A Conjoint Analysis of Paper Demand by Commercial Graphic Designers

J. McDermott, J.R. Bacon, J. Pesek, C.M. Gempesaw II, and H.D. Tilmon

Conjoint analysis was used to evaluate the preferences of graphic designers toward kenaf paper. Results indicate that price is of overwhelming importance to designers in their purchasing decisions regarding paper stock. If priced competitively with existing wood and recycled papers, kenaf products should gain market share among designers.

Kenaf, a substitute for wood fiber, is a tropical annual that can grow 12 to 18 feet high in 4 to 5 months (Webber). Research on the commercialization of this crop for paper production has been conducted by the Technical Association of the Pulp and Paper Industry (TAPPI), the American Forest and Paper Association, and Kenaf International, and all found kenaf to be extremely well-suited to paper manufacture (Young, Touzinsky et al. 1980[a] and 1980[b]; Kaldor and Fuwape). Kenaf is also relatively easy to cultivate, thriving on sandy soils with a minimum of care and requiring irrigation only in the arid climes of the desert southwest. Highly resistant to many pests that can negatively impact crops such as corn and soybeans, kenaf has been sponsored by the USDA as a readily renewable source of agricultural fiber for paper manufacture that could provide American farmers with additional income.

However, the paper industry has been reluctant to commit itself to the large-scale production of kenaf paper, due to uncertainty regarding the reliability of supplies of kenaf fiber. The industry may also be concerned that pricing issues and unfamiliarity with kenaf may make consumers reluctant to purchase kenaf paper. Studies by Taylor and Zhang and Dicks have expanded upon the technical aspects of utilizing kenaf in paper manufacture, by examining the production issues relative to its commercial development. Both found that kenaf could be a viable alternative under forward contract pricing, which would alleviate supply issues by guaranteeing a certain sale price to farmers willing to invest in kenaf production. However, these studies failed to address the important role which consumer demand plays in the development of new products. Knowledge of consumer preferences can be crucial in identifying products that will capture the highest market share among consumers, substantially lessening the risk manufacturer's face when introducing a new product. As kenaf is an unproved commercial commodity, potential producers must be assured that sufficient market demand exists for kenaf paper before they will invest the time and resources necessary for the successful commercialization of this alternative fiber crop. This study hopes to address this issue by utilizing conjoint analysis to evaluate the market potential for kenaf paper in terms of the overall preferences of graphic designers for such a product.

Procedures

This study utilized conjoint analysis to evaluate the preferences of graphic designers towards paper manufactured from farm-raised kenaf, as opposed to more conventional wood and recycled pulp blends, based on their assessment of various paper profiles specified in terms of underlying characteristics. In consultation with graphic designers and paper industry experts the attributes and attribute levels selected for this study were chosen to reflect the grades, finishes, and colors which graphic designers commonly use in design projects. Content levels were selected to approximate the pulp blends currently available, as well as potential fiber competitors to kenaf.

The six attributes selected for evaluation were finish, color, grade, 25% content and 75% content,

J. McDermott, J.R. Bacon, J. Pesek, C.M. Gempesaw II, and H.D. Tilmon are respectively, former graduate research assistant, associate scientist, associate scientist, professor, and cooperative extension specialist, in the Department of Food and Resource Economics at the University of Delaware.

with each attribute being divided into four levels (table 1). Price was also included as an attribute, and was divided into six levels. Dollar prices were not specified for several reasons. First, there is a wide variation in paper prices due to differences in content, finish, color, and weight. This price variation is augmented by the practice of discounting commercial paper purchases, as a reward to customers who submit bulk orders. Finally, the paper market is one in which fluctuations in the supply of raw (wood chips) and processed materials (recycled pulps) can result in significant price volatility (Null, Triplett). In order to obtain an approximate measure of the effect of price on preference, price levels were specified in terms of being below, equal to or above the price of wood pulp paper. An extreme of 100% above the price of wood pulp paper was included to reflect the current price of kenaf paper.

