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To the Graduate Council:

I am submitting herewith a thesis written by William Ruthvan Morrow entitled "Firewood Consumption and Marketing in Knoxville." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

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# FIREWOOD CONSUMPTION AND MARKETING IN KNOXVILLE

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A Thesis

Presented to

the Graduate Council of

The University of Tennessee

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In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

William Ruthvan Morrow

August 1966

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# CHAPTER I

## INTRODUCTION

Forest land constitutes one of Tennessee's most abundant natural resources. In 1961, forests occupied 52 per cent of the total land area in Tennessee.[1] This 52 per cent was composed of 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 private 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 dollars, 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 their importance to the economy, an assessment of their quality is necessary for a complete evaluation. Table I presents an inventory of

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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 I

SELECTED QUALITY CHARACTERISTICS OF TENNESSEE FORESTS, 1960-1961[a]

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

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

[b]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.

the quality of Tennessee's forest resources. A review of this table leads to several important implications. First, a high proportion of the states commercial forest acreage contains 70 per cent or more of undesirable trees. Secondly, 80.7 per cent of the total commercial forest acreage stocked with less than 40 per cent desirable trees, can not be improved by timber stand improvement measures. Rather, it needs to be replanted or seeded by methods other than natural regeneration, in which case removal of large quantities of low-quality hardwoods will be required in order to increase productivity. Thirdly, although 20.7 per cent or approximately one-fifth of the total volume of growing stock is composed of cull trees, only 11.5 per cent of the total volume is made up of sound culls. It is not likely that rotten cull trees will be able to add much to Tennessee's total forest product output due to their unfavorable use potential. Fourthly, nearly 80 per cent of Tennessee's commercial forest acreage can be classified as hardwood forests, and this high proportion of total acreage contains 97.3 per cent of the cull trees, and nearly 99 per cent of the sound cull trees. Lastly, although sound cull trees make up 11.5 per cent of the total volume of growing stock, they contribute only 3.0 per cent 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 "insufficient 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 forest management practices. Although the application of these practices will benefit society in the long-run, unless they offer some short-run economic incentives to individual woodland owners, their acceptance is likely to be limited.

## I. STATEMENT OF THE PROBLEM

The extent of low-quality hardwoods in Tennessee forests was pointed out in the preceding section. Increasing the productivity of Tennessee's forests requires either the removal of or the deadening of cull hardwoods. The presence of hardwood stands 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. Regardless of which situation prevails, improvement of the timber stand by application of forest improvement practices requires a positive decision on the part of the woodland owner.

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 partially due to the

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[4]Billy Gene Hicks, "Utilization of Low-Quality Hardwood in the Production of Charcoal" (unpublished Master's Thesis, The University of Tennessee, Knoxville, June, 1961), pp. 33-34.

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 markets for low-quality hardwoods. Such an approach has been stressed on the basis of its ability to offer woodland owners short-run cash returns.[5] Analyses of the application of this approach to the marketing of pulpwood and charcoal have been conducted by Britt[6] and Hicks[7], respectively. The importance of the marketing approach to improvement in forest productivity is magnified when applied to the Appalachian area of Tennessee, due to the possibilities it may offer in supplementing low incomes of woodland owners and stimulating local economic activity.

Purpose. The purpose of this study was to evaluate the possibilities of expanding present fireplace wood markets or of developing new markets for such a product.[8] Reference to Table II indicates that total fuelwood consumption and per capita consumption have both declined from

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[5]R. T. Britt, and J. A. Martin, Marketing Saw Timber and Pulpwood, Bulletin No. 295 (University of Tennessee Agricultural Experiment Station, January, 1959), p. 5.

[6]R. T. Britt, "The Marketing of Forest Products in Tennessee" (unpublished Master's Thesis, The University of Tennessee, Knoxville, 1957).

[7]Hicks, op. cit.

[8]Fireplace wood is defined in this study as raw roundwood, cut to length and split, and for use in an open residential roundwood fireplace.

TABLE II

APPARENT TOTAL CONSUMPTION AND PER CAPITA CONSUMPTION OF ROUNDWOOD FUELWOOD, UNITED STATES, 1950-1965[a]

| Year | Apparent total consumption | Per capita consumption |
|---|---|---|
| | (million cubic feet) | (cubic feet) |
| 1950 | 2,270 | 14.9 |
| 1951 | 2,230 | 14.4 |
| 1952 | 2,010 | 12.8 |
| 1953 | 1,920 | 12.0 |
| 1954 | 1,835 | 11.3 |
| 1955 | 1,745 | 10.5 |
| 1956 | 1,655 | 9.8 |
| 1957 | 1,565 | 9.1 |
| 1958 | 1,480 | 8.5 |
| 1959 | 1,390 | 7.8 |
| 1960 | 1,300 | 7.2 |
| 1961 | 1,215 | 6.6 |
| 1962 | 1,125 | 6.0 |
| 1963 | 1,110 | 5.9 |
| 1964[b] | 1,090 | 5.7 |
| 1965[b] | 1,075 | 5.5 |

[a]Source: U. S. Department of Agriculture, The Demand and Price Situation for Forest Products 1965, Miscellaneous Publication No. 1009 (Washington: Government Printing Office, 1965), p. 29.

[b]Preliminary estimates.

1950 to 1965. A closer look at the data reveals that the decrease in consumption has progressed at a decreasing rate. Since fireplace wood constitutes only a part of the total fuelwood produced and consumed, it is difficult to make valid inferences from Table II. Nevertheless, when the substitution of oil, gas, coal, and electricity for fuelwood, in the home and in industry is recognized, at least some part of the decreasing rate of decline in fuelwood consumption must be attributable to the growth of substantial fireplace wood markets in the metropolitan areas.[9]

In Tennessee approximately 63 per cent of the total output of hardwood fuelwood is from roundwood, with the remainder being derived from by-products of timber processing plants.[10] It is expected that an increasing proportion of the total volume of fuelwood consumed in Tennessee will come from by-products rather than from roundwood.[11] If such expectations become a reality, the reduced demand for roundwood fuelwood will adversely affect the application of timber stand improvement practices to Tennessee's forest resources. Development of new fireplace wood markets and expansion of existing markets may be a possible alternative to the increased use of mill residues as a source of fuelwood.

In Tennessee, with its large volume of low-quality hardwoods, the opportunity for expansion of the fireplace wood market as a means of

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[9]U. S. Department of Agriculture, The Demand and Price Situation for Forest Products 1965, Miscellaneous Publication No. 1009 (Washington: Government Printing Office, 1965), p. 20.

[10]U. S. D. A., Tennessee Forests, op. cit., p. 27.

[11]Ibid., p. 11.

utilising low-quality trees would appear to be promising. Such markets may be expected to be more prevalent in the large metropolitan centers than in the smaller urban and rural communities, due to a larger volume of new residential construction and the lack of accessibility to sources of "free" fireplace wood which are often present in smaller, less urbanized areas. On the assumption that such an expectation is valid, the present study was conducted in the Knoxville urbanized area.

Objectives. The multiple objectives of this study were directed toward obtaining information which would provide a basis for evaluating the possibilities of expanding existing fireplace wood markets and/or of developing new markets. The specific objectives can be stated as follows: (1) to analyze the present pattern of fireplace use in urban residential areas in order to determine how firewood consumers differ significantly from non-consumers of firewood; (2) to analyse firewood consumers preferences and consumption habits in order to more nearly be able to evaluate possibilities for market expansion and development; and (3) to analyze the marketing mechanism of fireplace wood in order to obtain an evaluation of market efficiency and development.

## II. METHOD OF STUDY

A review of literature pertaining to the marketing of fireplace wood contributed little toward designing and carrying out the present study, although it did emphasise the need for research on this subject. A recent article in Utah Farm Home Science, "Utah Wood and California

Fireplaces," seems worthy of reference due to its emphasis on the size which fireplace wood markets can obtain and the profitability of such markets.[12] Differences in topography and forest stand composition between Tennessee and Utah exclude the applicability of this study to Tennessee firewood markets. Nevertheless, this was the only written material located by the author which indicates the potential of a fireplace wood market.

The present study was initially divided into two parts; the study of firewood consumption and the study of firewood marketing. Data for both parts were obtained 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. The 4 traffic zones from which the sample was selected represented median income levels of $3000-4999, $5000-6999, $7000-9999, 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 4 traffic zones having the highest residential density. This density was determined by the ratio of "place of residence of labor force" to "place of employment of labor force."[13] The population chosen

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[12]Allen Lebaron, and Walter H. Johnson, "Utah Wood and California Fireplaces," Utah Farm Home Science, Vol. 26, No. 1 (Utah State University Ag. Exp. Station, Logan, March, 1965), pp. 7-11.

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

for study was assumed to be representative of the average urban residential community existing in the area.

Interviewing of consumers revealed that a large proportion of consumers having a fireplace either did not use the fireplace or used it in association with some product other than fireplace wood,[14] The appearance of these different classes of consumers led to the decision to make a comparative analysis of the differences existing between them, based on the assumption that these differences were of significance for evaluating market expansion and development possibilities. Chapter II presents the findings of the analysis of differences between nonusers, substitute product users, and firewood users. Chapter III presents the findings of an analysis of differences existing between firewood consumers, and summarises the consumer preferences obtained in the survey.

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 retailers survey, which was conducted in March, 1966. An attempt was made to obtain a complete list of retailers from the consumers interviewed, but the attempt was unsuccessful due to the fact that a large proportion of consumers bought wood from door-to-door peddlers. Chapter IV presents the findings obtained in the marketing survey.

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[14]The term "nonusers" shall be used throughout the remainder of this thesis for consumers making no use of their fireplace. "Substitute users" shall mean those consumers using their fireplace, but not using firewood.

The entire analysis of data was oriented toward testing relationships rather than estimating population parameters. Such an approach can be justified for the following reasons: (1) the existence of firewood markets in at least two of the major metropolitan centers of Tennessee presupposes that a demand for firewood exists; and (2) the improvement of existing markets in order to expand the utilization of low-quality hardwoods requires a knowledge of consumers differences and preferences.

## CHAPTER II

## AN ANALYSIS OF FIREPLACE USE

The analysis of data collected from consumers in the Knoxville urbanized area showed that 3 types of consumers existed with regard to the use of their fireplace. The largest group found in the study consisted of consumers who burned roundwood firewood in the fireplace. The second largest group made no use of their fireplace, and the smallest group consisted of substitute product users who used primarily electric logs and coal in their fireplaces. Table III indicates the number of dwelling units representing each type of consumer and the relative size of each group.

