difficult to purchase firewood when it was desired.

CONSUMER PREFERENCES

Firewood, like any other product, possesses certain qualities and characteristics which give the product the ability to satisfy needs. The following analysis of preferences as expressed by consumers was made in order to reveal the characteristics that firewood should have to maximize consumer satisfaction.

Preferences for Quantities Per Purchase

The availability of firewood in various purchase quantities might be a significant factor affecting demand in some markets. An enumeration of consumer preference for various quantities per purchase in the Knoxville area showed that about 84% of the users preferred delivered cord-size lots, only about 4% preferred small carry-home type bundles, and nearly 12% preferred that firewood be available in both these quantities (Table 12). These preferences may be partially a function of storage space available at the consumer's residence. However, none of the households sampled indicated that storage space for at least one cord of firewood would be a problem. Since firewood was found to be available in small carry-home type bundles at several retail outlets, it appears that purchase quantities available in the Knoxville market closely correspond to consumer preferences. However, such may not be the case in other existing or potential markets, and should be taken into consideration in attempting to develop new markets or expand those already present.

Table 12. Preferences of 189 firewood users regarding selected characteristics of the firewood product, Knoxville, Tennessee, 1965-66

Characteristic	Percent of consumers
Quantities per purchase	
Small carry-home type bundles	4.2
Delivered cord-size lots	84.1
Both of above	11.7
Degree of seasoning	
Seasoned firewood	48.7
Unseasoned firewood	6.3
Mixed seasoned-unseasoned firewood	37.1
No preference	7.9
Species of wood preferred	
Oak and hickory	43.3
Others	5.4
No preference	51.3

Degree of Seasoning Preferred

The recommendation that firewood should be well seasoned is common in the literature on this subject. Such a recommendation has been based on two considerations: the heating value of wood and safety. Unseasoned firewood burns at lower temperatures than seasoned firewood and is more likely to lead to the formation of an inflammable by-product of low temperature wood combustion called **creosote,** which when accumulated in the chimney in a sufficient amount becomes a potential source of hazardous chimney fires.[6] Although this problem continued to be a potential source of danger, the improved design of modern fireplaces has reduced its seriousness. This, coupled with the decreased emphasis on the heating value of firewood has left little basis for recommending that all firewood be well seasoned. In this study, about one-half of the consumers preferred seasoned firewood; and although only about 6% preferred unseasoned firewood, about one-third of the consumers preferred mixed seasoned-unseasoned firewood (Table 12). These data indicate that the demand for various degrees of seasoning warrants the consideration of firewood producers and retailers.

Species of Wood Preferred

Generally, the heating value of wood increases with the weight of a given volume of wood material.[7] Because of this, hardwoods have usually been preferred to softwoods, especially hardwoods such as oak and hickory. However, the present study showed that slightly over 50% of the consumers expressed no preference with regard to species. About 40% indicated a definite preference, naming oak and hickory as the preferred species (Table 12). With regard to undesired species, 51% of those listing such a species indicated pine, but 77% of the consumers expressed no feeling relative to undesired species.

Size Preferences

The length of firewood stick and the diameter constitute the size dimensions of firewood. The length of firewood used by the consumers interviewed in this study ranged from a minimum of

[6]Lawrence S. Hamilton and Fred E. Winch, Jr., **Making and Using Wood Fuel,** Extension Bulletin 940 (Cooperative Extension Service, New York State College of Agriculture at Cornell University, June 1955), pp. 6-7; and Archie A. Biggs, "Fireplaces," **The Yearbook of Agriculture 1965** (Washington: Government Printing Office, 1965), pp. 106-107.
[7]**Ibid.**

18 inches to a maximum of 36 inches, and the average length of firewood stick was approximately 24 inches. However, the preference pattern for length of stick in any given market will depend upon the size distribution of fireplaces and will fluctuate with changing sizes and designs of residential dwellings. Thus, the satisfaction of length preferences in any market will depend on the ability of producers and retailers to obtain this information from the consumers.