The total number of profiles which could be obtained from combining the above attribute levels was 5,120. The smallest fractional design using orthogonal arrays capable of estimating the attributes was used, narrowing the number of potential profiles to 49 combinations. As these were still considered too numerous for one respondent to evaluate, an incomplete block design was incorporated which allowed the profiles to be split into seven blocks. One advantage of the design process is that orthogonality guarantees that the attributes are uncorrelated and hence that multicollinearity is not a problem (Greene). The concept of blocks may be more familiar as stratified sampling (Cochran 1977). In stratified sampling different strata are sampled in the hope that they are less variable than the population as a whole. In the context of experimental design experiments are blocked into areas of uniformity to reduce variation (Cochran and Cox 1957). In this context blocks are part of the model but are used to reduce variation and not to make predictions. Incomplete block designs are used to run experiments where all treatment combinations cannot be run in a single uniform block (for this context a survey respondent). For more on incomplete block designs see (Cochran and Cox 1957).

Table 1. Paper Attributes and Levels

Attribute	Level
Finish	Felt
	Laid
	Vellum
	Smooth
Color	Unbleached
	White
	Neutral
	Colored
Grade	24# Writing stock
	65# Cover stock
	80# Cover stock
	110# Cover stock
25% Content	Cotton
	Hemp
	Recycled
	Kenaf
75% Content	Wood
	Recycled
	Hemp
	Kenaf
Price (compared to wood pulp paper)	25% Below
	Equal
	25% Above
	50% Above
	75% Above
	100% Above

In conjoint studies it is common to include a "holdout" profile in each block. This profile is the same for every block. The rating from the holdout profile is not used in estimating the model but is instead reserved for prediction to see how well the data fits the model. In this study each block contained a common holdout profile and seven of the 49 product profiles generated by the experimental design. Survey participants were then split into seven groups at random, with each group evaluating a single block of eight profiles, including the holdout profile. The holdout profile was described as being an unbleached, 100% kenaf 24lb writing stock, in a vellum finish available at a price 100% above that of wood pulp paper, and was similar to the paper used in printing the questionnaire. Respondents were instructed to use a rating scale from "0" to "10" in evaluating each paper profile, where 0 was the least preferred combination of attributes and 10 was the most preferred combination of attributes. Overall preference, R, was then specified as a function of the paper attributes included in this study.

$$R = f(\text{Blocks, Finish, Color, Grade, 25\% Content, 75\% Content, Price})$$

For all attributes except price, effects coding of the dummy variables was used. Although not traditionally used in econometric modeling, it is the standard in conjoint analysis (Gempesaw et al.). In the conventional econometric approach all dummy variables represent shifts from a base level of the quantitative attribute being studied and in effects coding the dummy variables represent shifts from the average level of the attributes and the sum of all the effects of an attribute is zero. For instance for color the values of the dummy variables are given in table 2. If the values 1, 0 and 0 respectively are chosen for these variables, the effect of

Table 2. Effects Coding for the Color Attribute

	$\beta_{neutral}$	β_{white}	β_{color}
Neutral	1	0	0
White	0	1	0
Colored	0	0	1
Unbleached	−1	−1	−1

neutral is obtained. If the values −1, −1 and −1 are chosen the effect of unbleached is obtained as the negative sum of the others. Some advantages of effects coding are not placing any level of an attribute in a preferential role and the ease of calculating relative importance.

Since price was a categorical variable representing a continuous variable in terms of percent, numerical values that approximated these levels were used in estimation. The level equal to wood pulp paper prices was specified as 1, with the remaining levels being calculated by subtracting or adding the appropriate percentage value. A cubic functional form was chosen for this attribute.

The analysis chosen for this study is the two limit tobit model (Anderson and Bettencourt; McMillen and McDonald). Since the rating values obtained by this study were essentially limited dependent variables, censored at zero and ten, estimation of overall preferences using Ordinary Least Squares was deemed inappropriate as OLS is unable to correct for the effect of censoring (Tobin). The ordered logit model approach as used in (Bacon et al.) was also considered but was dropped when the proportional-odds assumption was rejected.

