Positioning Cotton in the Market for Quality: An Application of Market Segmentation for West Texas

Sangnyeol Jung
Department of Agricultural and Applied Economics
Texas Tech University
Box 42132
Lubbock, TX 79409-2132
Tel.:806-742-0277 x229
Email: sang.jung@ttu.edu

Conrad P. Lyford
Department of Agricultural and Applied Economics
Texas Tech University
Box 42132
Lubbock, TX 79409-2132
Tel.:806-742-1921 x236
Email: conrad.lyford@ttu.edu

Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting in Mobile, Alabama, February 5, 2007

Positioning Cotton in the Market for Quality: An Application of Market Segmentation for West Texas

Sangnyeol Jung and Conrad P. Lyford

ABSTRACT

This study provides guidance for cotton marketing efforts by determining major market segments with quality thresholds for West Texas. Given its present quality performance, great potential segments are from higher-end international segments with significant value-added. Moreover, the potential to serve these market segments is growing with improvements in production technology.

Keywords: cotton economics, market segmentation, needs assessment, West Texas cotton

JEL: Q130, M310

Positioning Cotton in the Market for Quality: An Application of Market Segmentation for West Texas

Introduction

As the U.S. textile industry has declined, the market for U.S. cotton is shifting from domestic to export markets. Currently two-thirds of production is exported, a substantial increase from historically exporting about forty percent (ERS, USDA). Hence, West Texas as well as the U.S. is increasingly dependent on export markets. Further, foreign textile manufacturers' fiber quality requirements are more stringent, as compared to domestic demand (Estur, 2004). In West Texas, this issue takes on an even greater significance because this region's cotton was heavily used in the domestic coarse-count market for the past two decades (FAS, USDA). An important question for many West Texas producers is how to better position their products to achieve greater success in this new environment.

This issue of positioning takes on even more importance due to the relevance of a production region's reputation. Previous research, e.g. Bowman and Ethridge (1992), Chen, Ethridge, and Fletcher (1997), Lyford, Jung, and Ethridge (2004), found ongoing regional price effects where different regions receive returns based to some extent upon reputation.

West Texas cotton has established a reputation of being "coarse count" cotton, suitable primarily for bottom-weight textiles such as denim. This limits its marketability toward high-valued market segments, even for the portion of its higher-quality production. Thus, one issue is how West Texas can improve its reputation and marketability. Considering the international market's relatively more stringent quality requirements, this issue takes on more importance.

Recently, some prospective cotton growers in South Texas have recognized the importance of quality and that managing their cotton quality to make premiums is a top priority (*Cotton Farming*, Jan. 2005). However, there is no clear understanding about which fiber

characteristics (or sets of characteristics) should be given priority to improve marketability and increase returns.

In response to the ongoing interest on the quality enhancement issue, this study provides information to guide marketing efforts through quality enhancement. The purpose of this study is to develop a quality needs assessment for one specific U.S. cotton growth region, West Texas.

Conceptual Background

This study builds upon the concept of market segmentation (Chamberlin, 1933; Robinson , 1933; Lancaster, 1991). Market segmentation indicates the existence of heterogeneous demands such that market demand can be disaggregated into segments with distinct demands. Economic theory tells that a profit-maximizing firm can divide a total market into groups of markets with different elasticities of demand so that marginal revenues achieved in each market segment are equal. Here, a market segmentation approach is specifically developed to explain how West Texas cotton industry can be better off serving alternative markets in addition to the extant market which is primarily defined as the relatively low-end coarse-count market. Being able to serve alternative markets provide additions to the currently existing market (see the Appendix).

Figure 1 shows the relationship between the two markets with different elasticities of demand associating with the welfare effect from market segmentation toward a premium high-value market segment. The demand curve for market 2 on the left side of the diagram is flipped so that it is read in the opposite direction from the market 1 demand on the right side of the diagram. It is assumed that a part of quantities supplied to the extant market is transferred to a new submarket segment demanding high-quality premium product with less elasticity of demand

compared to the extant market demand. For simplicity, MC is set as a constant and there is no arbitrage between the two markets.[1]