Diameter preferences for firewood sticks revealed that 64% of the consumers indicated "no preference." The average maximum diameter specified by consumers was 6.8 inches, with the largest value being 16 inches and the smallest value being 3 inches. The modal value was 7 inches. Thirty-one percent of the consumers indicated "no preference" with regard to a minimum diameter of firewood stick. The average minimum diameter for those consumers showing a definite preference was 2.2 inches, with the largest value being 8 inches and the smallest value being 1 inch. The modal value relative to a minimum diameter preference was 2 inches. The results of the analysis of diameter preference indicated that consumers are more likely to discriminate against purchase quantities of wood made up of excessive amounts of small dimension sticks than against purchase quantities composed mostly of large diameter sticks.

MARKETING FIREWOOD IN KNOXVILLE

The analysis of firewood marketing in Knoxville was based on a survey of 13 individuals who marketed firewood in Knoxville. Of these, 3 were farmer retailers, 4 were part-time firewood retailers, and 6 were retailers who sold firewood from an established outlet. Firewood retailing was the sole source of income for only one of the established retailers. The estimated average annual gross firewood receipts was about $90.00 for the farmer retailers, $226.00 for the part-time retailers, and $1,282.00 for the established retailers, with the estimated annual gross firewood receipts for all retailers ranging from a low of $40 to a high of $4,040 (Table 13). The established retailers marketed an average of about 99 cords of firewood annually and had been marketing firewood for an average of about 9 years, while the farmer retailers and the part-time retailers had marketed an aver-

age of 8 and 19.4 cords annually, respectively, and had been marketing firewood an average of 3 and 4 years, respectively (Table 13).

Table 13. Descriptive characteristics of 13 firewood retailers by primary business classification, Knoxville, Tennessee, 1965-66

Characteristics of retailer	3 Farmer retailers	4 Part-time retailers	6 Established retailers
Cords marketed annually			
Average	8.0	19.4	98.8
Minimum	4.0	5.0	25.0
Maximum	11.0	30.0	300.0
Annual gross firewood receipts			
Average	$ 89.33	$226.06	$1282.33
Minimum	40.00	50.00	174.00
Maximum	120.00	374.25	4040.00
Number of years marketing firewood			
Average	3.0	4.0	8.5
Minimum	2.0	2.0	2.0
Maximum	4.0	10.0	30.0

The Supply and Transportation of Firewood

Due to the bulkiness of firewood and cost of transportation, the volume of firewood supplied was expected to decrease as the distance from the supply area to the retail area increased. Such was the case in this study, with nearly 64% of the volume supplied coming from within the city of Knoxville, about 19% coming from Knox County, and the remaining 17% coming from adjacent counties. An analysis of the volume of firewood provided by various classifications of suppliers showed that 51% of the firewood was supplied by building contractors, 30% by woodland owners, 13% by urban homeowners, and the remaining 6% from various other sources.

The transportation of firewood by the retailer, from its point of production to the retail establishment, accounted for 93% of the total volume obtained by the established retailers. Farmer retailers and part-time retailers delivered the firewood directly to consumers from the point of production. With the exception of one retailer who transported firewood in a two and one-half ton truck, all of the retailers used a one-half ton truck for delivery.

Prices Paid by Retailers

Prices paid by retailers were extremely variable. Firewood supplied to one farmer retailer and to all part-time retailers was obtained at the cost of cutting and removing the firewood. Two farmer retailers marketed firewood from their own woodlot. Established retailers obtained 15.9% of their firewood for the cost of cutting and removing it from the source. The total volume of firewood obtained by retailers was supplied at the following average prices:

Location	Number of cords	Price per cord
"Free wood," at source	183	harvesting cost
On the stump, at source	453	$1.05
Cut and split, at source	4	5.00
Cut and split, at retail establishment	41	8.00

Price setting in the market between supplier and established retailers was done by suppliers in 4 out of 6 cases. The remaining 2 established retailers indicated that they quoted a price to the supplier which would allow a "normal" profit.