The differences between these groups of consumers with regard to income, age of dwelling, size of dwelling, number of fireplaces, and occupational distribution are important from the standpoint of evaluating possibilities for establishment of new firewood markets or expansion of existing markets. The choice of the variables evaluated was made on the basis of hypotheses concerning factors believed to be significant in influencing the use of fireplaces by consumers.

Methods used in testing significance. Differences hypothesized to be significant, regarding average income, average age of dwelling, average size of dwelling, and average number of fireplaces per dwelling, were tested using the t-test.

TABLE III

DISTRIBUTION OF DWELLINGS ACCORDING TO USE OF FIREPLACE, AND PER CENT EACH USE GROUP IS OF THE TOTAL SAMPLE

| Use of fireplace | Number of dwellings | Per cent 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 |

Assuming the population of nonusers, substitute product users, and firewood users to be normally and independently distributed with identical standard deviations, the following general formula was used to compute the value of t:[1]

$$t = \frac{d}{\sqrt{s_x^2 + s_y^2}}$$

where: d = difference in the means of the variable in question

$s_x^2$ and $s_y^2$ = (standard error of the means)$^2$.

The differences in the distribution of occupation of the head of household were tested using a Chi-square test of the following general form:[2]

$$X^2 = \text{sum of } \frac{(f - F)^2}{F}$$

where: f = observed frequency

F = expected frequency.

## I. DIFFERENCES IN INCOME

Income has received considerable attention in economic literature relative to its influence on consumption. The appearance of significant

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[1]Henry L. Alder, and Edward B. Roessler, Introduction to Probability and Statistics (third edition; San Francisco: W. H. Freeman and Company, 1964), p. 130.

[2]George W. Snedecor, Statistical Methods (fifth edition; Ames, Iowa: The Iowa State College Press, 1959), pp. 26-27.

differences in the income levels of the 3 fireplace use groups, or the lack of differences, should be an invaluable aid in predicting future trends in roundwood fireplace wood consumption. Because of this and general observations that firewood consumption appeared more prevalent in higher income groups, income was hypothesized to be an important variable influencing use of the fireplace.

The income distribution for the 3 use groups is found in Table IV. This table indicates that for firewood users the per cent of consumers in the highest income range was greater than for the other 2 use groups and for the entire sample. Computation of the average income level for each group and for the sample led to the same conclusion. Tests of significant difference in these averages revealed the following: (1) the difference between the average level of income of all 3 groups and the average level of income of the sample were found to be highly significant at the $t_{.05}$ level of significance, using a two-tailed test with infinite degrees of freedom;[3] (2) the difference between the average income of firewood users and the average incomes of both other use groups was found to be highly significant at the $t_{.025}$ level of significance, using a one-tailed test.

Results of the tests of significance led to the acceptance of the hypothesis that fireplace use is influenced by level of income. Given increased levels of real income and the corresponding changes in tastes

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[3]Degrees of freedom on all t-tests is equal to $(n_1 + n_2) - 2$, with infinite degrees being used where the degrees of freedom computed exceeds 120.

TABLE IV

AVERAGE INCOME FOR EACH TYPE OF FIREPLACE USER, AND PER CENT OF EACH GROUP IN THE VARIOUS INCOME RANGES

| Use group | n | Average income | Range of income | | | |
|---|---|---|---|---|---|---|
| | | | $3000-4999 | $5000-6999 | $7000-9999 | $10,000 and over |
| | | | ----------Per cent---------- | | | |
| 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 |

*Significantly different from sample average at $t_{.05}$ level with a two-tailed test.

#Significantly greater than the average for nonusers and substitute users at $t_{.025}$ level with a one-tailed test.

and preferences of consumers which are usually associated with the income changes, then the use of fireplaces for the consumption of roundwood firewood would be expected to increase. The magnitude of an increase in demand for firewood associated with an increase in real income would, of course, be a function of the income elasticity of firewood. Nevertheless, a knowledge of the differences existing between fireplace users using firewood, non users, and substitute users, offers 1 criterion by which marketing possibilities may be evaluated.

## II. DIFFERENCES IN AGE OF DWELLING

Observations made while obtaining the survey data led to the statement of the hypothesis that the age of dwelling is a relevant variable in determining whether a fireplace will not be used, will be used for some type of substitute product only, or will be used for the consumption of firewood. The reasons for not using the fireplace, or if using it not using it for firewood, 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 of construction factors which made it either unsafe for any type of open-flame fuel, or unsatisfactory because of improper draft control, due to failure to have installed a damper. The installation of dampers in all fireplaces would be expected to increase the use of the fireplace for firewood consumption. A considerable number of consumers indicated the necessity of a continuous fire if loss of heat from the house was to be prevented. The damper allows control of the intensity of the fire as well as a means of pre-

venting loss of heat from the main heating system.[4] Proper fireplace construction should contribute significantly to use of fireplace in burning firewood.

Table V indicates that the average age of dwelling varied considerably between users, substitute product users, and nonusers. Results of the tests of difference in the mean ages of dwellings were as follows: (1) when the mean of each group was tested against the sample mean, substitute product users and firewood users had an average age of dwelling significantly different from the sample average. No significant difference was found between the average age of dwelling for nonusers and the sample average. All of the above tests were two-tailed tests at the $t_{.05}$ level of significance; (2) using a one-tailed test at the $t_{.025}$ level of significance, the average age of dwelling for firewood users was significantly lower than the average age of dwelling for both nonusers and substitute product users. The results of the t-tests led to the acceptance of the hypothesis that age of dwelling is a relevant variable in influencing use of fireplace.

Inferences from the tests of significance regarding age of dwelling point to increased use of fireplaces for firewood consumption as new housing projects are developed, provided the average age of dwelling decreases over time. Improvement in safety factors and functional characteristics of fireplaces is expected to have a favorable effect on the

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[4]Archie A. Biggs, "Fireplaces," Consumers All, 1965 Yearbook of Agriculture (Washington: Government Printing Office, 1965), p. 104.

TABLE V

AVERAGE AGE OF DWELLINGS FOR NONUSERS, SUBSTITUTE USERS, AND FIREWOOD USERS

| Use group | n | Average age of dwelling (years) | Range (years) |
|---|---|---|---|
| Nonusers | 110 | 18.25 | 38 |
| Substitute users | 44 | 23.25* | 65 |
| Firewood users | 182 | 13.32*# | 109 |
| Sample | 336[a] | 16.24 | 109 |

*Significantly different from the sample average at $t_{.05}$ level with a two-tailed test.

#Significantly less than the average for nonusers and substitute users at $t_{.025}$ level with a one-tailed test.

[a]17 persons did not know the age of their house.

demand for firewood.

## III. DIFFERENCES IN SIZE OF DWELLING

Analysis of data indicated that the average size of dwelling of firewood users was greater than that of the other 2 use groups. Table VI shows that the per cent of dwellings having 1 and 2 bedrooms decreased when going from nonusers to substitute users, and then to firewood users. Reading in the same order, the per cent of 3 and 4 bedroom dwellings increased.

Tests of significant differences between the average size of dwelling for each use group yielded the following results: (1) the average size of dwelling for firewood users and for nonusers was found to differ significantly from the sample average at the $t_{.05}$ level using a two-tailed test; and (2) the average size of dwelling for firewood users was significantly greater than the average size of dwelling for both nonusers and substitute users at the $t_{.025}$ level with a one-tailed test.

## IV. DIFFERENCES IN NUMBER OF FIREPLACES PER DWELLING

Table VII presents the findings regarding the number of fireplaces per dwelling. These findings indicate that as we go from dwellings of nonusers to those of substitute users, and thence to firewood users, the dwelling will contain more than 1 fireplace. When averages were computed for each use group and subjected to tests of difference only 2 significant differences were revealed.

TABLE VI

AVERAGE SIZE OF DWELLING, BY NUMBER OF BEDROOMS, FOR EACH TYPE OF FIREPLACE USER, AND PER CENT OF EACH GROUP LIVING IN VARIOUS SIZES OF DWELLING

| Use group | n | Avg. no. of bedrooms per dwelling | Bedrooms per dwelling | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 |
| | | | Per cent | | | | | |
| Nonusers | 118 | 2.53* | 2.5 | 48.4 | 43.2 | 5.9 | --- | --- |
| Substitute users | 46 | 2.74 | --- | 39.1 | 50.0 | 8.7 | 2.2 | --- |
| Firewood users | 189 | 3.08*# | --- | 13.2 | 68.8 | 15.4 | 2.1 | 0.5 |
| Sample | 353 | 2.85 | 0.9 | 28.3 | 57.8 | 11.3 | 1.4 | 0.3 |

*Significantly different from the sample average at $t_{.05}$ level with a two-tailed test.

#Significantly greater than the average for nonusers and substitute users at $t_{.025}$ level with a one-tailed test.

TABLE VII

AVERAGE NUMBER OF FIREPLACES PER DWELLING FOR EACH USE GROUP, AND PER CENT OF EACH USE GROUP HAVING ONE, TWO, AND THREE OR MORE FIREPLACES

| Use group | n | Avg. no. of fireplaces per dwelling | Fireplaces per dwelling | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 or more |
| | | | ----------Per cent---------- | | |
| Nonusers | 118 | 1.09* | 91.5 | 7.6 | 0.9 |
| Substitute users | 46 | 1.28 | 78.1 | 19.6 | 2.3 |
| Firewood users | 189 | 1.29# | 74.6 | 21.7 | 3.7 |
| Sample | 353 | 1.22 | 80.7 | 16.7 | 2.6 |

*Significantly different from sample average at $t_{.05}$ level with a two-tailed test.

#Significantly greater than the average for nonusers at $t_{.025}$ level with a one-tailed test.

First, the average number of fireplaces per dwelling for firewood users was significantly greater than the average number of fireplaces per dwelling for nonusers at the $t_{.025}$ level with a one-tailed test. Secondly, the average number of fireplaces per dwelling for nonusers was significantly different from the average number of fireplaces per dwelling for the sample, using a two-tailed test at the $t_{.05}$ level of significance.