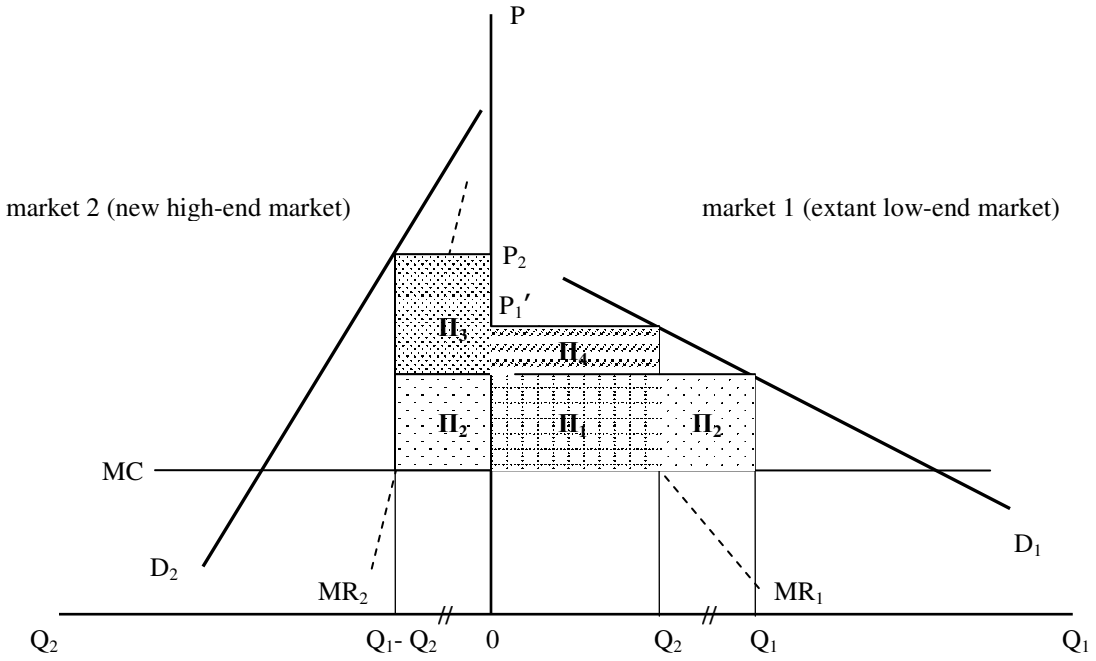

Figure 1. New High-Value Market Segment Development and Welfare Effect

The initial price and output is established as P_1 and Q_1 for the original demand (D_1) prior to the segmentation, achieving the profit of Π_1 and Π_2 (i.e., price-cost margin of (P_1-MC) multiplied by Q_1). Now, the market is segmented by the addition of high-end submarket with less price elasticity of demand (D_2) under the fixed supply of Q_1. Then, the part of quantity supplied, Q_1- Q_2, is transferred to the new submarket. This reallocates the quantity supplied and resets the price in each market. The optimal price and output sets are (P_1', Q_2) for the extant market and (P_2, Q_1-Q_2) for the new submarket. The resulting profits are the sum of Π_1, Π_2, Π_3 and Π_4. Thus, Π_3 and Π_4 are additional profits attributed to the premium market segment

[1] No arbitrage means that buyers are unable to purchase the product in Market 1 and resell it in Market 2 for a profit.

development derived from the optimal condition of MR=MC for the profit maximizing firm. Hence, the conceptual derivation showed how benefits are increased when a firm or an industry separates groups of buyers (markets) with different price elasticities of demand where marginal revenues achieved in each market segment should be equal. Therefore, adding appropriately defined market segments to an existing market provides opportunities to increase prices and profits.

Methods and Data

This study uses a needs assessment to accomplish its goal of evaluating market opportunities for West Texas cotton. Needs assessment refers to the procedural approach of assessing or evaluating the needs (or gaps) between the desired state and present situation. Gap analysis is a business technique to perform the needs assessment by identifying the actual and potential performance of a firm or an industry. By performing the gap analysis, needs assessment systematically identifies gaps between 'what should be' and 'what is' and explores the way to improve performance through addressing the gaps. In a market for quality, such gaps create incentives for marketers to enhance quality and prioritize market segment opportunities for strategic purposes.

Table 1 shows a master matrix for the cotton quality needs assessment, which enables linking the research questions with their associated data elements, data sources, and methods of analysis. Firstly, major information sources for demand segments consist of composite data from 1) U.S. textile mill contracts, 2) foreign spinners' views on fiber quality, and 3) published academic or technical papers. U.S. mill contracts are used as the primary data because the contracts stipulate specific minimum quality standards. In addition, secondary survey data about

Table 1. Master Matrix for West Texas Cotton Quality Needs Assessment

(A) Research Questions	(B) Data Elements	(C) Data Sources	(D) Analysis Methods
1) What are the cotton quality market demand segments?	• Textile mills' quality requirements/thresholds for major characteristics	▪ U.S. Textile Mill Contracts ▪ Foreign Spinners' Views on Fiber Quality ▪ Published academic/technical papers	▪ Market segmentation based upon quality demand
2) What is the quality of cotton currently produced in West Texas region and its associated target markets?	• Current quality supply capabilities • Distribution of West Texas current quality supply	▪ *Cotton Quality Classed* by AMS, USDA ▪ *Final Crop Quality Summary*, Cotton Incorporated ▪ Spot Transaction Data	▪ Information summarized in charts and tables for West Texas cotton quality distribution and quality reflected in the market transaction data
3) What quality frontiers can West Texas cotton reach in order to serve high value market segments?	• Quality potential of West Texas cotton supply • Available seed varieties for better performance	▪ *Cotton Varieties Planted* by AMS, USDA ▪ *Cotton Performance Tests* ▪ Cotton Variety Tests Results- certified quality performance	▪ Collect and analyze the experimental cotton quality performance test results with interrelations
4) Which market segments present the best opportunity in terms of the revenue generation?	• Price of cotton based on different quality levels • Expected returns from high valued market segments	▪ *Cotton Price Statistics* by AMS, USDA ▪ Daily Price Estimation System by Cotton Economics Research Institute	▪ Estimate the expected returns of classified market segments with the application of hedonic model developed

foreign spinners' views on fiber quality are used to determine export market quality thresholds. Research from the International Cotton Advisory Committee and Australian survey were used for this.[2] The requirements are compared with other sources of information available from review of literature and industry-specific periodicals.[3] Thus, market segments are determined with thresholds and the requirements of quality characteristics by mills such as length, strength, color, trash content, micronaire, region of growth, and harvesting method (Appendix Table 1).

The second step in the analysis is to evaluate current supply capabilities. The current quality of the region's cotton production is identified using information (Annual *Cotton Quality Classed*) from the Agricultural Marketing Service of the U.S. Department of Agriculture and from the research (Annual *Final Crop Quality Summary*) of Cotton Incorporated. In addition, the annual *Quality Summary of U.S. Upland Cotton by Classing Office* by Fiber Quality Research of Cotton incorporated is used as supplementary information. In particular, the daily producer spot market transaction data with quality information provided by Plains Cotton Cooperative Association (PCCA) covering the period of 2001/02 to 2005/06 marketing years are used to determine the current quality performance of West Texas cotton. The quality information is collected at classing offices serving counties in the region.[4]

Thirdly, the feasible quality potentials of West Texas are evaluated by the quality performance. For this, most popular cotton varieties in the region are determined by using information from annual *Cotton Varieties Planted* (AMS, USDA). Then, the results of cotton variety tests performed by Texas Agricultural Experiment Station (TAES) are used to relate the