Services Performed by Retailers

It is apparent that very few consumers are interested in or have the tools and equipment to cut and split poles and logs into firewood. In general, consumers prefer to have firewood delivered and stacked on their lot in the form ready for use in the fireplace. Retailers cut to length and split 94% of the wood sold. About 83% of the wood was delivered to the home by the seller, and of the amount delivered 85% was stacked. Almost without exception the charge for these services was included in the price of firewood. For those purchases made at the retail establishment, it was customary for the retailer to load the wood into the purchaser's car.

Retailing Practices

An analysis of the movement of firewood from the retailer to the consumer provided data regarding the relationships between the retailers interviewed and their customers, the nature of the product retailed, and the prices charged for the product. Table 14 presents the results of the analysis of several selected variables associated with firewood retailing.

Table 14. Selected characteristics of firewood retailed, by 13 retailers, and percent of total volume retailed constituting each class, Knoxville, Tennessee, 1965-66

Characteristic	Percent of total volume
Type of sales	
Casual	8.7
Repeat	52.4
Standing order	38.9
Seasonality of sales	
October-December	57.5
January-March	42.5
Unit of measure	
Single stick	0.2
1 dozen sticks	15.2
Cord	1.4
Rick	10.1
Truckload	73.1
Degree of seasoning	
Seasoned	43.7
Unseasoned	39.6
Mixed seasoned-unseasoned	16.7

Type of Sales: Three types of sales were defined in the retailer interview schedule: 1) casual sales were defined as sales to consumers with whom the retailer had had no previous associations, 2) repeat sales were defined as sales to consumers known to have made previous purchases, and 3) standing order sales were defined as sales to consumers who had made prior arrangements for the purchase. Only about 9% of the sales were of a casual nature. Over half of the sales were classified as repeat order type, while nearly 39% of the sales were of the standing order type. Sales were found to be seasonal in nature, with about 60% of the volume being marketed in the October-December quarter and the remainder in the January-March quarter.

Unit of measure: Analysis of the unit of measure by which firewood was retailed revealed a sharp difference from that obtained in the consumer survey. In the consumer survey about 90% of the buyers reported that they had purchased firewood by the cord, while the retailers survey revealed that sales by the cord accounted for less than 2% of the total volume retailed, with about 15% being marketed by one dozen stick bundles, about 10% by the rick, which is equivalent to the cord, and about 73% by the truckload. It seems likely that this discrepancy is more

apparent than real and perhaps is due to the loose manner in which the three units of measure—cord, rick, and truckload—are used by both buyers and sellers. That the various units of measurement are not very meaningful shows up clearly in respect to pricing as will be discussed later.

Seasoning of firewood: The sales of unseasoned and mixed seasoned-unseasoned firewood made up about 56% of the total volume marketed. The established retailers were the only retailers providing the consumer with the three different degrees of seasoning. Neither the part-time retailers nor the farmer retailers had marketed firewood of mixed seasoning. The part-time retailers provided only unseasoned firewood to their customers.

Prices received: The prices charged for delivered firewood varied greatly within the same units of measure, but the average prices for the three different units of measure were nearly the same notwithstanding the fact the average pick-up truckload contains only about three-fourths of a cord or rick of wood. The price charged for delivered firewood marketed by the cord ranged from a low of $8.00 to a high of $14.00. The smallest price range was found for firewood marketed by the truckload; it ranged from a low of $8.00 to a high of $12.00. Firewood marketed by the rick varied from a low of $8.00 to a high of $14.00. There was no difference in prices based on the length of stick or the degree of seasoning of the product. The average prices for the various units of measure of delivered firewood were as follows:

Unit of measure	Average price
Cord	$10.65
Rick	10.88
Truckload	10.40

A very small volume of firewood was marketed as single sticks. Where it was marketed in this manner, 8 cents per stick was charged for "normal" sized sticks, and 25 cents was charged for a "backlog."