This study utilized a discrete rating scale to obtain information on the overall preference of graphic designers for various paper profiles. However, there is a concern over certain scaling issues that arise in the use of this technique. While it may be possible to state with certainty that the distance between 1 and 2 is the same as that between 5 and 6 for a particular respondent rating a single profile, it is impossible to determine whether these distances are consistent across the sampled population due to differences in individual perceptions (Alwin). Additionally, distances between ratings values may change across profiles for individual respondents due to the learning curve. The tobit model remains vulnerable to these scaling issues, as it was designed to accommodate censoring in dependent variables which are continuously distributed. To accommodate the model, the values of the ratings were converted to z-scores prior to estimation according to the following formula:

$$Z_{ji} = (r_{ji} - \mu_i)/\sigma_i,$$

where j indicates product profile j, i refers to the i-th respondent: Z_{ji} is the z-score for the product profile j and the i-th respondent; r_{ji} is the rating for profile j and the i-th respondent; μ_i is the respondent mean rating; and σ_i is the standard deviation of the ratings of the profiles evaluated by the i-th respondent (holdout profile not included). The z-scores were regarded as continuous variables bounded from −3 to +3, meeting the conditions for estimation by the tobit model. However, to preserve the positive nature of the original scale, three was added to the scores, making the new limits zero and six.

Due to these constraints, a double tobit model was specified to estimate overall preference:

$$y_{ji}^* = \beta_0 + \Sigma\, \beta_k\, x_k + \varepsilon_{ji},\ \varepsilon_{ji} \sim N[0, \sigma^2].$$

where y_{ji}^* is the latent preference for the j-th profile of the i-th respondent, β_k is the coefficient for χ_k, and ε_{ji} a normally distributed error term. In the tobit model the connection between the latent preference y_{ji}^* and y_{ji} the z-score of the observed rating is given by:

$$\text{if } y_{ji}^* \leq 0, \text{ then } y_{ji} = 0, \text{ (lower tail censoring)}$$

$$\text{if } y_{ji}^* \geq 6, \text{ then } y_{ji} = 6, \text{ (upper tail censoring)}$$

$$\text{if } 0 < y_{ji}^* < 6, \text{ then } y_{ji} = y_{ji}^* = \beta_0 + \Sigma\beta_k\, x_k + \varepsilon_{ji}$$

The purpose of the model is to predict the latent variable, y_{ji}^*, which is a measure of the true level of consumer preference. In a tobit model these predictions may fall beyond the limits of 0 and 6 since unlike the observed variable the latent variable is not limited.

Data

The data for this study were collected from a survey on tree-free paper that was mailed to commercial graphic designers and graphic designers at various educational institutions nationwide. The mailing list was compiled from two separate listings. The first list comprised 3,000 commercial graphic designers from thirteen states in the Northeast and Mid-Atlantic region. These names were purchased from a firm whose business is centered around providing representative mailing lists to their clients (Hugo Dunhill Mailing List, Inc.). The 873 graphic designers from educational institutions nationwide came from an internal database maintained by the University of Delaware.

The tree-free paper survey consisted of several

sections, the first of which assessed the impact of environmental concerns upon the respondents in their business decisions. Separate sections asked respondents to provide information regarding the size of their business in terms of sales, clientele and paper usage. Respondents evaluated several different paper profiles based on weight, cost, finish and grade; providing information on the potential use of kenaf paper in several different design applications. Finally, participants assessed the general interest level of various client groups regarding kenaf paper.

Respondents were first sent a cover letter that introduced the survey and invited them to participate. A sample of kenaf card stock was included with the introductory letter to familiarize participants with kenaf. A four-page questionnaire printed on kenaf writing stock was mailed within two weeks, containing a postage paid reply envelope and a letter promising confidentiality. After two weeks, a reminder postcard was prepared and sent out, asking respondents to complete and return the survey. The postcard was followed by a second mailing of the survey two weeks later. Of the 3,873 surveys sent out, 237 were returned as undeliverable, reducing the sample population to 3,636 commercial graphic designers. Of these, 1,214 usable surveys were returned for a 33.4% percent response rate.