[2] Spinners' views and needs surveyed for the Australian cotton provide information on how the preferred value and the performance of cotton fiber characteristics show gaps according to the mills' processing methods (van der Sluijs et al., 2004).
[3] Published academic/technical papers include *Proceedings of the Beltwide Cotton Conference* and papers in *International Cotton Advisory Committee*, and periodicals refer to as *Cotton Farming*, *Cotton Grower*, and *Farm Press Daily* with its subsidiaries of Southwest Farm Press, Southeast Farm Press, and Western Farm Press.
[4] West Texas cotton is classed in three classing offices located in Lubbock, Lamesa, and Abilene.

varieties with their quality performance. In addition, expected value-added for each segment due to the potential quality enhancement are evaluated for each segment. Particularly, possible revenue generation from quality achievement due to a different set of variety selection is investigated by using the share of cotton varieties planted in West Texas and such price information as AMS price quotes, loan rates, and estimated prices of key fiber characteristics analyzed by the Daily Price Estimation System (DPES).[5] Thus, the possibility frontier for West Texas cotton to better serve higher value market segments is determined by quality gap analysis.

Lastly, the target segments that present the best opportunity are selected based on their needed quality requirements and West Texas's quality potentials. Here, key obstacles for reaching higher segments are identified based on the quality thresholds for target segments. In the end, the most attractive segments are determined based on the comparative advantages among the market segments and recommended as potential market opportunities.

Results

It has been discussed that the quality needs assessment has four important parts. The following sections accomplish each part of the assessment with gap analysis in turn.

1. Cotton Market Segments by Quality Demands

The importance of fiber quality attributes by different spinning types are shown with brief summaries of quality requirements for each technologies (see Appendix Table 2). From these spinning technologies and their corresponding quality requirements, central components of the segments are established such as rotor, ring, and high-end ring. Considering its widespread

[5] *Texas-Oklahoma Producer Cotton Market Summary,* various marketing years. Cotton Economics Research Institute, Texas Tech University.

usage (with over 60 percent of world's short-staple spinning)[6] and its sensitivity in fiber selection, ring spinning is divided into two segments: ring and high-end ring. High-end ring requires higher quality attributes than general ring spinning.[7]

Based on the quality profile, market segments are derived for relevant regions and spinning requirements. Four U.S. cotton regions are evaluated: San Joaquin Valley (SJV), South Texas, South (often referred to as East/Memphis (E/M)), and Southwest (SW) including West Texas. South is divided into two different segments based on the quality threshold attributed to demands from two of the most popular spinning technologies: ring and rotor (open-end) spinning. Ring spinning that requires higher cotton quality than rotor spinning establishes the E/M 1 market segment, whereas rotor spinning represents the E/M 2 market segment. These are chosen here to make a needs assessment of West Texas quality as relevant positions in terms of performance. In addition, the short staple segment is important because large quantities of cotton are sold with these specifications for relatively low end markets. In the large, Texas has traditionally served this market. It includes cotton with minimum quality requirements which are stripper harvested.

Table 2 shows the five relevant market segments, cotton quality requirements, and corresponding premiums and discounts from the base price for each segment. From this it is possible to evaluate demand segment quality requirements and potential returns.

First, the *SJV market segment* is defined not only by the properties of SJV cotton but also from the major export market requirements of cotton fiber[8]. Since most SJV cotton serves export market demands with relatively high quality standards, the SJV segment represents a high-end

[6] The proportion of world yarn produced using short-staple spinning on ring system is an estimate from van der Sluijs (p13, 2004).
[7] See Appendix Table 1 and Appendix Table 3 for the cotton types and relevant types of end products.

Table 2. Quality Requirements and Value by Types of Cotton Market Segments

Charact-eristics	Five Cotton Market Segments				
	SJV	**South Texas**	**E/M 1**	**E/M 2**	**Traditional**
Color	Min:31 Avg:21	Min:41 Avg:31	Min:41 Avg:31	Min:41	per recap***
Leaf	Min:3 Avg:2	Min:3	Min:3	Avg:3	Avg:4
Length	Min: 1.13 inch (36) Avg:1.14 (37)	Min: 1.12 inch (36) Avg:1.14 (37)	Min: 1.10 inch (35) Avg:1.12 (36)	Min:0.99-1.04 (32) Avg:1.05-1.07 (34)	Min:1.00-1.02 (32) per recap
Length Uniformity	Min: 81 Avg: 82 or 83	Min: 81 Avg: 82	Min: 81 Avg: 82	Min: 80 Avg: 81	Min: 79 per recap
Strength (GPT)	Min: 29 Avg: 31	Min: 28 Avg: 29	Min: 26.5 Avg: 28	Min: 26.5 Avg: 28	Min: 25 per recap
Micronaire	3.7-4.2	4.1-4.7	3.8-4.6	3.5-4.9	No less than 3.0
Variety/ Region	SJV Or equivalent	South Texas Fibermax Or equivalent	East/Memphis Non-SJV CA, AZ	East/Memphis Southwest	Southwest TX , OK stripper variety
Harvest Method	Spindle picked	Spindle picked	Spindle picked	Stripped or Spindle picked	Stripped
Target Spinning*	Vortex & Ring	Ring (High-end)	Ring	Open-end Rotor	Open-end Rotor
Premium/ Discount (Points per pound)**	1180~1600	270~540	170~450	0~80	-(80~290)

* See the Appendix Table 1 and 2 for detailed spinning technologies.
** The premium or discount is calculated to find out the value of each market segments with the given minimum quality specification by applying *2004-2005 Cotton Price Statistics*, AMS, USDA (2005). Unit: 100 point=1 cent. Uniformity and micronaire are excluded in the calculation for simplicity since their amounts are not significant. 31-3-36 refers to the quality levels of color, leaf and length, i.e., middling, leaf grade 3, and 1.11-1.13 inches in length.
*** A recap is a summary of the quality of a lot of cotton. Most recaps include averages for the characteristics. (Source: Personal contact with Barbara Meredith, Market News Branch Chief, Cotton Program, AMS, USDA.)