The method used to set prices in the market varied among the retailers. Setting price to cover cost of harvesting and handling, plus a normal return, was indicated by four retailers. The existing market price was used as the price setting criterion by seven of the retailers, and two retailers, both of whom were farmers, reported that they accepted the price offered to them

by the customer. Several of the established retailers estimated that a profit margin of $2.00 to $3.00 per load or cord of firewood was considered a fair return.

Cost of Harvesting and Marketing Firewood

Although cost data were not secured from retailers in this survey, some general idea of the cost of harvesting and moving firewood to the consumer is necessary for evaluating the possibility of marketing firewood as a means of utilizing low-quality hardwoods. Table 15 presents some estimated costs of harvesting and marketing firewood with various wage rates.

These cost estimates indicated that the average price of firewood in the Knoxville consumer market of $10.16 per cord would not cover the total cost of harvesting and marketing a cord of firewood through an established retail outlet. At a wage rate of only $.50 per hour, the estimated total cost was $11.15 per cord. At $1.25 per hour for labor, the estimated cost was about $17.00 per cord. However, if firewood were sold by the "truckload," as it was by 5 of the 6 established retailers interviewed, the average value per cord would be about $13.50 (the average one-half-ton

Table 15. Estimated average costs of harvesting and marketing a fireplace cord of firewood in the Knoxville area for several wage levels, 1965-66

Costs	Hourly wage rates			
	$ .50	$ .75	$ 1.00	$ 1.25
Harvesting costs				
Labor[1]	2.75	4.13	5.50	6.88
Other[2]	1.25	1.25	1.25	1.25
Total	$ 4.00	$ 5.38	$ 6.75	$ 8.13
Hauling cost[3]	2.50	2.50	2.50	2.50
Total cost at retail establishment	6.50	7.88	9.25	10.63
Retailing cost[4]	4.65	5.23	5.80	6.38
Total Cost	$11.15	$13.11	$15.05	$17.01

[1]Based on assumption that cutting a standard cord of wood into two fireplace cords of 24 inch wood requires one-third more labor time than does cutting a standard cord of mixed hardwood pulpwood.

[2]Includes costs of power saw maintenance and fuel costs.

[3]Based on output data taken from Solon L. Baraclough and Alfred Pleasanton, **Data for Planning Woodland Opportunities on West Tennessee Farms,** Bulletin No. 276 (University of Tennessee Agricultural Experiment Station in cooperation with Southern Forest Experiment Station, U. S. Department of Agriculture, November, 1957); and Gordon D. Lewis and Lee M. James, "Costs and Returns for Pulpwood Production in Michigan," **The Quarterly Bulletin,** Vol. 44, No. 2 (Michigan State University Agricultural Experiment Station, November, 1961), p. 225.

[4]Cost of loading, hauling to consumer, and unloading, plus $2.00 per cord profit margin.

truckload of firewood was reported to be equal to three-fourths of the volume of a fireplace cord). Since firewood undergoes little change when it moves through retail establishments, the cost of retailing—which is the result of the large amount of labor time necessary to load the firewood—haul it to the consumer, and unload it, can be eliminated by direct delivery of the firewood from its source of production to the consumer. Given this direct movement, the total cost at the $1.00 per hour wage rate would be $9.25, which is below the average price of firewood and would allow a stumpage value to be placed on low-quality hardwoods going into the firewood market.

This general cost-price analysis is specific to the Knoxville market where the average retail price of $10.16 per delivered cord of firewood appears to be lower than in most larger metropolitan areas. This relatively low price is perhaps related to two factors: 1) a large volume of "free wood" and very low cost wood available within the city, and 2) a highly competitive and unorganized retail market dominated by door-to-door peddlers.