Results

The purpose of this study was to obtain information regarding the preferences of commercial graphic designers for tree-free paper, especially that manufactured using kenaf bast fiber. This section contains a discussion of the tobit model results including model validation, the relative attribute importance, individual attribute preference ratings, and product simulations.

Validation of Tobit Model

A White test performed on the model indicated that heteroscedasticity was present in the data. To correct for this, a weighted tobit was estimated in which the price values were adjusted by the reciprocal value of the residual variances grouped by price. Support for the validity of the model is given by the omnibus chi-square test χ^2 (24 d. f.) = 49358, $p < 0.0001$ rejecting the hypothesis that the model as a whole is a constant. Further support for the validity of the model is given by comparing the average z-scores of the holdout profile (which was not used to estimate the model) to that predicted by the model. In table 3 where the mean and predicted z-scores are given, the agreement is quite good. Predictions are made for each block as well as averaging over blocks. Also the estimated functional form for price is monotone decreasing. Thus there is considerable support for the validity of the model.

Attribute Relative Importance

For the qualitative attributes the relative importance of each attribute was obtained by dividing the range of the attribute by the sum of all the attribute ranges. Since price was specified as a continuous variable within the model, it was necessary to multiply the estimated coefficients for price, price squared and price cubed by the corresponding numerical value for each price level. These values were then summed to obtain values for each specified price level. The relative importance of price was then calculated in the manner outlined above.

According to the results, price was found to be the most important attribute by an overwhelming margin (table 4). Although it was expected that price would play a significant role in a designers choice of paper, the relative importance of 80.71% implies that it is the deciding factor in determining paper recommendations and purchases. An explanation may be that designers are keenly aware of the wide variation in price among different papers, the price volatility of the paper market and the effect that changes in price may have on design and printing costs. In order to remain competitive, graphic designers must be keenly aware of both paper and printing costs, especially when preparing project bids. Since most clients have limited budgets, designers must be prepared to alter their paper recommendations as prices change to keep design and printing costs manageable.

Color (6.38%) was next in importance to the designers surveyed, followed by 75% content (3.93%) and finish (3.79%). The paper grade and

Table 3. Comparing Average z-Score to Predicted for the Holdout Profile

	Average z-score	Predicted z-score
Block 1	2.044	1.999
Block 2	1.901	1.981
Block 3	2.119	2.010
Block 4	1.997	1.991
Block 5	1.964	1.985
Block 6	2.046	1.998
Block 7	1.882	1.977
Overall	1.996	1.992

Table 4. Relative Importance of Paper Attributes

Attribute	Relative Importance (%)
Color	6.38
Grade	2.87
Finish	3.79
75% Content	3.93
25% Content	2.31
Price	80.71
Total	100.00

25% content were the least important attributes with a relative importance of 2.87% and 2.31%, respectively. Varying the color, grade and finish of paper utilized in a design project can aide designers in attracting the eye and holding the attention of consumers by creating textural and visual interest. This is especially important in advertising and marketing, where it becomes especially important to raise the interest level of consumers in new or existing products. However, the relatively low importance assigned to these attributes is an indication that there are ample substitutes for any type of paper designers may choose for a client's project, due to the variety of grades, colors, pulp blends and finishes now available. This position is reinforced by the high relative importance assigned to price by the designers surveyed, a strong indication that paper choice in the graphic design market is dominated by pricing constraints.

Attribute Preference Ratings

Coefficients from the effects coded data used in the tobit model represent deviations from the mean paper product. The mean product rating is represented by the intercept plus the price level equal to that of wood pulp paper (table 5). This gave the mean product profile a mean rating of 3.553 on a scale of zero to six.