It is not clear why a highly significant difference in the average number of fireplaces per dwelling existed between nonusers and firewood users. One possible explanation might be that the existence of more than 1 fireplace contributes to an increased desire to use the fireplaces. It is also possible that a large proportion of the dwellings of fireplace users, especially those who burn firewood, are occupied by the original owner and the presence of a fireplace manifests the owners desire to have and use a fireplace. On the other hand, the significant difference existing between the sample average and the nonuser average might suggest that a large proportion of nonusers dwellings are occupied by families that are not original owners. The significant difference existing in the age of dwelling between users and nonusers supports this suggestion.[5]

## V. DIFFERENCES IN OCCUPATIONAL DISTRIBUTION

The function of the fireplace in the American home has changed drastically since the founding of this country. Heating of residential

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[5]Refer to Part II of this chapter.

homes is now accomplished by some type of more efficient heating system using either gas, oil, coal, or electricity. The fireplace has become a "luxury" rather than a necessity.[6] The association of fireplace usage with the term "luxury" led to the hypothesis that the use of the fireplace for firewood consumption is, in part, a function of non-economic factors. The acceptance of this general hypothesis led to the statement of the more specific hypothesis that a significant difference should exist between the distributions of occupation of the head of household, for the 3 fireplace use groups.

Table VIII presents the findings of this study regarding the occupational distribution of the head of household for nonusers, substitute users, and firewood users. The most outstanding aspect of this distribution was the per cent of firewood users in the professional and technical occupation group. Also of interest was the per cent of substitute users comprising the retired group.

An analysis of these distributions, using the Chi-square test, revealed the following: (1) at the $X^2_{.05}$ level of significance with 9 degrees of freedom, the computed Chi-square values for all 3 use groups exceeded the tabular values, indicating that the occupational distribution of each group was significantly different from that of the sample; (2) when the occupational distributions of the nonusers and substitute users was tested against the distribution of the firewood users, both

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[6] U. S. Department of Agriculture, Forest Industry Opportunities, Forest Service Agriculture Information Bulletin No. 222 (Washington: Government Printing Office, March, 1960), p. 19.

TABLE VIII

OCCUPATIONAL DISTRIBUTION OF HEAD OF HOUSEHOLD FOR THE TOTAL SAMPLE, NONUSERS, SUBSTITUTE USERS, AND FIREWOOD USERS

| Occupational group | Sample (n=353) | Nonusers*# (n=118) | Substitute users*# (n=46) | Firewood users* (n=189) |
|---|---|---|---|---|
| | Per cent | | | |
| 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 |
| Operatives 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 |

*Significantly different from sample distribution at $X^2_{.05}$ level.

#Significantly different from firewood users distribution at $X^2_{.025}$ level.

values were found to be highly significant at the $X^2_{.025}$ level with 9 degrees of freedom. Results of these tests suggest that with increasing levels of formal education and larger proportions of the labor force being engaged in professional and technical occupations, an increase in the use of the fireplace for firewood consumption is likely to follow. One plausible explanation for the large per cent of retired persons among substitute users is that firewood usage requires carrying wood and cleaning the fireplace at frequent intervals. The disutility of these requirements may exceed the utility of burning firewood, especially for persons in the retired group.

It is interesting to note the significant differences in the occupational distributions of nonusers, substitute users, and firewood users, because of the implications such differences have for long-run consumer behavior. However, it is unlikely that the occupational structure in most areas will change sufficiently in the short-run to influence consumer demand significantly.[7]

## VI. THE RELATIONSHIP BETWEEN INCOME, AND THE AGE AND SIZE OF DWELLING

The significant differences which appeared in age of dwelling and size of dwelling between nonusers, substitute users, and firewood users, were the results of t-test values which were sufficiently large to war-

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[7]Gardner Ackley, Macroeconomic Theory (New York: The Macmillan Company, 1961), p. 298.

rant the consideration of possible significant differences in these variables due to level of income. The hypothesis that a significant difference in age of dwelling, and in size of dwelling existed between consumers with various levels of income was tested. The following list of the average age of dwelling for each income group suggested that as the income level increased, the average age of dwelling would be significantly lower:

| Income level | Average age of dwelling | Range |
|---|---|---|
| $3000-4999 | 26.09 | 59 |
| 5000-6999 | 19.47 | 51 |
| 7000-9999 | 18.25 | 107 |
| 10000 and over | 10.72 | 66 |

Using a one-tailed test at the $t_{.025}$ level of significance, a highly significant difference in age of dwelling was found to exist between all income levels except the $5000-6999 and the $7000-9999 income groups. On the basis of comparisons between the highest income level and the other income levels, it appeared that at least part of the difference in age of dwelling between nonusers, substitute users, and firewood users, was attributable to level of income.

Results of tests concerning differences in the average size of dwelling were not as indicative of a general relationship between income and size of dwelling as was apparent between income and age of dwelling. The following summary of the average size of dwelling for each income group, as measured by the number of bedrooms, shows size of dwelling increasing as income level increases:

| Income level | Average number of bedrooms |
|---|---|
| $3000-4999 | 2.42 |
| 5000-6999 | 2.62 |
| 7000-9999 | 2.91 |
| 10000 and over | 3.08 |

At the $t_{.025}$ level of significance, using a one-tailed test, there was no indication that size of dwelling became significantly larger as income increased. The lack of any definite significant relationship between size of dwelling for the various income levels can be partially accounted for by what appeared to be a wide variance in the cost of dwellings of a given size, as measured by the number of bedrooms. The inference drawn from the tests of significance was that there is only a small relationship between level of income and size of dwelling when the size is measured by the number of bedrooms.

Larger and more significant differences would be expected to exist between average size of dwelling for various income groups, using some criterion of measurement which would reflect the size of the dwelling for a given amount of cost. It was concluded that the significant differences found in the size of dwelling, as measured by number of bedrooms, between the various use groups reflected little income effect.[8]

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[8]See Table VI, p. 21.

# CHAPTER III

## CONSUMERS DIFFERENCES AND PREFERENCES

The importance of the consumer in the marketing mechanism is expressed by the modern day tendency for producers to produce what the market demands, rather than expecting the market to absorb whatever is produced. This tendency can be termed "market orientation," which can be characterized by a shift in emphasis from a production orientation to a market orientation, and the discovery of consumer wants.[1] Kohls has stated that marketing is "a process of matching the right form of a product at the right place and time to a particular buyer."[2] A large portion of the consumer interview schedule was designed for the specific purpose of obtaining knowledge concerning firewood consumers preferences and consumption habits. A knowledge of these preferences and habits is considered to be of primary impertance to persons marketing firewood and persons interested in establishment of new markets.

### I. ANALYSIS OF DIFFERENCES BETWEEN FIREWOOD CONSUMERS FOR SELECTED VARIABLES

An analysis of the level of firewood consumption was conducted as

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[1]Hugh L. Moore, and Gorham Hussey, "Economic Implications of Market Orientation," Journal of Farm Economics, May, 1965, pp. 421-427.

[2]Richard L. Kohls, Marketing of Agricultural Products (second edition; New York: The Macmillan Company, 1961), p. 31.

a means of discovering differences between firewood consumers which might significantly affect the demand for firewood. The basic hypothesis tested in this section can be stated as follows: it was believed that consumption would be significantly different for various levels of income, the number of fireplaces in the dwelling, the availability or convenience of obtaining firewood, and the price of firewood. The method of analysis of differences was identical to that outlined in the previous chapter.[3] Consumption was considered to be the dependent variable in the analysis, and is stated in terms of quarter-cords of fireplace wood.[4] Table IX presents a summary of the distribution of consumers for the variables tested.

Income. In general, according to economic theory, as income increases the consumption of most commodities will increase, other things being equal.[5] Based on this general premise, the consumption of firewood was expected to increase significantly as income level increased. Table IX shows no such relationship. Contrary to expectations, the highest level of average consumption was found to be in the lowest income group, although a positive difference in average consumption of approximately one-fourth cord did appear between the highest income group and the 2

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[3]See Chapter II, p. 14.

[4]A "cord" in this thesis refers to a "face cord" which can be defined as a stack of wood 8 feet long, 4 feet high, and with the length of stick being of variable dimensions.

[5]Sidney Weintraub, Intermediate Price Theory (Philadelphia: Chitton Company, 1961), p. 80.

TABLE IX

DISTRIBUTION OF CONSUMERS BY SELECTED CHARACTERISTICS, NUMBER OF CONSUMERS, AVERAGE CONSUMPTION, AND RANGE OF CONSUMPTION

| Characteristic of interest | Number of consumers | Average consumption | Range of consumption |
|---|---|---|---|
| | | --Quarter cords-- | |
| **Level of income** | | | |
| $3000-4999 | 17 | 7.76 | 36 |
| 5000-6999 | 21 | 4.61 | 24 |
| 7000-9999 | 33 | 4.52 | 12 |
| 10000 and over | 116 | 5.54 | 40 |
| **Number of fireplaces** | | | |
| 1 fireplace | 40 | 5.27 | 40 |
| 2 or more fireplaces | 47 | 6.02 | 24 |
| **Availability of firewood** | | | |
| No difficulty obtaining wood | 110 | 5.50 | 24 |
| Difficulty obtaining wood | 21 | 8.86 | 40 |
| **Price paid for firewood** | | | |
| Less than $10 per cord | 10 | 6.90 | 18 |
| $10 to $12 per cord | 55 | 8.04 | 40 |
| More than $12 per cord | 12 | 5.50 | 14 |

successively lower income groups. The significance of these differences in average consumption were tested using 3 approaches.

First, differences between the average consumption of each income level and the average consumption of all consumers were tested for significance. Using a two-tailed test at the $t_{.05}$ level of significance yielded no significant differences in means. Secondly, differences between the average consumption of each level of income and the other income levels were tested for significance. Using a one-tailed test at the $t_{.025}$ level of significance yielded no significant differences in means. It is worthy of mention that the t-value computed between the $7000-9999 income level and the $10000 and over income level was greater than the t-value computed between the $3000-4999 income level and the $7000-9999 income level, even though the numerical differences indicated the reverse relationship. In order to fully substantiate the lack of a significant difference in average consumption based on levels of income, a comparison of average incomes was computed assuming level of consumption as the independent variable. No significant differences were found between the average income levels for various levels of consumption, using this approach.

Results of the t-tests computed for firewood consumers indicate that although income may be a significant variable in determining use of fireplace, it has little significance in influencing the per capita consumption in any predictable manner. Simple correlation computations, between income and consumption, yielded an insignificant coefficient at the 5 per cent level of significance, supporting the results of the other

tests.