CONCLUSIONS

The conclusions of this study can be grouped into those which are assumed to have general applicability to firewood marketing and consumption, and those which are considered applicable to the specific area in which the study was conducted.

General conclusions: The demand for firewood, as indicated in this study, may be expected to increase with an increase in real income of consumers, and an increase in the number of homes constructed with a functional fireplace. Findings in this study were consistent with the general hypothesis that fireplaces are being built into a large proportion of new homes, and these fireplaces are being used for the consumption of firewood. As the number of people in the professional, technical, and managerial occupations increase, the demand for firewood may increase. Consumption per household, of those using firewood, is not expected to be greatly affected by changes in income, number of fireplaces per dwelling, or the price of firewood. Because of the stability of consumption per household, promotional efforts in increasing the demand for firewood should be directed toward gaining new consumers rather than increasing consumption of present consumers.

Firewood consumers obtain satisfaction from firewood consumption mostly through its aesthetic value. Although firewood marketing has been considered in this study as a means of utilizing low-quality hardwoods, it cannot be viewed as an outlet for all types of low-quality wood. Consumers do have preferences regarding firewood, which must be satisfied if firewood sales are to be maximized. Contrary to the general idea that all firewood should be seasoned, the demand for firewood of a mixed degree of seasoning is probably sufficient to warrant producers and retailers to make available this characteristic in the firewood product. Species preferences do not appear to be a barrier to the movement of most of the hardwoods common to this area into the firewood market. It would generally be expected that in areas where storage space is available, cord-sized delivered units of firewood would provide the largest outlet for firewood. It appears that there is no real substitute for firewood and that changes in price, at least within certain limits, will have little effect on the consumption of firewood.

Specific conclusions: The firewood market in the Knoxville area can be characterized as a predominantly door-to-door sales market, with little or no effort going into advertising and promotion among retailers for a larger share of the existing demand. Although the case studies of the retailers showed that 26% of the firewood acquired by retailers was "free wood," and that only 30% of the firewood supplied by the 13 retailers came from commercial woodland, these data are not reliable indicators of the effect of firewood marketing on the utilization of low-quality hardwoods from commercial woodland. None of the retailers interviewed peddled firewood on a door-to-door basis, which suggests that the retailers interviewed were not representative of the total market. The presence of a high proportion of door-to-door sales as reported by consumers suggests that a complete list of persons selling firewood to consumers would contain a significantly greater number of farmer retailers or woodland owner retailers than appeared in this study.

The prevalence of new home construction in the Knoxville area and the favorable attitudes expressed by the retailers interviewed, point toward an increase in demand for firewood. Although a large quantity of the firewood acquired by the retailers studied was supplied by building contractors and urban homeowners, it does not necessarily follow that the supply of firewood from these sources constitutes a high proportion of the total firewood consumed in the area. The lack of a complete list of all persons marketing firewood made it impossible to determine the amount of firewood coming from commercial woodland.

Although an adequate demand for firewood was indicated by all of the established retailers, their present supply situation appeared unfavorable for expansion of their firewood enterprise. Established retailers acquired 16% of their firewood as "free wood." Estimates of marketing costs indicated that even if established retailers could acquire their total supply as "free wood," the present average retail price of firewood would not cover the cost of harvesting and marketing through established retail outlets at a competitive wage level.

On the other hand, it appears that if firewood were moved directly from its source to the consumer, woodland owners should be able to cover costs of harvesting and marketing, and receive a return to labor comparable with other alternative labor uses of a

part-time or income supplementing nature, plus a positive stumpage value for their wood.

The primary goal of marketing low-quality hardwoods, from the standpoint of the forest owner, is the improvement of the forest resource. Therefore, any attempt to use the firewood market as an outlet for low-quality hardwoods should be part of an overall forest management program. Low-quality hardwoods may have one or more alternative uses or markets, and the forestland owner should, of course, seek his most profitable outlet.

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