In terms of color, designers rated all the attribute levels as being significantly different from the mean paper product. The negative coefficients for the neutral and unbleached attribute levels imply that designers view these natural shades in a less than favorable light. Designers may feel that these colors allow the consumer to see the underlying texture of the paper pulp too clearly and therefore may distract from the intended visual image sought by the client. Coefficients for both colored and white were positive, indicating that designers prefer papers which contain these more traditional attribute levels. Many designers may see colored stock as a means to give added punch to advertising projects, especially those involving the use of flyers or inserts, where creating visual interest becomes an important technique in attracting consumers. Colors also allow designers to utilize lower quality papers, as the dyes used aide in covering specks and other finish flaws which may cause an unbleached or neutral stock to appear dirty, negatively affecting the overall appearance of the design project. However, results indicate that designers strongly rate white over the other attribute levels in this category. White paper has a crisp, clean quality which provides design projects

Table 5. Tobit Coefficients for the Estimated Model

Attribute Level	Coefficient
Intercept	1.392****
Blocks	
Block1	0.007
Block2	−0.010
Block3	0.018*
Block4	−0.001
Block5	−0.006
Block6	0.006
Block7	−0.015
Color	
Neutral	−0.044****
White	0.074****
Colored	0.034****
Unbleached	−0.064****
Stock	
65# Cover	0.024**
80# Cover	−0.000
110# Cover	−0.038****
24# Writing	0.014*
75% Content	
75% Wood	−0.020***
75% Recycled	0.046****
75% Hemp	0.013
75% Kenaf	−0.039****
25% Content	
25% Cotton	0.030****
25% Recycled	−0.002
25% Hemp	−0.008
25% Kenaf	−0.020***
Finish	
Smooth	0.050****
Felt	−0.032****
Laid	−0.015*
Vellum	−0.003
Price Level	
Price	8.248****
$Price^2$	−8.229****
$Price^3$	2.142****
Normal Scale Parameter	0.572

Notes:
Omnibus Test χ^2 (24 d.f.) = 49358 $p < 0.0001$.
*Significant at the .05 level or better.
**Significant at the .01 level or better.
***Significant at the .001 level or better.
****Significant at the .0001 level or better.

with a more finished, professional look. These qualities are highly valued in preparing important business documents, such as corporate and stockholder reports, where white paper can augment the professional image of a client while allowing designers to showcase graphics and fonts which can enhance the message clients wish to convey. The advent of color printing may also have contributed to the strong preference given to white, as designers may feel that the resulting contrasts may enhance visual interest, causing their designs to have a greater impact on clients and consumers.

A smooth finish increased the mean rating where as all the other paper finishes reduced the rating. This may be due to technical concerns, as smooth papers may be more suitable for use in high-speed presses and laser printers used in commercial printing. However, designers may also feel that the textural qualities of smooth finishes allow them to design for a greater variety of clientele and business applications. Vellum, felt and laid finished papers may be seen as specialty products, with limited appeal and design applications in advertising and business projects.

In terms of grade, designers rated the 110# cover stock as significantly reducing the mean paper product rating. The negative coefficient of this attribute level may be an indication that this grade may have limited application in graphic design due to its high weight. Heavier grades are utilized by designers for cover applications, and survey respondents may feel that with the price differential between this grade and the others included in the study it may be more economical to substitute a lighter weight paper. Designers may feel that there are simply not many applications that would justify the expense of using a cover stock of this weight. The positive and significant coefficient for the lighter 65# cover stock and 24# writing paper supports this view.

Of the 25% content level evaluated by the respondents, only the cotton level was judged to significantly increase the mean paper product rating. Cotton adds quality to any paper product even at low content levels, making it a desirable paper ingredient. However, of the 75% content levels only the recycled level was rated as significantly increasing the mean paper product rating. That they prefer a 75% recycled content, indicates that designers are keenly aware of the positive message which recycling conveys to consumers. Using recycled stock allows designers to promote their clients as being environmentally responsible, which may enable their clients to increase market share for their products among consumers. Both the 75% and the 25% kenaf contents resulted in lowering the mean paper product rating. Samples of kenaf card stock supplied to each survey participant and the kenaf paper upon which the survey was printed was the only paper available at the time and was not of the highest quality relative to traditional papers on the market. For most participants, this was their first exposure to kenaf paper and the results indicate that they were less than impressed. Results of this study support the need for technical refinements to be developed that will allow higher quality paper to be produced from kenaf. This is a must if kenaf is to become a competitive force in the market place.