Number of fireplaces. The number of fireplaces per dwelling was hypothesized to be of significant influence on the level of consumption. In the total sample of 353 dwellings, 48 had 2 or more fireplaces and 47 of these used firewood. The average consumption for households with 2 or more fireplaces exceeded that of households with only 1 fireplace, but no significant difference in these means appeared at the $t_{.025}$ level, using a one-tailed test. A second test yielded no significant difference between the average consumption of each group and the average consumption of all consumers, with a two-tailed test at the $t_{.05}$ level.

Results of the tests of significance led to a rejection of the hypothesis. The implications are that, although firewood users have a significantly greater number of fireplaces per dwelling than do nonusers of fireplaces, fireplace users with 2 or more fireplaces must normally use only 1 of their fireplaces at a time. This relationship between averages could have an important bearing on estimating firewood consumption by a simple random count of fireplaces existing in an area.

Availability of firewood. Consumers were classified as having had difficulty finding the quantity of firewood desired or not having had difficulty, on the basis of a positive or negative answer to a question relating to this problem. Given the individuals demand for firewood, the hypothesis was formulated that there would be a significant difference in average consumption between these groups.

The results of a t-test indicated that consumers who had diffi-

culty in finding firewood when they wanted it had an average consumption significantly greater than those indicating no difficulty, if one accepts the $t_{.10}$ level of significance with a one-tailed test. No significance existed at the $t_{.05}$ level using a one-tailed test. The range of consumption shown in Table IX, page 31, indicates that those consumers having difficulty finding firewood when it is wanted may be high level consumers. The implication of this analysis is that the consumption of this group might be greater if the availability of firewood were increased.

Prices paid for firewood. The price system in most Western economies is considered to be the allocator of scarce resources, and prices are primarily determined by conditions of supply and demand. Generally, the lower the price of a good the more of it will be taken by consumers, other things being equal. It was expected that the average consumption for consumers paying higher than average prices would be significantly different from the average consumption of consumers paying lower than average prices.

No significant differences were found between the average consumption of consumers paying a low, medium, and high range of prices for firewood, using a one-tailed test at the $t_{.025}$ level. However, the average consumption of consumers paying $10 to $12 per delivered cord was significantly greater than the average consumption of the total sample.

The implication of this finding was that consumers have a general idea of the market price of firewood, and they may hesitate when purchas-

ing firewood at a price much below or much above the average price, because, in their mind, such firewood might be inferior in burning quality or may be outrageously priced. However, questioning of consumers seemed to provide reason to doubt the effectiveness of price in determining the quantity consumed. More than three-fourths of the consumers answered "no" to a direct question asking if the price of firewood determined the amount of firewood consumed.

Generalization of findings. A review of the results of the analysis of differences in average consumption for the selected variables led to the following generalization: Given the fact that a consumer uses firewood, the quantity that he consumes in a given period is a relatively stable characteristic. Assuming such a generalization to be valid, increased utilization of firewood is likely to come from shifts in fireplace use groups; specifically, from shifts of nonusers and substitute users to the firewood user group.

## II. CONSUMERS PREFERENCES

The remainder of the present chapter is primarily concerned with the enumeration of the characteristics of the firewood consumed, the preferences of the consumers regarding the product, and the relationship of the consumers with the marketing mechanism. The enumeration of such data is believed to be a necessary prerequisite to satisfying consumers needs, and to developing and improving the firewood market.

"When consumers finally make a choice and pay for their particular

'product bundle' they essentially have decided that the purchase satisfies some desire or need."[6] Firewood is no different than any other product with regard to the possession of certain qualities and dimensions which gives a product the ability to satisfy needs. Two recent government publications indicate that firewood should be well seasoned, cut to the desirable length, and split.[7] Such characteristics are much too general for recommendations to persons interested in marketing firewood. The analysis of consumers preferences regarding specific qualities and dimensions of firewood was expected to provide answers necessary for the production and marketing of a product which maximizes consumer satisfaction.

Reasons for firewood consumption. General observations indicate that firewood is consumed not for its heating value, but for some more intangible reason seemingly related to psychological, social, and cultural values. Modern day firewood consumption is more likely to occur because "the cheerful glow of burning wood in a fireplace still draws the family."[8] Response to direct questioning of the firewood consumers indicated that such was the case among consumers interviewed in this study.

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[6]Kohls, op. cit., p. 31.

[7]U. S. Department of Agriculture, Special Forest Products for Profit, Forest Service Agriculture Info. Bul. No. 278 (Washington: Government Printing Office, August, 1963), p. 14; and U. S. Department of Agriculture, Forest Industry Opportunities, Forest Service Agriculture Info. Bul. No. 222 (Washington: Government Printing Office, March, 1960), p. 19.

[8]Ibid.

Consumers indicating that they burned firewood because they "just like a fire in the fireplace," accounted for 62.4 per cent of the total number of firewood users. This and other reasons given for consumption of firewood are presented in Table X. The proportion of consumers burning firewood just because they liked a fire in the fireplace was probably larger than the data indicated, based on the fact that none of the consumers listing "weather" as the reason for consumption used firewood as the major source of heat. Weather conditions appeared to stimulate the lighting of the fireplace.

Although only firewood consumers could be logically asked "why" they burned firewood, the general experience of the author in obtaining the data pointed toward the possibility that some of the nonusers and substitute users might burn firewood, provided they had a fireplace which was safe and functional. The following list provides an indication of the relationship between the average age of houses in residential blocks and the proportion of houses having a fireplace:

| Sample area | Average age of houses | Per cent with fireplace |
|---|---|---|
| 1 | 23.7 years | 19.9 |
| 2 | 23.6 years | 3.9 |
| 3 | 18.8 years | 27.9 |
| 4 | 12.3 years | 59.9 |

The proportion of fireplaces being built into newer homes suggests that an increased emphasis is being placed on fireplaces by homeowners, and the source of this emphasis appears to be some aesthetic value rather than some tangible, functional value such as heating.

TABLE X

PRIMARY REASON GIVEN FOR CONSUMPTION OF FIREWOOD, NUMBER OF RESPONDENTS, AND PER CENT OF TOTAL SAMPLE

| Reason for consumption | Number of consumers | Per cent of sample |
|---|---|---|
| Weather conditions | 17 | 9.0 |
| Holidays and social activities | 35 | 18.5 |
| Just liked a fire in the fireplace | 118 | 62.4 |
| All reasons listed above | 16 | 8.5 |
| Other reasons | 3 | 1.6 |
| Total | 189 | 100.0 |

Preferences for quantities per purchase. A priori knowledge of the firewood market in the Knoxville area revealed that firewood was available in small carry-home type bundles only to a very limited extent. Correspondence with several Northeastern agricultural experiment stations suggested the possibility of marketing firewood in small bundles which could be easily carried in the trunk of an automobile. A simple, inexpensive jig for tying bundles about 12 inches in diameter, 16 to 18 inches in length, and weighing approximately 30 pounds, has been designed by the Department of Agricultural Engineering at Cornell University.[9]

The availability of firewood in various purchase quantities might be a significant factor affecting demand in some markets. An enumeration of consumers preferences for various quantities per purchase provided the following data:

| Preference | Per cent of consumers |
|---|---|
| Small carry-home type bundles | 4.2 |
| Delivered cord size lots | 84.1 |
| Both of above listed quantities | 11.7 |

The preferences for size of purchase quantity is believed to be partially a function of storage space available at the consumers residence. In large metropolitan areas such as New York City, storage space for large quantities of firewood is usually lacking.[10] Such did not

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[9]E. W. Foss, "Packaged Fireplace Wood" (Ithaca: Department of Agricultural Engineering, New York State College of Agriculture, May, 1959), (Mimeographed.)

[10]Ibid.

appear to be the case in the Knoxville area. None of the households sampled indicated that storage for 1 cord of firewood would have been a problem. Since several retailers in the Knoxville market provide firewood in bundles of 1 dozen sticks, it appears that consumers needs are being at least partially fulfilled relative to the availability of different purchase quantities of firewood.

Degree of seasoning preferred. Every reference to firewood reviewed by the author specifically mentioned that firewood should be seasoned. Such a recommendation is based on 2 considerations; the heating value of wood, and safety. Unseasoned wood burns at lower temperatures than seasoned wood, 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.[11] The improved design of modern fireplaces and the small emphasis placed on the heating value of firewood has reduced the importance of these 2 considerations.

Although the creosote problem remains a potential source of danger when high temperatures are not maintained in the chimney, consumers in this study were evidently not greatly concerned about this problem. The

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[11]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," Consumers All, 1965 Yearbook of Agriculture (Washington: Government Printing Office, 1965), p. 106-107.

following preferences were indicated by consumers interviewed, with regard to degree of seasoning:

| Degree of seasoning preferred | Per cent of consumers |
|---|---|
| Seasoned wood | 48.7 |
| Unseasoned wood | 6.3 |
| Mixed seasoned-unseasoned wood | 37.1 |
| No preference | 7.9 |

The implication of the above distribution was that the desirability for unseasoned firewood and especially for firewood of mixed seasoning is sufficiently large to warrant producers and retailers to provide these characteristics in the product. The small number of consumers indicating "no preference" regarding seasoning of firewood is believed to be an indication of the ability of a great majority of firewood consumers to discriminate between seasoned and unseasoned firewood.

Species of firewood preferred. Preference for certain species of firewood originated when firewood was a major source of heat. As a general rule, the heating value of wood increases with the weight of a given volume of wood material.[12] Because of this, hardwoods have been preferred to softwoods, especially hardwoods such as oak and hickory. Consumers in this study were heavily weighted toward a preference for oak and hickory. Those consumers indicating a preference for these

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[12] Ibid.

species constituted 89.0 per cent of all consumers who showed a preference for a particular species. The significance of this figure should probably be deflated somewhat since 51.3 per cent of all consumers had no preference for any particular species of firewood. With regard to undesirable species, 51.0 per cent of the consumers who listed a particular species listed pine. It is believed that this figure should also be deflated due to the fact that 77.2 per cent of all firewood consumers expressed no feeling relative to an undesirable species.

The appearance of a large number of consumers having no preference for either a desirable species or an undesirable species suggests the possibility that the specific preferences found may be a part of past patterns, developed when firewood was considered primarily as a source of heat. Nevertheless, these patterns are real to consumers and must be recognized by firewood producers and retailers. Associations with many of the consumers, while obtaining the data, indicated that species preferences may be less evident in the future, and that an increased emphasis may be placed on the cleanliness and soundness of firewood.