export market.[9] As the result, this segment shows the quality requirements and premiums that are the highest among the segments, reaching 1,600 points on the average level of 21-2-36 with

[8] Even though some low quality cotton ("bottom feeders") goes into the export market with significant discount (about 2,000 points off the New York price), the segment defined here represents the mainstream export markets requiring high quality such as China, Mexico, Turkey, Indonesia, and Korea. In contrast, central Asia markets including Pakistan for coarse count cotton are not considered for this segment.
[9] Traditionally, about 80 percent of SJV cotton is exported (*Cotton Farming*, October 2005).

the strength of 31 GPT.[10] The quality threshold for this high quality market segment is consistent with the previous studies (Larsen, 2003; Estur, 2004; and van der Sluijs et al., 2004). Further, industry specific publications such as *Farm Press Daily* and *Cotton Farming* (Oct. 2005) had set the export demand for cotton as 21-2-36[11] or 21-3-36 for the SJV cotton. This segment serves for the high-end ring spinning process or vortex spinning for the mills' processing. The value for this segment ranges from 1180 to 1600 premium points based on the minimum (31-3-36 with 29 GPT) and average (21-2-36 with 31 GPT) of quality standards.

Second, the *South Texas market segment* has the similar quality requirements but not as high quality as SJV in color, strength, and micronaire.[12] Much of this segment meets export demand requirements. Further, this segment serves a specific mills' spinning process, i.e., high-end ring spinning process. Compared to the E/M 1 segment, the quality requirements are more stringent in length, strength, and micronaire. The region of growth and variety are distinguishably specified as South Texas and FiberMax or equivalent, respectively, confirming the quality potentials recently achieved this region.[13] In its value (i.e. quality premiums), this market is the second. This segment is valued with premium range from 270 to 540 based on the minimum (41-3-36 with 28 GPT) and average (31-3-36 with 29 GPT). This South Texas market represents a bridging segment between the E/M 1 segment and the SJV high quality segment market.

---

[10] SJV cotton classed at Visalia classing office showed that the color grade of 21-3 or better were more than 83%, 75% and 60% in crop year of 2002, 2003 and 2004, respectively. The lengths of 36 or longer were 90%, 94% and 77% in crop year of 2002, 2003 and 2004, respectively. The average strength was 32.6 over the two crop years in both 2003 and 2004.

[11] 21-2-36 refers to the quality levels of color, leaf and length, i.e., strict middling, leaf grade 2, and 1.11-1.13 inches in length, as defined for the SJV segment in Table 4.

[12] This segment is classified base on current quality improvements in the South Texas cotton that positioned in the market for quality as a second only to the SJV cotton, capable for serving export demand of 36 staple and an 82 length uniformity (Cotton Farming, February 2005).

[13] During the 2004 crop year, it is estimated that more than 65% of cotton acreage planted to the South Texas region was FiberMax (AMS, USDA).

Third, the *E/M 1 market segment* stands for the first one of two segments of traditional domestic cotton mainly produced in South region named East/Memphis (E/M). This market segment specifies required quality standards higher than E/M 2 market segment, especially in length, the most important fiber quality characteristics for ring spinning as shown in Appendix Table 2. It is important to specify this market segment because of increasing use of ring spinning.[14] Both South Texas and E/M 1 segments represent about 1/3 of U.S. spinning currently in place,[15] and higher-end products such as apparel and fine yarns counts are produced in these ring spinning segments (Felker, 2001). This segment represents the USDA base quality classification of 31-3-35 that is normally used as A-index price for international cotton price reports.[16] The value for this segment ranges from 170 to 450 premium points based on the minimum (41-3-35 with 26.5 GPT) and average (31-3-36 with 28 GPT).

Fourth, the *E/M 2 market segment* stands for the second segment of traditional domestic cotton mainly produced in the East/Memphis region. It shows the quality requirements almost the same as the USDA base quality level: color 41, leaf, 4, staple length 34, micronaire 3.5-3.6 and 4.3-4.9, strength readings of 26.5-28.4 grams per tex (GPT), uniformity of 81 units in the local spot market. The only difference is in micronaire of 3.5-4.9 for this segment that possesses the premium level of 3.7-4.2. This segment corresponds to the open-end rotor technology that represents about 40 percent of spinning in U.S. in 2000. As the export market becomes the main outlets for U.S. cotton due to declines in domestic mills, this segment serving traditional domestic market has shrunk in its share.[17] This segment serves comparatively lower-end textile

[14] In 2004, U.S. had an installed spinning capacity of about 1.6 million ring spindles, compared to about 570,000 open-end rotors (ITMF, 2004)
[15] The majority of cotton from the West region and about half or more of Texas cotton are exported (Estur, 2004).
[16] International base levels of cotton fiber characteristics are 31-3-35 in length, 28 in strength, 3.8-4.6 in micronaire, and 82-83 in length uniformity index.
[17] As shown in Appendix Table 1, about two-third of world market uses ring spinning, while less than one-third use open-end rotor spinning. Thus, it is not surprising to see that the customer base for cotton appropriate for ring

products than SJV, South Texas or E/M 1 segment products, e.g., shirting and fine knits (see Appendix Table 3). The value of this segment ranges from 0 to 80 premium points based on the minimum (41-4-34 with 26.5 GPT) and average (41-3-34 with 28 GPT) of quality standards.[18]

The fifth market segment is specified as *traditional short staple segment*. This market segment is distinguishably classified because it represents the traditional West Texas coarse cotton with short staple length as well as the base loan rate quality. This segment typically uses stripper harvesting that is discounted in the market relative to spindle picked harvesting due to mill preferences and a belief that stripping results in some inherently lower quality attributes. This means that using stripper harvesting itself appears to be an important factor limiting market access. In terms of value, typical discounts are about 80 (based on 41-4-32 with 25 GPT) or 290 (based on 41-4-33 with 26.5 GPT) and this cotton represents the general lower end of the quality spectrum. This is why price, i.e. discount amount, is a key driving force in this market rather than quality. Most cotton in this segment is used for lower- or bottom-weight coarse textile products such as denim, or to be used for blending with cotton of better quality.