Product Simulations

Predicted ratings were calculated from the tobit estimates by summing selected attribute level coefficients from the attributes contained in the model with the intercept. The worst case scenario received a rating of 1.91 and consisted of 100% kenaf paper in a felt finish. The paper was available as an unbleached, 110# cover stock at a price 100% above that of wood pulp paper. Designers are clearly unwilling to consider purchasing kenaf paper at a price double that of wood pulp blends currently on the market. This supports the position that price is the overwhelming factor considered by respondents in the selection of paper for design projects. Although designers may recognize the value of promoting an environmentally friendly image for their clients, these results indicate that pricing constraints may prevent designers from utilizing kenaf paper. The low rating assigned to this product may also be attributed to the study participants' unfamiliarity with kenaf, the relative lower quality of the samples provided, and a concern over investing in a product that has not been tested in commercial design applications. Also, designers may be recalling the poor quality and high prices associated with the first recycled papers available on the market. An expectation of poor quality could compound the pricing issue for kenaf paper by increasing their unwillingness to consider kenaf paper as a viable alternative to recycled and wood pulp papers.

The ideal product received a rating of 4.03, and consisted of a colored, 75% recycled, 25% cotton blended paper, 65# cover stock, in a smooth finish at a price 25% below that of wood pulp paper. Once again, the low price level appears to be the driving force behind the rating given to this profile by the designers surveyed. This profile also indicates that designers would prefer an environmentally friendly paper manufactured using the more familiar 75% recycled, 25% cotton fiber. This may

be an indication that designers are conscious of the positive message conveyed by recycled paper, and wish to capitalize on this perception from a marketing standpoint by continuing to use high recycled content.

However, due to pricing and production constraints, the ideal product may not be reproducible in reality. As a result, paper manufacturers must closely examine consumer tradeoffs to obtain information that will enable them to develop products that will satisfy market demand. In terms of this study, it is clear that graphic designers are unwilling to purchase a 100% kenaf paper at a price double that of wood pulp paper. However, by examining the preference coefficients, paper manufacturers may be able develop alternative products which will receive increased ratings. For example, lowering the price of the worst rated paper profile to 25% above the price of wood pulp paper would raise overall preferences by 1.74 points to a 3.65 rating. However, changing the content of the ideal paper profile to a 75% recycled/25% kenaf blend would result in a ratings drop of only 0.10 on the zero to six scale, keeping all other attributes constant.

The results of this study indicate that while changing the content, finish, grade or color may result in a slight increase in preference ratings for paper products among graphic designers, the key to successfully marketing a kenaf or any other natural fiber blend paper lay in lowering the price. Manufacturers must lower production and input costs sufficiently to price kenaf paper at levels comparable to that of wood pulp and recycled stock if they hope to gain market share among graphic designers.

Summary and Conclusions

This study examined preferences for kenaf paper with the goal of obtaining information as to the potential market demand for kenaf among graphic designers. To obtain this information, a conjoint study was undertaken to evaluate the preferences of graphic designers for various paper products. Results indicate that price is of major concern to the graphic designers who participated in the survey. Producers who wish to manufacture kenaf paper should keep in mind that the environmental appeal of kenaf is limited primarily by its price relative to that of hemp and recycled papers. Introducing a kenaf based paper at more than 25% above wood pulp paper prices will result in lower demand by commercial graphic designers.

Blending kenaf with at least 75% recycled pulp would increase support among graphic designers for kenaf paper, most likely due to their familiarity with existing recycled papers. Such a blend would allow manufacturers to reassure designers concerning the finish and quality of kenaf paper, which may pave the way for later introductions of 100% kenaf stock. Graphic designers also prefer that manufacturers produce kenaf paper in a 65# cover stock in addition to a 24# writing paper. These results indicate that kenaf could fill a niche for environmentally friendly products in the graphic design market, provided kenaf paper is priced competitively with existing wood and recycled stock.