Length preferences. Length of fireplace wood was initially included in this study as a characteristic of major importance. Observation of the dwelling units in the sampling areas led to the conclusion that any distribution of fireplaces by length would be subject to considerable fluctuations due to the changing sizes and the numerous designs of residential dwellings. The average length of firewood which was being used by consumers at the time of the interview was 25.8 inches; the maximum

length 36.0 inches; and the minimum length 18.0 inches. Data from the consumer and retail studies indicated that information regarding length of wood desired was being effectively transmitted from the consumers to the retailers and producers.

Diameter preferences. Regarding maximum diameter, 64.0 per cent of the consumers indicated "no preference". The average maximum diameter specified by the consumers was 6.8 inches, with the largest value being 16.0 inches and the smallest value being 3.0 inches. The modal value was 7.0 inches. Thirty-one per cent of the consumers indicated "no preference" with regard to a minimum diameter of firewood stick. The average minimum diameter computed for those consumers showing a definite preference was 2.2 inches, with the largest value being 8.0 inches and the smallest value being 1.0 inch. The modal value relative to a minimum diameter preference was 2.0 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. If the average maximum diameter computed in this study is meaningful, it would seem necessary for producers or retailers to split sticks exceeding 10 inches in diameter. Several consumers mentioned the desirability of having a "back-log" when a fire is lighted; they suggested a stick diameter of 10 to 12 inches for this purpose.

The tendency of consumers to be more discriminating with regard to

a minimum diameter of firewood stick is considered to be of significant importance to firewood producers. Nearly 68 per cent of all growing stock hardwood trees on commercial forest land in Tennessee is less than 3 inches in diameter.[13] Coupled with the fact that a large proportion of the commercial woodland in the state can not be improved by natural regeneration, this points toward a large supply of small dimension low-quality hardwood stock, much of which may not be acceptable to the consumer as firewood.

## III. CHARACTERISTICS OF FIREWOOD CONSUMPTION IN THE KNOXVILLE AREA

The preceding section dealt with what consumers preferred or what consumers thought the market should provide. The following data were included in the analysis to provide an indication of the actual characteristics of firewood consumption at the time of data collection.

Use of substitutes. Substitute products were used alone in 46 of the 333 households interviewed. Table XI presents the findings regarding the use of substitute products. A noticable difference was recognized between the use of electric logs and the use of coal by the substitute product users and the firewood users. The difference was hypothesized to be a reflection of the use of coal by firewood users, not as a substitute

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[13] U. S. Department of Agriculture, Tennessee Forests, Forest Survey Release 86 (New Orleans: Southern Forest Experiment Station, 1962), p. 21.

TABLE XI

PER CENT OF SUBSTITUTE USERS AND FIREWOOD USERS USING VARIOUS OTHER PRODUCTS IN THEIR FIREPLACE

| Other products used in the fireplace | Substitute users | Firewood users[a] |
|---|---|---|
| Electric logs | 71.7 | 11.1 |
| Coal | 13.1 | 77.8 |
| Pressed wood | 6.5 | 5.5 |
| Gas logs | 6.5 | --- |
| Others | 2.2 | 5.6 |

[a]Only 18 of the 189 firewood users used some other product in their fireplace as well as using firewood.

but as a supplementary product. The large use of electric logs by substitute users was consistent with the finding that the average age of dwelling for substitute users was significantly greater than for firewood users.[14] These dwellings contained a considerable number of unsafe or malfunctioning fireplaces, based on interviewers observations.

The use of firewood substitutes among firewood users was found to be small. Of all firewood consumers, 90.5 per cent burned only firewood and 7.4 per cent burned coal. The remaining 2.1 per cent were distributed as follows: (1) 2 consumers used electric logs, (2) 1 used pressed wood, and (3) 1 used lumber scraps.

The use of pressed wood firelogs was expected to be greater than was indicated by the study.[15] Several retail outlets were found to exist for this product. Although consumer use of this product has been substantial in areas of the state of Washington, and in Canada, the same was not found to be the case in the Knoxville area.[16] Only 4 fireplace users out of 235 fireplace users used pressed wood logs. Assuming that fireplace use is a function of some intangible aesthetic value, the small use of pressed wood logs may be due to their difference in physical appearance from roundwood firewood.

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[14]See Table V, p. 19.

[15]Pressed wood logs refers to the artificial logs manufactured from wood waste material.

[16]Peter Kock, Using Low-Grade Hardwood, Special Bulletin 413 (Michigan State University Agricultural Experiment Station, March, 1957), p. 8.

If consumer satisfaction from the use of their fireplace is largely a function of the physical appearance of actual roundwood firewood logs burning in the fireplace, then firewood is a unique product. Analysis of the data concerning the use of other products by consumers indicated that this was generally the case, and that the demand for firewood was not greatly influenced by the presence of other products which may be used in a fireplace.

Types of purchases. An analysis of the types of purchases made by consumers provided information regarding both the purchase quantities bought by consumers and the frequency of the purchases. Because the consumer survey was conducted during what was assumed to be the mid-season of firewood marketing, the consumers were asked to list the types of purchases made in the present season and in the previous season. During the specified period, 60.3 per cent of the consumers had made purchases, 34.9 per cent had obtained no firewood at all, and 4.8 per cent indicated that they had used "home grown" firewood.[17] The fact that over one-third of the consumers had acquired no firewood at all during the period suggested that firewood purchases are infrequent in nature, which is generally not expected for most non-durable consumer goods.

Two types of purchase quantities of firewood were found among the

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[17]"Home grown" firewood was obtained from trees cut on the residential property of consumers, and was most prevalent on sites of newly constructed homes.

consumers studied. Delivered cord size quantities were purchased by 91.0 per cent of the consumers who had made purchases. Small carry-home type purchases were made by only 7.2 per cent of the consumers, and 1.8 per cent of the consumers had made both types of purchase.

Carry-home type purchases were all bought in bundles containing 1 dozen sticks of firewood. Delivered cord size lots were purchased according to 3 different units of measure: (1) the cord, (2) the rick, and (3) the truck load. Of these 3 units of measure, the rick and the cord are standardized units of equivalent volume. The truck load is not a standardized unit and varies in volume with the design and model of the vehicle used to deliver the firewood. Purchases of firewood by the cord, the rick, and the truck load were made by 86.5 per cent, 10.1 per cent, and 3.4 per cent of the consumers, respectively.

Some dissatisfaction with the three-way classification of unit of measure was expressed by consumers during the interview. This dissatisfaction could be a source of reduced demand for firewood. As Kohls has stated, "it is possible that consumers will not buy as much of products that are uneven in quality or that have been misrepresented to them."[18]

Prices paid for firewood. Prices paid for firewood were analyzed from 2 standpoints; the average price paid for the different units of measure, and the seasonality of prices. It was hypothesized that there would be no significant difference in the average price paid for delivered firewood regardless of the unit of measure. It was further

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[18]Kohls, op. cit., pp. 204-205.

hypothesized that there would be significant differences in the average price paid for firewood during different seasons of the year.

The following average prices were paid for delivered cord size lots of firewood:

| Unit of measure | Number of consumers | Average price per unit |
|---|---|---|
| Cord | 77 | $10.18 |
| Rick | 9 | 10.50 |
| Truck load | 3 | 11.67 |

Results of tests of significant difference in these average prices with a one-tailed test at the $t_{.025}$ level yielded no significant differences in the prices paid for the different units of measure. These results led to the acceptance of the hypothesis and the conclusion that consumers purchasing firewood in truck load units are paying approximately the same price for firewood as those purchasing firewood by the cord or the rick. However, information obtained from retailers in the area indicated that the average truck load of firewood is equal to only three-fourths of the volume contained in a cord or rick.

Small carry-home bundles were all purchased at the price of $1.00 per dozen sticks. The purchase of firewood in this quantity was almost negligible in the consumer study.

Seasonality of price was analyzed using only the purchase of delivered firewood purchased by the cord. The average prices paid during the various seasons of the year were as follows:

| Seasons | Number of consumers | Average price |
|---|---|---|
| Oct. - Dec. 1964 | 16 | $10.16 |

| | | |
|---|---|---|
| Jan. - March 1965 | 8 | $10,50 |
| July - Sept. 1965 | 3 | 9,33 |
| Oct. - Dec. 1965 | 50 | 10.04 |

Tests of significant difference in means revealed no significant difference either between the various periods or between the sample average and the various periods. The number of consumers making purchases during the various periods indicates the seasonality of purchasing firewood. The seasonality of consumption corresponded somewhat with that of purchasing, with only 9.0 per cent of the households using firewood from April through September. Of the 17 consumers who used firewood from April through September, 15 of them used 25 per cent or less of their average annual consumption during this period. The revelation that only 3.4 per cent, 6.3 per cent, and 7.6 per cent of the nonusers, substitute users, and firewood users, respectively, had outside fireplaces suggests that fireplace use does not compete with the charcoal grill for warm weather leisure activities.

## IV. CONSUMER-MARKET RELATIONS

The importance of consumer-market relationships has been emphasized by the following quotation:

> The over-all rules and coordinator of marketing activities in a society organized in a basically private enterprise framework such as ours, is the consumer. The end product of all productive processes is consumption. The consumer has the freedom to allocate much of his income among various goods and services as he sees fit. The farmer, the processor, the retailer, and all other agencies involved in the marketing process must receive their final payment from some consumer who decides

"that is what I want" and lays down his money to buy it.[19]

Consumer satisfaction is the end to which all production and marketing processes are directed. Evidence of this is seen every day on television, on buses, along highways, and in retail outlets in the form of advertisements. Due to consumer sovereignty the inclusion of an evaluation of consumer-market relations is considered to be a necessary part of any attempt to improve marketing and expand consumer demand. Three aspects of consumer-market relations were included in this study; (1) consumer-retailer cohesiveness, (2) consumer knowledge of product outlets, and (3) consumer satisfaction with the marketing mechanism.