In short, five types of market segments are classified based on the quality characteristics specified in the contracts and other sources. Results are developed that indicate the potential value of relevant market segments. The average market value of the highest market segment exceeds the base price by 1600 points, whereas the lowest segment is discounted by about 80 or 290 points per pound. Within this range are the potential targets for West Texas cotton.

---

spinning serving the traditional domestic market loses its market share. Moreover, the growth in this segment in 2003 crop were possible because cotton in this segment was sold with discounts in price (*Cotton Grower*, July 2004).

[18] There are critics on the value of this segment, e.g., saying that "41-4-34 staple can be a discounted lot in the export trade (*Southeast Farm Press*, August 2004)," and "the world market discounts SLM 1-1/16-inch cotton, although the U.S. classing system continues to reward such a growth (*Cotton Grower*, July 2003)."

2. Current Quality Supply of West Texas Cotton

As a part of cotton quality gap analysis, the current performance of the industry and its quality against existing standards is evaluated. The current supply capabilities regarding quality of West Texas cotton is identified by each major quality characteristic.

Color. The majority of the color grade is over the base grade of 41. In the years of both 2003 and 2005, more than 70 % of total bales were the color grade of 21 or 11. This indicates that West Texas cotton has reached the highest market segment close to the quality of SJV cotton in terms of color grade. However, in 2002 and 2004, the color of 22 or better was only 11% and 3%, respectively. Annual fluctuation in the color grade distribution is noticeable in the region. This creates problems for the buyers who want consistent color quality in cotton.

Leaf and Trash Content. Among the white color grade (base color grade of 41 or better), the percentage of leaf grade better than 4 (base grade) was consistently two thirds or higher from 2002 to 2005. The average leaf grade varies between 3 and 4. Occasionally, the average reached between 2 and 3 in such crop years as 2003 and 2005. Leaf grade in good quality crop years (e.g. 2003 and 2005) satisfied the minimum leaf grade of 3 defined in South Texas and E/M 1 market segments, but did not yet reach the SJV market segment.

Along with leaf grade the trash content measures the amount of non-lint materials in the cotton. Considering the trash contents for the region were 48%, 23%, 60% and 26% in year 2002, 2003, 2004 and 2005, respectively, we can say that leaf grade was somewhere around 3 and 4, because the four-year average was 39.25%. This implies that West Texas cotton quality has been somewhat lower than the quality level of E/M 2 market segment in terms of leaf and trash content. Hence, leaf grade and trash content should be improved further to meet higher-end market segments.

Length. The average length grade ranges from 33 to 35. Over the period of 2002-2005, the average lengths have increased steadily from 33.4 (2002), 33.9 (2003) and 34.2 (2004) to 34.7 (2005).[19] The percentage of short staple (31 or less) has decreased, and the share of longer staple (35 and over) has increased over the period. Since 2003, more than half of West Texas cotton fits the base grade of 34. However, less than 20 % can be considered for the SJV market segment with high premiums until 2004. In 2005, the length of 35 and above occupied 59% of the total and provides the possibility of West Texas cotton supplying higher end segments. Still, to reach higher valued market segments such as E/M 1 or South Texas segment, the staple length needs to be further extended to at least 36 on the average.

Strength. The strength grade was consistent over the period, averaging 28.8, 29.0, 28.5 and 28.8 for the crop year 2002, 2003, 2004 and 2005, respectively, which is a little over the base quality level of 26.5-28.4 grams per tex (GPT). About 80% or more cotton is 28 and over and about 50-60% is classified as over 29. This indicates that West Texas cotton can be placed either E/M 1 or E/M 2 segment, and close to the South Texas segment, but still quite far from the SJV segment that requires the strength of 31 on the average.

Micronaire. The distributions between 2004 and 2005 crop year are very similar as well as those between 2002 and 2003. During the period of 2002 and 2003, the distribution was skewed to the high micronaire with averages of 4.3 (2002) and 4.4 (2003), whereas the recent two crop years show lower average micronaire of 3.6 (2004) and 3.7 (2005). The percentages of base micronaire range of 3.5-4.9 over the period are 83%, 74%, 65% and 66%, in 2002, 2003, 2004 and 2005, respectively. On the other hand, the percentages of premium micronaire of 3.7-4.4 over the period are 29%, 25%, 41% and 39%, in 2002, 2003, 2004 and 2005, respectively.

[19] This is a notable improvement for West Texas cotton to serve foreign markets because the world cotton export market wants 35 in length rather than the old standard of 34. In addition, for both ring and air jet, a minimum of 35 average in length is required, whereas open-end requires 34 or above.

Although the amount of base grade cotton has decreased in the distribution, the share of premium level cotton has increased. Relatively a high percentage of 2.9 and below cotton was produced in 2004 and 2005 period. Overall, the West Texas micronaire distribution shows that about two-thirds is within the base grade but the amount within the premium range of 3.7-4.2 is only about a third of all classed cotton. Thus, to reach the SJV or South Texas segments, the micronaire should be improved further with less variability in distribution because market segments targeting ring spinning requires narrower ranges in micronaire distribution than those for open-end spinning.

Uniformity. The uniformity over the period, averaging 80.8, 80.9, 80.2 and 80.2 for the crop year 2002, 2003, 2004 and 2005, respectively, which is about the base quality level of 81. The uniformity levels of 82 or higher were 25%, 30%, 11% and 15% in 2002, 2003, 2004 and 2005, respectively. This indicates that West Texas cotton can be placed closer to the E/M 2 segment rather than any other segments. To satisfy the ring spinning requirement, the uniformity should be 81.5 or better, while open-end needs 81 and above (Felker, 2001). Therefore, uniformity in West Texas should be improved further to meet higher end spinning requirements.