References

Alwin, D.F. 1997. "Feeling Thermometers Versus 7-Point Scales." *Sociological Methods and Research* 25, 3:318–340.

Anderson, J.L., and S.U. Bettencourt. 1993. "A Conjoint Approach to Model Product Preferences: The New England Market for Fresh and Frozen Salmon." *Marine Resource Economics* 8:31–49.

Ayres, E. 1993. "Making Paper Without Trees." *World Watch* 6, 5:5–8.

Bacon, J.R., C.M. Gempesaw II, K. Michel, M.R. Jenkins, and J.A. Hankins. 1998. "Producer Acceptance of Alternative Extension Services in the Appalachian Region." *Journal of Applied Aquaculture* 8, 1:1–18.

Cochran, W.G. 1977. *Sampling Techniques* 3rd Ed. John Wiley & Sons, New York, NY.

Cochran, W.G., and G.M. Cox. 1957. *Experimental Designs,* 2nd Ed. John Wiley & Sons, New York, NY.

Fuwape, J.A. 1993. "Paper from Kenaf Fiber." *Bioresource Technology* 43:113–115.

Gempesaw II, C.M., J.R. Bacon, M.R. Jenkins, and J.A. Hankins. 1995. *Freshwater Aquaculture in Appalachia: Infrastructure Development for an Emerging Industry.* The Conservation Fund's Freshwater Institute, Sheperdstown, WV.

Greene, W.H. 1997. *Econometric Analysis.* Prentice Hall, Upper Saddle River, NJ.

Hugo Dunhill Mailing Lists, Inc. *The 1996 Mailing List Catalog.* 630 3rd Ave., New York, NY 10017-6705.

Kaldor, A.F. 1989. "Preparation of Kenaf Bark and Core Fibers for Pulping by the Ankal Method." *Tappi Journal* 72, 9: 137–140.

Lewis, R.C., S. Ding, and U. Geschke. 1991. "Using Trade-Off Analysis to Measure Consumers Choices: The Full Profile Method." *Hospitality Research Journal* 15, 1:75–92.

McMillen, D.P., and J.F. McDonald. 1990. "A Two-Limit Tobit Model of Suburban Land-Use Zoning." *Land Economics* 66:272–282.

Maddala, G.S. 1983. *Limited Dependent and Qualitative Variables in Econometrics.* Cambridge University Press, Cambridge.

Null, D. 1996. "Risks of Recycled Fiber Projects make Virgin Fiber more Attractive." *Pulp & Paper* 70, 7:115–119.

Pulp & Paper. 1993. "U.S. Printing and Writing Papers Demand to Grow Substantially in Next Decade." 67, 1:95–98.

Taylor, C.S. 1984. *A Systems Approach to the Commercialization of Kenaf.* Ph.D. Dissertation, University of Missouri, Columbia, MO. 202 pp.

Tobin, J. 1958. "Estimation of Relationships for Limited Dependent Variables." *Econometrica* 26:24–36.

Touzinsky, G.F., R.L. Cunningham, and M.O. Bagby. 1980a. "Papermaking Properties of Kenaf Thermochemical Pulp." *Tappi* 63, 1:53–55.

_____. 1980b. "Laboratory Paper Machine Runs with Kenaf Thermochemical Pulp." *Tappi* 63, 3:109–110.

Triplett, T. 1994. "Economics Meets Ecology as Recycled Paper Matures." *Marketing News* 28, 5:2.

Young, J. 1987. "Kenaf Newsprint is a Proven Commodity." *Tappi Journal* 70, 11:81–83.

Webber, C.L. 1996. "Introduction to Kenaf." Pamphlet prepared by the International Kenaf Association, Ladonia, Texas.

Zhang, J., and M.R. Dicks. 1994. *An Economic Evaluation of U.S. Kenaf Markets.* Oklahoma Agricultural Experiment Station, Division of Agricultural Sciences and Natural Resources, Oklahoma State University, Stillwater, OK. 37 pp.