Consumer-retailer cohesiveness. It was assumed that a distribution of consumers, on the basis of the number of dealers from whom they had purchased firewood during a given period, would provide an indication of the competitive nature of the retail market. The following distribution, although indicative of a strong consumer-retailer relationship, must be analysed with caution.

| Number of dealers from whom consumers made purchases | Per cent of consumers |
|---|---|
| 1 dealer | 51.9 |
| 2 dealers | 36.1 |
| 3 or more dealers | 12.0 |

The large number of consumers making semi-annual purchases of firewood provides reason to doubt the effectiveness of the above distri-

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[19] Ibid., pp. 6-7.

bution in indicating the competitive nature of the retail market. Contrary to the results indicated above, only 17.5 per cent of the firewood consumers were able to provide the name and/or the specific location of a retail source for firewood.

Consumer location of firewood source. In order to gain an understanding of how information concerning the availability of firewood for sale was transmitted to consumers, the consumers were asked how they had located their present dealer. The most prevalent means by which retailers had informed consumers of their product was by contacting them at their home. This type of consumer-retailer contact was indicated by 55.3 per cent of the consumers who had made purchases. The second most prevalent means by which a consumer-retailer association was consummated, was by "word-of-mouth," or receiving information from another consumer. "Word-of-mouth" location of retailers was indicated by 20.2 per cent of the consumers. Point-of-sales displays were the third most important source of consumer location of a firewood source; they were indicated by 14.9 per cent of the consumers. The remaining 9.6 per cent of initial consumer-retailer contact was the result of newspaper advertisements, telephone directory references, and other types of advertising.

Results of the consumer-retailer contact information point toward the limited use, by firewood retailers, of the more formal types of advertising. Also indicated was the presence of a sizable door-to-door firewood peddling system in the Knoxville area.

Consumer satisfaction with the market. The consumers evaluation

of the effectiveness of the market in providing firewood in the purchase quantities wanted and at the time it was wanted, was favorable. Even with the lack of knowledge on the part of consumers concerning source of firewood, which seemed prevalent, 87.9 per cent of the consumers indicated that they found no difficulty in purchasing the quantities they desired. The 16.7 per cent of consumers who revealed difficulty in finding firewood when it was wanted, is taken as an indication of the lack of any firmly established retail outlets, and the lack of either the necessary quantity or quality of consumer oriented information.

The evaluation of the firewood market from the standpoint of consumer-market relations indicated a market in which nearly 1 out of 5 consumers found it difficult to purchase firewood when it was desired; a market in which competition for consumers by the retailers appeared insignificant; and a market in which the advertising of the product was nearly lacking. For a complete study of this market, the analysis of the retailing of firewood was believed to be the important concluding step.

## CHAPTER IV

## MARKETING FIREWOOD IN THE KNOXVILLE AREA

The analysis of firewood marketing in the Knoxville area can best be characterized as a case study. It was the initial objective of this study to contact all firms and individuals who marketed firewood in the Knoxville area; however, the large proportion of sales to consumers from door-to-door peddlers, and the inability of many consumers to provide information necessary for the location of the retailers, made it impossible to contact all retailers. The retailers interviewed were those located through use of information provided by consumers and individuals who had knowledge of a marketing outlet.

Of the 13 individuals interviewed, 3 were classified as farmer retailers, 4 as part-time firewood retailers, and 6 as established firewood retailers. The differences found to exist between these groups of retailers are presented in Table XII. Firewood retailing was the sole source of income for only one of the established retailers interviewed. Of the remaining 5 established retailers, 1 hauled earth fill material, 1 marketed sawlogs, and 3 marketed bag coal. Gross firewood receipts were 100.0 per cent, 89.8 per cent, and 80.0 per cent of total gross business receipts for the 3 largest established retailers. Firewood marketing among the other retailers could be characterized as a supplementary endeavor.

TABLE XII

DESCRIPTIVE CHARACTERISTICS OF FIREWOOD RETAILERS
BY PRIMARY BUSINESS CLASSIFICATION

| Characteristic of interest | Farmer retailers | Part-time retailers | Established retailers |
|---|---|---|---|
| Cords marketed annually[a] | | | |
| 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[b] | | | |
| 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 |

[a]Based on estimates made by retailers.

[b]Based on estimates of volume marketed annually and the per cent of volume marketed at various prices.

## I. THE SUPPLY AND PROCUREMENT OF FIREWOOD

Due to the bulkiness of firewood and its cost of transportation, sources of firewood were expected to decrease with the distance from the retailing area. Greater margins of profit would normally be expected with smaller transportation costs, other things being equal. The volume of firewood obtained from various areas and the approximate distance of these areas from the retailing area are shown as follows:

| Source of firewood supply | Approximate distance from Knoxville | Per cent of total volume obtained |
|---|---|---|
| Within Knoxville | ---- | 63.6 |
| Knox County | 10 miles | 18.9 |
| Surrounding counties | 35 miles | 17.5 |

The supply of firewood did decrease as the distance of the source increased. An analysis of the volume of firewood provided by various classifications of suppliers showed that 50.9 per cent of the total volume was supplied by building contractors, 29.8 per cent by woodland owners, 13.2 per cent by urban homeowners, and the remaining 6.1 per cent from other sources. These data indicate that the firewood which was marketed by the retailers interviewed, made little contribution to commercial woodland improvement.

Supplier-retailer relationships. Relationships among the retailers studied were informal.[1] No written contracts existed between the

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[1] This analysis included only 11 retailers since 2 of the retailers cut firewood from their own woodlot.

retailers and suppliers, but 40.8 per cent of the total volume obtained had been obtained through a verbal agreement. Initial attempts to move firewood through the marketing channel were, for the most part, initiated by the suppliers. The suppliers contacted the retailers over 90 per cent of the time in 9 out of 11 cases. Advertising was used to obtain firewood by only 1 retailer.

The transportation of firewood. The transportation of firewood by retailers, from its point of production to the retail establishment, accounted for 93.2 per cent of the total volume purchased by established retailers.[2] The remaining 6.8 per cent was purchased at the retail outlet. Firewood was transported to the retail establishment in one-half ton trucks, in 5 out of 6 cases. A two and one-half ton truck was used by 1 retailer.

Prices paid by retailers. Prices paid by retailers were extremely variable. Firewood supplied to 1 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 per cent of their firewood at the cost of cutting and removing it from the source. The total volume of firewood obtained by retailers was supplied at the following prices:

| Location | Number of cords | Price per cord |
|---|---|---|
| "Free wood" at source | 183 | harvesting cost |

[2]Farmer and part-time retailers delivered directly to consumers.

| | | |
|---|---|---|
| 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 |

A differential price, based on species of firewood, was paid by only 1 retailer. The differential paid was $2.50 per cord for hickory firewood.

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

## II. FUNCTIONS PERFORMED BY RETAILERS

The fact that 65.3 per cent of the firewood purchased, and 100.0 per cent of the firewood obtained through cutting and removing it, was stumpage, emphasised the number of functions which were undertaken by the retailers. Only a small amount of firewood obtained by retailers was ready to retail to the consumer. Retailers cut to length and split 94.2 per cent of the total volume of wood received from suppliers. They seasoned 50.8 per cent of the firewood. None of the firewood obtained by the retailers was stored over 1 year, indicating no carry-over of inventories.

The data regarding services offered to consumers showed that 83.2 per cent of all firewood had been delivered to the consumer. This was consistent with what had previously been found regarding consumers preferences on purchase quantities. The consumers survey showed that 84.1

per cent preferred delivered firewood.[3] The charge for delivering firewood to the consumer was included in the price of the firewood. Stacking firewood for consumers was a prevalent service offered by retailers. Retailers stacked 85.4 per cent of the delivered firewood for the consumers. The charge for stacking the firewood was included in the price. In most cases retailers indicated that they stacked the firewood only at the request of the consumer. One retailer did charge $1.00 per truck load to carry the firewood and stack it away from the truck. Following a purchase made at an established retail outlet, it was customary for the retailer to load small carry-home type bundles of firewood into the car for the consumer.

The acquisition of firewood supplies by retailers was expected to be seasonal in nature, corresponding to the seasonality of purchasing by consumers.[4] Although firewood acquisition took place continuously throughout the year, some seasonality seemed to be in evidence. Firewood acquisitions or cuttings were made mostly in the October-December quarter and in the April-June quarter, with 35.6 per cent and 35.8 per cent of the total volume, respectively, being purchased or cut during these periods. Since there was no carry-over of inventories, these purchase or cutting periods partially explain why approximately one-half of the firewood marketed by retailers was seasoned firewood. The remainder of the purchasing or cutting took place as follows: (1) 17.6 per cent in

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[3]See page 39.

[4]See page 49.

the July-September quarter, and (2) 11.0 per cent in the January-March quarter.

## III. RETAILING FIREWOOD

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. This information was found to be of use in evaluating the relationship between the consumers and the retail market studied in this project. Table XIII presents the results of the analysis of several selected variables associated with firewood retailing in the Knoxville area.

Type of sale. 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. A very small per cent of the sales were of a casual nature, indicating the stability of the consumer-retailer relationship over time. The fact that over 90 per cent of the sales were due to prior arrangements by the consumer, while the consumer survey showed that only 17.5 per cent of the consumers had any knowledge of their source of firewood, suggests that the retail market studied was not the retail market supplying the consumer population in the Knoxville

TABLE XIII

SELECTED CHARACTERISTICS OF FIREWOOD RETAILED, AND PER CENT OF TOTAL VOLUME RETAILED CONSTITUTING EACH CLASS

| Characteristic of interest | Per cent 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 |
| Truck load | 73.1 |
| **Size of stick** | |
| 12 inches | 0.2 |
| 18 inches | 6.1 |
| 24 inches | 80.3 |
| 30 inches | 11.2 |
| 36 inches | 2.2 |
| **Degree of seasoning** | |
| Seasoned | 43.7 |
| Unseasoned | 39.6 |
| Mixed seasoned-unseasoned | 16.7 |

area, but only a sub-part of the total retail market.[5]

Seasonality of sales. Retailing of firewood was found to be highly seasonal in nature. Even though no retail sales were made during the months from April through September, it can not be definitely stated that some sales would not be possible during these months due to the fact that all of the established retailers discontinued their retailing operation during these months. However, the consumption of firewood as indicated by consumers closely corresponded to the seasonality of sales which appeared in the retailer study.