Harvesting method: Stripper vs. Picker. West Texas primarily uses the stripper harvesting method. About 85% of cotton in Texas is stripper harvested (Glade et al., 1996). It is perceived that stripper harvesting causes lower quality because of possible high trash content, neps and short fiber content.[20] However, substantially higher costs may incur if harvesting method is changed to a more quality preserving method such as picker harvesting. According to

[20] "The stripper picks up more trash than conventional pickers, although on-board cleaning systems help reduce trash." (Delta Farm Press, August 2001)
"Stripper harvesting is less expensive than spindle harvesting. The initial cost of the machine is about half the cost of spindle pickers and maintenance is much less. Strippers get a higher percentage of the crop off the stalk. Stripped cotton contains much more foreign material per bale than spindle picked cotton. Typical stripped cotton will contain about 700 pounds of foreign material while spindle picked will contain 100 to 150 pounds." (Gibson, 1999)

the web-based *cotton harvest cost calculator* developed by the Cotton Economics Research Institute at Texas Tech University, the average cost for customer picker harvesting exceeds the cost of stripper by up to 300 to 400 points per pound, varying by acres and machines used. Besides costs, the marketing of cotton via marketing pools in the region does not distinguish the harvest method. This may discourage incentives for upgrading to picker harvesting.

Overall, West Texas falls short of the high-value market segment targets such as SJV and South Texas, or even E/M 1. Particularly, micronaire, length and length uniformity should be given more careful attention in terms of quality improvements to enhance marketability and returns. However, the recent (2005 crop year) improvement in some quality characteristics provides potential to place better position in the segments considering the high percentage of 21 in color grade and leaf grade of 3 along with increasing length. This indicates that the potential to serve higher end market segments is growing.

3. Potential Quality Frontiers for West Texas Cotton

This section evaluates variety selection and possible improvements in quality. Seed variety selection is a significant first growers' decision that affects quality performance. Growers select varieties considering all the contingencies for cotton production and marketing such as irrigation, insect resistance, herbicide tolerance, harvesting technology, lint yield, turnout percentage, fiber quality, earliness, seed and ginning cost, and market value. Table 3 shows the potential quality performance of major cotton varieties planted in West Texas (Lubbock Experiment Station) during the 2004 and 2005 crop years. In addition to the quality performance for each quality properties, calculated loan values and their corresponding market values in terms of estimated points in premiums or discounts are reported.[21]

[21] Loan value (per pound) is calculated with the base loan rate for the Lubbock region and the premiums and discounts for each quality characteristics. The market values are from AMS price quote and the DPES estimates.

Table 3. Cotton Variety Potential Tested in West Texas (Lubbock), 2004 and 2005

2004

brand name	variety	color	leaf	length	stre-ngth	micro-naire	unifo-rmity	loan points/lb	points /lb†
Bayer FiberMax	FM 958 (D)	41	3	1.14 (37)	32.4	3.8	82	5465	201
	FM 958	41	3	1.15 (37)	30.5	4.0	82	5428	201
	FM 958 (late)	31 or 33	3	1.11 (36)	28.1	3.3	83	5048	-107
	FM 989RR	41	3	1.15 (37)	30.5	3.5	82	5325	194
	FM 989RR (D)	41	3	1.13 (36)	32.7	3.5	82	5440	190
	FM 960RR	41	3	1.14 (37)	30.8	3.4	81	5338	19
	FM 960RR (D)	41	3	1.15 (37)	32.4	3.3	82	5135	23
	FM 960BR	41	3	1.11 (36)	30.9	3.7	81	5420	194
	FM 960B2R	41	3	1.16 (37)	31.2	3.3	81	5150	94
	FM 989BR	41	4	1.13 (36)	29.3	3.6	82	5385	126
AFD seed	AFD 3511RR (D)	42 or 52	4	1.09 (35)	30.3	4.4	82	4898	-156
Payma-ster	PM 2326RR	41	4	1.07 (34)	29.4	4.4	83	5283	19
	PM 2266RR	41 or 51	5	1.07 (34)	28.7	4.1	81	4885	-115
All-Tex	Atlas RR	41	4	1.04 (33)	29.3	3.8	81	4905	-95
Stoneville	ST 2454 R	41	3	1.07 (34)	27.7	4.2	82	5315	83
Average		41	3	1.11 (36)	30.3	3.8	81.6	5228	58

2005

brand name	variety	color	leaf	length	stre-ngth	micro-naire	unifo-rmity	loan points/lb	points /lb
Bayer FiberMax	FM 958 (D)	31	2	1.10 (35)	29.9	4.3	81	4824	403
	FM 958	41	3	1.15 (37)	30.4	4.0	83	4891	330
	FM 958 (late)	21	2	1.13 (36)	30.7	3.9	82	5662	589
	FM 989RR	31 or 41	2	1.13 (36)	29.7	3.5	81	5624	410
	FM 989RR (D)	31	1	1.09 (35)	29.8	4.0	81	5406	411
	FM 960RR	31	2	1.12 (36)	29.8	3.3	82	5532	369
	FM 960RR (D)	21 or 31	2	1.04 (33)	28.6	3.8	79	5139	64
	FM 960BR	41	3	1.13 (36)	30.6	3.7	83	5134	277
	FM 960B2R	41	2	1.13 (36)	30.0	3.6	80	5658	283
	FM 989BR	31	2	1.13 (36)	29.1	3.8	81	5140	534
AFD seed	AFD 3511RR	31 or 41	2	1.07 (34)	27.5	4.4	83	5487	176
Payma-ster	PM 2326RR	41	3	1.07 (34)	29.2	4.4	83	5262	78
	PM 2266RR	41	3	1.08 (35)	28.2	4.3	82	5362	175
All-Tex	Atlas RR	31 or 41	2	1.07 (34)	27.6	4.0	82	5413	184
Average		31 or 41	2	1.10 (35)	29.4	3.9	81.5	5324	306

Source: *Cotton Performance Tests*, TAES. 2004 & 2005.

Note: (D) indicates dryland cotton varieties and (late) represents late planted varieties.