Unit of measure. Analysis of the unit of measure by which firewood was retailed revealed a sharp difference from that obtained in the consumer analysis. In the consumer survey, purchases of firewood by the cord predominated, while the retailers survey revealed that sales by the cord accounted for a very small per cent of the total volume retailed. A further breakdown of retailers revealed that the farmer retailers marketed 2.5 per cent of their firewood by the rick and the remainder by the cord, while the established retailers marketed 81.8 per cent of their firewood by the truck load, and only 0.1 per cent by the cord, with none being marketed by the rick. If this is an indication of the unit of measure used by the 2 different groups of retailers, then it is possible that the part of the market associated with the consumer survey may have been dominated by farmer or woodland owner retailers. The large amount

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[5]See page 52.

of door-to-door peddling found in the consumer survey supports this line of reasoning.[6]

Length of firewood. The most prevalent length of firewood stick among the retailers interviewed was 24 inches. This size stick was followed by the 30 inch stick. These lengths of firewood stick accounted for 91.5 per cent of the total volume marketed. Only 1 retailer had marketed firewood less than 18 inches in length, and he indicated that the wood was used for kindling and stove-wood rather than for fireplace use.

Seasoning of firewood. The sales of unseasoned and mixed seasoned firewood made up 56.3 per cent of the total volume marketed, indicating that the market was providing consumers with the type of product desired, in line with the preferences revealed in the consumer survey.[7] The established retailers were the only retailers providing the consumer with the 3 different degrees of seasoning. Neither the part-time retailers or 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 3 different units of measure were nearly the same. The price charged for delivered firewood marketed by the cord, ranged from a low of $8.00 to a

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[6] Ibid.

[7] See pages 40 and 41.

high of $14.00. The smallest price range was found for firewood which was marketed by the truck load; 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. No perceivable difference seemed to exist in firewood 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 |
| Truck load | 10.40 |
| Rick | 10.88 |

The prices charged for firewood at the retail establishment were inconsistent with those charged for delivered firewood. Only 3 retailers had retailed cord size lots of firewood at their establishment. Both of the retailers marketing firewood at their establishment by the cord, priced it at $12.00 per cord. The 1 retailer who marketed firewood at his establishment by the truck load, charged an average price of $7.00 per truck load.

The price charged for small bundles of firewood was the same for each retailer marketing it in this manner; it was $1.00 per dozen sticks. A very small proportion of the total 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."

Retailers who had marketed firewood by the truck load, revealed

that the average one-half ton truck load of firewood contained only three-fourths the volume of a standard fireplace cord. It may be that if consumers become more familiar with the various units of measure and the price structure in the market, they will force prices to reflect the differences in the quantity of firewood between the truck load, the cord, and the rick.

Price setting in the market varied among the retailers. Setting price to cover cost of harvesting and handling, plus a normal return, was indicated by 4 retailers. The existing market price was used as the price setting criterion by 7 of the retailers, and 2 retailers, both of who were farmer retailers, accepted the price offered to them by the consumer. Several of the established retailers estimated that a profit margin of $2.00 to $3.00 per truck load or per cord of firewood, was considered a fair return.

Evaluation of firewood retailing. Retailers were asked to evaluate the firewood retail business from several standpoints. From the standpoint of investment only one-half of the retailers felt that their investment opportunities in the firewood business equaled or exceeded other possible alternative investments. However, response to the question regarding investment opportunties may not be a good indication of investment opportunities in the total retail market because of what appeared to be a lack of knowledge on the part of the retailers concerning their actual investment.

Expansion possibilities in the firewood market were seen as being

"very good" by 6 of the 12 retailers responding to the question. Five retailers indicated that expansion possibilities were "good," and only 1 retailer thought the possibilities were "poor." The present market was expanding according to 8 retailers, 6 of whom were classified as established retailers, 1 a part-time retailer, and 1 a farmer retailer. A static market situation was indicated by 4 retailers, and only 1 retailer indicated a declining market for firewood.

Competition in the market was viewed as insignificant by 11 of the retailers, and as normal by 2 of the retailers. None of the retailers interviewed thought that competition was a significant factor in determining the extent of their present operation. The possibility of a demand which exceeds supply was indicated by 10 of the retailers, who listed as their most serious problem the procurement of an adequate quantity of firewood to satisfy their customers needs. Three of the retailers listed hiring labor at a price which would allow normal profits, as a major problem in their retailing operation. An over-all evaluation of the market by the retailers was favorable, indicating that market expansion is expected to occur in the immediate future.

## IV. USEFULNESS OF THE RETAIL INFORMATION OBTAINED

A comparison of the data obtained in the consumer survey with that obtained in the retailer survey led to the conclusion that the retail market studied could not be used to make valid inferences concerning the total retail market in the Knoxville area. The total market would be

expected to be more heavily weighted with farmer retailers and part-time retailers. Nevertheless, the information obtained was a valuable supplement to that obtained in the consumer survey, and provided support for several of those findings. The data were also considered useful for the yielding of an approximation of the marketing channel through which firewood moves, from the source of production to the consumer.

## V. THE COSTS OF HARVESTING AND MARKETING FIREWOOD

Although cost analysis was not an objective of the present study, some general idea of the cost of harvesting and moving firewood to the consumer seemed necessary to evaluate the possibility of marketing firewood as a means of utilizing low-quality hardwoods. Table XIV presents some estimated cost figures on the harvesting and marketing of fireplace wood. Although these figures are very general it is believed that individual small-volume producers and retailers, such as appeared in this study, could not reduce costs much below these estimates.

A recent study suggested that a hauling cost of $4.25 to $4.50 per standard cord of miscellaneous hardwood pulpwood, for a 30 mile haul, was considered to be near minimum cost.[8] Baraclough and Pleasanton estimated hauling cost of mixed hardwood pulpwood, for a 10 mile haul over mostly graveled roads, to be $5.00 per standard cord; their cost estimates being based on use of a two-ton truck, while all of the retailers in

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[8]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. 223.

TABLE XIV

ESTIMATED AVERAGE COSTS OF HARVESTING AND MARKETING A FIREPLACE CORD OF FIREWOOD IN THE KNOXVILLE AREA FOR SEVERAL WAGE LEVELS[a]

| Costs | Hourly wage rate | | | |
|---|---|---|---|---|
| | $.50 | $.75 | $1.00 | $1.25 |
| Harvesting cost | | | | |
| Labor[b] | $2.75 | $4.13 | $5.50 | $6.88 |
| Other[c] | 1.25 | 1.25 | 1.25 | 1.25 |
| Total | $4.00 | $5.38 | $6.75 | $8.13 |
| Hauling cost | 2.50 | 2.50 | 2.50 | 2.50 |
| Total cost at retail establishment | 6.50 | 7.88 | 9.25 | 10.63 |
| Retailing cost[d] | 4.65 | 5.23 | 5.80 | 6.38 |
| TOTAL COST | $11.15 | $13.11 | $15.05 | $17.01 |

[a]Based on 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 Exp. Sta. in cooperation with Southern Forest Exp. Sta., U. S. Department of Agriculture, November, 1957); and retailer information from present study.

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

[c]Includes cost of power saw maintenance and fuel cost.

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

this study except 1 used a one-half ton truck, for which the cost of hauling per unit of wood would be expected to be greater.[9]

Since the average cost for a delivered cord of firewood, computed from the consumer study data was $10.16, it appears that even with a wage rate as low as $.50 per hour, cost of harvesting and transportation would not be covered.

However, if firewood were retailed by the truck load, the average value per cord would be $13.55, assuming that an average truck load of firewood is equal to three-fourths of the volume of a cord. This may be a partial explanation for the use of the truck load as a unit of measure by 5 of the 6 established retailers in the area.

Although the estimated cost figures in Table XIV are of a general nature, they do indicate that for the market as a whole the average price of firewood does not allow a positive stumpage value to be placed on firewood when it is marketed through an established retail outlet. Unlike highly processed products, firewood undergoes little change when it moves through retail establishments. Because of this, the cost of retailing firewood can be eliminated by direct delivery of the firewood from its source of production to the consumer. Given this direct movement of firewood from its source to the consumer, and hourly wage rates of $1.00 or less, woodland owners should generally be able to obtain a stumpage

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[9]Selon L. Baraclough and Alfred Pleasanton, Data For Planning Woodland Opportunities on West Tennessee Farms, Bulletin No. 276 (University of Tennessee Agricultural Exp. Sta. in cooperation with Southern Forest Exp. Sta., U.S.D.A., November, 1957), p. 20.

value sufficient to provide incentive to market low-quality hardwoods as firewood. This is believed to partially explain the appearance, in the consumer survey, of a high proportion of door-to-door firewood sales, and the inability of a major portion of the consumers to provide the name of the individual from whom they purchased their firewood.

# CHAPTER V

## SUMMARY AND CONCLUSIONS

Tennessee's timber resource as indicated in Table I, page 3, is characterized as having a relatively large amount of cull hardwood trees. The improvement of the productivity of this resource is a function of the removal or deadening of these cull trees in order to obtain maximum growth of desirable species compatible with the site on which they are growing. Forest management research has pointed out the necessity for the removal or deadening of these culls, and has led to the development of various methods of economically destroying cull trees. Nevertheless, these methods have failed to gain widespread acceptance among woodland owners. This failure is believed to be due to the lack of short-run monetary rewards accruing to the woodland owners. The lack of monetary incentives offered by destroying these cull trees through use of chemicals or girdling, has shifted the emphasis on forest improvement to a cull tree utilization approach. Marketing cull hardwoods is considered an important function in this approach.

The research in this thesis was designed to explore the possibilities of developing or expanding markets for fireplace wood, as a means of utilizing low-quality hardwoods. These possibilities were analyzed through the use of a consumer survey and retailer survey. Firewood consumption was analyzed through fireplace usage data, and consumer preference and consumption pattern data, obtained from 353 dwelling

units containing fireplaces, which were located in randomly selected residential blocks in Knoxville. Findings regarding firewood marketing were the result of a case study of 13 firewood retailers located in the marketing area. Market improvement and expansion possibilities were initially intended to be provided by a complete study of the retail market. The unsuccessful attempt to locate all of the retailers in the area made the retailer study useful only as a supplement to the consumer study.