† refers to the quality premiums in points on the base prices. Negative means discounts.

The average quality properties among the most popular varieties selected were color of 41, leaf 3, length 1.11 (36), strength 30.3, micronaire 3.75, and uniformity of 81.6 in 2004. In 2005, the overall quality averages were color 31, leaf 2, length 1.10 (35), strength 29.4, micronaire 3.9, and uniformity 81.5. This indicates potential quality frontiers for West Texas with the available varieties and suggests that West Texas cotton has the quality capability to achieve the E/M 2 market segment, and even E/M 1 market if it maintains the color grade of 31 or better, length of 36 or longer, uniformity of 82 or higher on the average. FM 958 (late), FM 960RR, and FM 989BR varieties showed potentials for serving E/M 1 market segments in 2005/06 crop year. In terms of each quality properties, leaf, strength, and uniformity reach even the South Texas market segments, although staple length and micronaire distribution fell short.

Among the varieties, FiberMax varieties such as FM 958 (the most popular in West Texas in 2004 and 2005), FM 960RR, FM 960BR and FM 960B2R showed favorable quality performance with their varieties adapted for irrigation and planting time (e.g., dryland and late types). The leading variety in performance such as FM 958 (late) showed quality performance close to the requirement of SJV segment amounting 616 premium points per pound in 2005. However, there is a significant variance between the crop years because FM 958 (late) variety in 2004 showed problems in low strength and low micronaire and that resulted in critical discounts.

The average loan value per pound due to the quality improvement has increased from 52.28 cents in 2004 to 53.24 cents in 2005. This indicates an increased return achievable from the efforts made by the growers throughout the production process along with the appropriate production conditions (e.g., weather and insects) during the crop years.[22]

[22] Besides weather or other natural conditions, an important note to make is the costs of production involved in the improvement of quality between both crop years. They include all the costs associated with the cotton production from the costs of different varieties to the use of pesticides and harvesting methods and they tend to vary year by year. However, costs are assumed constant during the quality performance tests at experiment stations over years.

When it comes to the potential market values for quality of cotton, Table 3 presents average premiums and discounts for each variety in both 2004 and 2005 crop year. While there are differences in the amount of premiums from various varieties, the average premium increased from 58 points in 2004 to 306 points in 2005. This increase of 248 points per pound can be converted to about 12 dollars per bale (1 bale=480 pound), and it accounts for about $50 million increase in producers' return in the region, considering the over four million bales classed in Lubbock. Thus, the potential quality increase from the popular varieties and their enhanced performance in quality characteristics significantly increases returns to cotton growers in the region. This indicates the importance of quality improvement from the varieties selected with other growing conditions, as well as market demand for quality, in pursuing high returns from cotton production.

Given the current quality capabilities, West Texas has potential to serve the E/M 2 or even E/M 1. This is based on the variety test results without changing major technologies in production. In particular, some varieties show excellent performance potential, although variability among crop years exists. Thus, depending upon the variety mix, the percentage of cotton suitable for serving high-value markets changes. To better serve the E/M 1 or higher value market segment, West Texas will need to use pickers for harvest, according to the quality requirements in Table 2, as well as providing the relevant fiber characteristics. However, the cost of pickers replacing strippers may offset part or most of the benefit from serving high segment.

In terms of the potential value of cotton from the base quality, E/M 1 market segment will generate up to 450 additional premium points per pound (or extra $21.60 per bale) according to the premiums and discounts shown in Table 2. In comparison, up to 80 additional premium

points per pound will be possible if the E/M 2 market segment is served. Considering the undervalued traditional market segment that may be discounted up to 290 points per pound, even serving E/M 2 from traditional segment may generate up to 370 points per pound or $71 million (based on 4 million bales of production in 2005 for Lubbock region). Therefore, enhancing quality by targeting high-value segments may significantly benefit cotton growers in West Texas.

4. Selection of Target Market Segments for Positioning West Texas Cotton

The goal of quality positioning is to place cotton in the market or in the mind of the customer on its quality basis. This focuses on which market segments West Texas cotton can serve on an on going competitive basis. To successfully position West Texas cotton in the appropriate quality market segments, it is important to examine its target markets based on the quality thresholds for each quality segment and its key obstacles to reach higher segments.

Quality Characteristics. The potential target markets were investigated by examining if West Texas cotton meets the threshold of quality characteristics for each market segment. Table 4 shows the quality possibility frontier for West Texas to reach. Not only the quality requirements by segments but also the shared distributions of quality characteristics are presented to suggest the current quality performance of West Texas cotton on the left side of the table. On the right end side, the potential quality achievable for West Texas from TAES is provided to compare with quality requirements in each target segment. In order to identify the opportunities and challenges for West Texas to select target markets, the current and potential quality capabilities are determined based on the combined quality as well as each quality characteristic.

Besides the current and potential performance of individual quality characteristic, combined quality shows how much overall quality of West Texas cotton as a composite product