The analysis of fireplace usage in residential dwelling units yielded 3 types of households: (1) those in which the fireplace was not used, (2) those in which only a firewood substitute was used in the fireplace, and (3) those in which roundwood firewood was used in the fireplace. These 3 groups made up 33.4 per cent, 13.0 per cent, and 53.6 per cent, respectively, of the total number of households interviewed. An analysis of the differences in the means of selected variables between these groups gave the following results: (1) the average income of firewood users was significantly greater than that of substitute users and nonusers; (2) the average age of dwelling for substitute users was significantly greater than the average age of dwelling for the total sample; (3) the average age of dwelling for firewood users was significantly less than that of both the substitute users and nonusers; (4) the average size of dwelling for firewood users was significantly greater than that of both the substitute users and nonusers, with the size being measured by number of bedrooms; (5) the average number of fireplaces per dwelling for firewood users was significantly greater than

that of the nonusers; and (6) the occupational distribution of firewood users was significantly different from that of substitute users and nonusers, with the firewood users being more heavily weighted by the professional, technical, managerial, and proprietary occupations.

An analysis of consumption revealed: (1) no significant difference in consumption for various income levels, number of fireplaces per dwelling, availability of firewood, or for various ranges of price paid for firewood; and (2) the average consumption for consumers paying $10 to $12 per delivered cord, which was the most frequently occuring range of price paid, was significantly greater than the average consumption of the sample.

The primary reason given, by 62.4 per cent of the consumers, for consumption of firewood was "just liked a fire in the fireplace." Consumers were found to prefer delivered cord size lots of firewood in 84.1 per cent of the cases. Preferences for degree of seasoning indicated that 48.7 per cent and 37.1 per cent of the consumers preferred seasoned and mixed seasoned-unseasoned firewood, respectively. Although 89.0 per cent of the consumers who indicated a preference for certain species preferred oak and hickory, 51.3 per cent of the consumers had no preference for any particular species of firewood. With regard to diameter preferences, 64.0 per cent of the consumers had no maximum diameter preference, while only 31.0 per cent indicated no minimum preference. The average values for the maximum and minimum preferences were 6.8 inches and 2.2 inches, respectively. The modal values corresponded closely with these values, being 7.0 inches for the maximum diameter

and 2.0 inches for the minimum diameter.

The use of substitute products among firewood users was small. Only 18 out of 189 firewood users had ever used a firewood substitute in their fireplace, and even then the product used was more of a supplement than a substitute. Several firewood users indicated that they sometimes burned coal and firewood together, while others indicated that they used electric logs, coal, or other products only when they could not obtain firewood.

In contrast with the 18 firewood users, who only occasionally used some other type of product in their fireplace, were the 46 substitute users who consumed no firewood whatsoever. Electric logs and coal were used by 71.7 per cent and 13.1 per cent of these households, respectively.

Consistent with the findings regarding consumers preferences concerning purchase quantities, actual patterns showed that 91.0 per cent of the consumers had purchased delivered cord size lots of firewood. Purchases by the cord accounted for 86.5 per cent, purchases by the rick accounted for 10.1 per cent, and purchases by the truck load accounted for 3.4 per cent of the delivered purchases. Although, according to information obtained in the retailer survey, the average truck load of firewood is approximately equal to three-fourths of a cord or rick of firewood, no significant differences were found in the average prices of these 3 units of measure. The average prices for delivered firewood by the cord, the rick, and the truck load, were $10.18, $10.50, and $11.67, respectively. Although the data indicated

a high degree of seasonality of consumption and purchasing, no significant difference in prices were found to exist for the 4 quarters of the calender year.

A view of the over-all nature of the firewood retailing market was provided by the consumer interviews. Purchases were made by 51.9 per cent of the consumers from only 1 dealer, and 12.0 per cent of the consumers had made purchases from 3 or more dealers. The flow of information concerning the whereabouts of firewood for consumer purchase was predominantly informal. Only 9.6 per cent of initial consumer-retailer contact was the result of formal types of advertising. Initial retailer contact due to door-to-door peddling and "word-of-mouth" was indicated by 55.3 per cent and 20.2 per cent, respectively, of the consumers. Although 87.9 per cent of the consumers found no difficulty obtaining the quantities of firewood they desired, nearly 1 out of every 5 consumers found it difficult to purchase firewood when it was wanted.

The retailers contacted were classified as farmer retailers, part-time retailers, and established retailers, with these groups having 3 retailers, 4 retailers, and 6 retailers, respectively. Retailing firewood was the sole source of income for only 1 retailer and the major source of income for the 3 largest established retailers.

Analysis of the supply sources of firewood showed that 63.6 per cent, 18.9 per cent, and 17.5 per cent of the firewood acquired by retailers, came from within Knoxville, from Knox County, and the immediately surrounding counties, respectively. Building contractors supplied 50.9 per cent of the firewood; 13.2 per cent of the firewood

came from urban homeowners; and only 29.8 per cent of the firewood came from commercial woodland.

Retailer-supplier agreements were strictly informal, although 40.8 per cent of the volume of firewood acquired by retailers was through verbal agreements. Retailers acquired 26.4 per cent of the total volume of firewood supplied, at the cost of cutting and removing the firewood. Of the firewood for which the retailers paid a price, 91.1 per cent was purchased on the stump at an average price of $1.05 per fireplace cord. Only 8.2 per cent of the volume acquired by retailers was purchased at the retail outlet. This firewood, cut and split, commanded an average price of $8.00 per fireplace cord. Price setting was done by the suppliers in 4 out of the 6 cases where a price was paid by retailers.

A review of the functions performed by the retailers showed that 93.2 per cent of the firewood obtained by established retailers was transported from the source of supply to the retail establishment. Farmer retailers and part-time retailers delivered firewood directly from its source to the consumer. Retailers harvested 93.6 per cent of the total volume acquired, and cut to length and split 94.2 per cent of the total volume. Delivered firewood accounted for 83.2 per cent of the volume marketed to consumers, and 85.4 per cent of this was stacked for consumers. The costs of delivering and stacking were considered part of the quoted retail price.

Analysis of the movement of the firewood product between the retailer and the consumer showed that retailer-consumer relationships were highly stable. A breakdown of type of sales indicated that 8.7 per

cent of the volume marketed was due to sales of a casual nature, 52.4 per cent was due to sales to previous customers, and 38.9 per cent was due to prior arrangements by the consumers. Firewood retailing was found to be seasonal in nature, with all sales taking place from October through March, and 57.5 per cent of these sales being made from October through December. A noticable difference in the unit of measure, applied to delivered firewood, appeared between the consumer and retailer data. Delivered firewood marketed by the cord accounted for only 1.4 per cent of the volume marketed by established retailers, whereas 86.5 per cent of the consumers indicated that their purchases had been based on the cord measure. Price data for delivered firewood showed little difference in the average price charged for a cord, a rick, or a truck load of firewood, even though retailers marketing firewood by the truck load revealed that the average truck load of firewood was approximately equal to three-fourths of a fireplace cord, or rick. Price setting by 4 retailers was classified as a "cost plus" procedure, while 7 retailers indicated that the existing market price was the criterion for price setting.

In general, the evaluation of the retailing market for firewood by the retailers was favorable. Market expansion possibilities were seen as "very good" by 6 retailers, as "good" by 5 retailers, and as "poor" by only 1 retailer. Only 1 retailer indicated that his present market was decreasing and none of the retailers thought that competition was a significant factor in their present operation. Retailers indicated that their major problem was obtaining an adequate supply of firewood to

satisfy their customers, followed by the problem of obtaining labor at a price which would allow a normal return on their investment in the firewood marketing enterprise.

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, would be expected to increase with an increase in real income of consumers, and with a decrease in the average age of dwelling. 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. It is also believed that as the educational level of consumers increases and the proportion of consumers in the professional, technical, and managerial occupations increase, the demand for firewood will also increase. Per capita consumption, on the other hand, 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 per capita consumption, promotional efforts in increasing the demand for firewood should be oriented 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 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 wood be seasoned, the demand for wood of a mixed degree of seasoning would probably be sufficient to warrant producers and retailers to make available this characteristic in the firewood product. Species preferences are believed to be a reflection of past emphasis on the heating ability of wood, and as such are expected to decline in importance in the future, being replaced by more emphasis on the soundness and physical appearance of the firewood. It would generally be expected that in areas where storage space is available, cord size delivered units of firewood would provide the largest outlet for this product. It appears that there is no real substitute for firewood and that changes in price, at least within certain limits, will have little affect on the consumption of firewood.

This study points toward an increase in the demand for firewood in the future, given a favorable rate of economic growth and barring any serious national economic disasters. This demand can be stimulated by providing the consumer with a source of firewood and a product which embodies the characteristics desired by the consumer. The opportunities seem to be particularly favorable to woodland owners living close to the urban and suburban residential areas of larger cities.

Specific conclusions. The firewood market in the Knoxville area,

as it appears from the data collected in the present study, can be characterized as a predominantly door-to-door sales market, with little competition among retailers for a larger share of the existing demand. Although the case study of the retailers showed that 26.4 per cent of the firewood acquired by retailers was "free wood," and that only 29.8 per cent of the firewood supplied came from commercial woodland, these data are not believed to be reliable indicators of the effect of firewood marketing on the utilization of low-quality hardwoods from commercial woodland. Because none of the retailers interviewed peddled firewood on a door-to-door basis, the case study of retailers was considered to be invalid when making inferences concerning the total market. The presence of a high proportion of door-to-door sales 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 increased demand for firewood. Although a large proportion of the volume of 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 makes it impossible to analyze the effect of firewood from these sources on the supply of firewood coming from commercial woodland. However, the consumer survey in this study

suggests that the magnitude of this effect is less than was indicated by the case study of retailers.

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 15.9 per cent 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 marketing through established retail outlets. The inability of the established retailers to pay woodland owners an adequate stumpage price, coupled with the limited availability of "free wood," is believed to partially explain why all of the established retailers mentioned acquisition of an adequate supply of firewood as their major retailing problem.

On the other hand, it appears that woodland owners should generally 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, provided the firewood is moved directly from its source to the consumer. Because of this contrast in costs between types of retailers, it is expected that farmer retailers and part-time retailers will dominate the market in the Knoxville area, and that until such time that the market price will cover the high costs of retailing firewood from established outlets, these outlets will show little, if any, expansion.

The ultimate goal of marketing low-quality hardwoods is the im-

provement of the forest resource. Therefore any attempt to improve forest stands must be accompanied by a knowledge of the value of timber stand improvement measures by woodland owners. Until a large proportion of woodland owners realize that historically established stumpage values do not always reflect the real stumpage value of low-quality hardwoods, it is not likely that the opportunities for the utilization of cull wood will be recognized. It is therefore strongly recommended that increased efforts on educational activities, directed toward teaching woodland owners the real value of their forest resources, be taken by all agencies, the objective or function of which is forest resource improvement.

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