Table 4. West Texas Cotton's Potential for the Quality Thresholds by Segments

Charact -eristics	Quality Requirements and Their Distribution by Segment				West Texas Cotton Quality	
	SJV	South Texas	E/M 1	E/M 2	Current	Potential
Color	**Min:31, Avg:21** 31+: 95% or 19%* 21+: 79% or 3% Highly variable	**Min:41, Avg:31** 41,12,& 22: 3%, 43% 31: 16%, 16%	**Min:41, Avg:31** 41,12,& 22: 3%, 43% 31: 16%, 16%	**Min:41** 41+: 98% or 62% Highly variable	**Avg:31** very high variance by crop years	**Min:41, Avg:31** E/M 1 & 2 South Texas
Leaf	**Min:3, Avg:2** 3+: 86% or 46% 2+: 29% or 6%	**Min:3** 3: 57% or 41%	**Min:3** 3: 57% or 41%	**Avg:3** 3: 57% or 41% 4+: 98% or 70%	**Avg:3 or 4** high variance by crop years	**Min:3, Avg:2** E/M 1 & 2 South Texas
Length	**Min:36, Avg:37** 36+: 32% or 19% 37+: 10% or 5%	**Min:36, Avg:37** 36+: 32% or 19% 37+: 10% or 5%	**Min:35, Avg:36** 35+: 59% or 44% 36+: 32% or 19%	**Min:32, Avg:34** 32+: 98% or 97% 34+: 81% or 67%	**Avg:33~35** over 4 crop years	**Min:34, Avg:35** E/M 2 nearly meet E/M1
Strength (GPT)	**Min:29, Avg:31** 29+: 59%, 48% 31+: 14%, 10%	**Min:28, Avg:29** 28+: 81%, 74% 29: 26%, 24%	**Min:26.5, Avg:28** 27: 12%, 16% 28: 22%, 25%	**Min:26.5, Avg:28** 27+: 93%, 90% 28+: 81%, 74%	**Min:28, Avg:29** over 4 crop years	**Min:28, Avg:29.4** E/M 1 & 2 South Texas
Micronaire	**3.7-4.2** 39% or 41%	**4.1-4.7** 8% or 5%	**4.4-4.9** 58% or 66%	**3.5-4.9** 65%	65% for 3.5~4.9; 37% for 3.7~4.4 but high variance	**Avg: 3.3-4.4**
Length Uniformity	**Min:82, Avg:83** 82+:15% or 11% 83+: 3% or 1%	**Min:81, Avg:82** 81+: 43% or 41% 82+: 15% or 11%	**Min:81, Avg:82** 81+: 43% or 41% 82+: 15% or 11%	**Min:80, Avg:81** 80+: 74% or 77% 81+: 43% or 41%	**Avg:80~81** over 4 crop years	**Min:80, Avg:81.5** E/M 2 nearly meet E/M1
Harvesting Method	Picker	Picker	Picker	Stripper or Picker	Stripper	Stripper or Picker
Combined Quality**	Min:0%, 0% Avg:0%, 0%	Min:0.5, 0% Avg:0%, 0%	Min:8%, 0% Avg:0%, 0%	Min:36%, 0% Avg:6%, 0%	from 6% to 36% eligible for E/M 2 in 2005	May serve E/M 1 or E/M 2 from variety potential

Note: Green if West Texas meets the thresholds of specified quality characteristics in that segment.
Yellow if West Texas may narrowly meets the thresholds of specified quality characteristics in that segment but not by much.
* The first percentage refers to the share of cotton classified in 2005 crop year, and the second one is for 2004.
** The combined quality shows the share of lot-specific cotton traded in spot market with the combination of each quality requirement either by min. or by average, classed in Lubbock office (see detailed share of each segment in Appendix Table 4).

has met and may meet the requirements of market segments. Until 2004/05 crop year, most of West Texas could serve only the traditional market segment based on the combined quality requirements for each segment. In 2005/06, one of the best quality crop years, about 6 percent (based on the average requirements) or up to 44.5 percent (based on the minimum requirements) of cotton traded from Lubbock classing office meets to serve the E/M 2 or higher market segments. It is an encouraging improvement in quality performance of the region. Given the current and potential quality performance and capability, including the current quality development, West Texas may serve E/M 2 or even E/M 1 market segments. Particularly for the E/M 1 market, however, the improvement in harvesting is critically important.

Harvesting method. Harvesting with the stripper method does not satisfy those buyers insisting on spindle picking and is one factor limiting the ability to reach high value markets such as E/M 1 or higher segments. As shown in Table 4, a major difference between West Texas cotton quality and the requirements for target segments is harvest method. However, the costs associated with different methods (strippers vs. pickers) makes the implementation of picker harvesting difficult. Thus, a feasibility condition will be that the amount of benefits should be greater than the amount of costs for changing from a stripper to a picker. Then, the marginal benefits (premiums per pound) from the picker should exceed the marginal costs (picker costs per pound) incurring from the picker implementation. Considering the cost differentials of picker compared to stripper harvesting are about 300 to 400 points per pound, then the incentives need to be greater.[23] The potential target segments should compensate the cost differentials.

[23] In terms of the cost differential, there is no single number to post because of the variability by the size of farm as well as by the number of rows in the harvester. Particularly, the coefficient of variation in the cost of cotton production is shown the highest for Texas compared to other U.S. cotton farms (Libera, 2006). A general difference can be found in custom rates for harvesting, that is, 571 points for stripper with burr extractor and 892 points for picker harvesting and the difference is 321 points per pound (NASS, USDA. 2004). Further, according to the mill contract data, buyers explicitly discount for stripper-harvested cotton approximately 300 to 500 points per pound compared to the picker harvested.

Therefore, for those who implement picker harvesting the E/M 1 or higher market segment can be the most appropriate market segment to target and to position for West Texas in the market for quality given the quality frontier established. In the future, the South Texas segment can be a potential target market for some growers in West Texas once length and micronaire are improved substantially with a major improvement in the production such as the implementation of picker.

Conclusion

This study provides a prospect for improving West Texas cotton marketability using a needs assessment approach. The present quality performance and capability were identified with a gap analysis. By evaluating market demand for cotton quality and current and potential fiber quality produced in West Texas, needed quality changes to meet specific market segments are developed and evaluated for their potential returns.

Based on five major market segments and their quality characteristics, West Texas falls short of the high-value market segment targets due to its weakness in micronaire, length, and uniformity. Among the segments defined, however, West Texas cotton can meet the requirements for E/M 2 and some of E/M 1 market segments for those who adjust their harvesting method from stripper to picker. By serving E/M 2 market segment from the traditional segment, West Texas cotton may add about 80 to 370 points per pound in its value, and that may generate about $15 to $71 million by varying degrees (based on quality combinations) due to the quality enhancement by itself for the Lubbock region.

One of the major constraints for West Texas cotton for reaching E/M 1 or higher segments is harvesting method: picker vs. stripper. Considering that the export market demands are currently increasing, meeting the quality requirements of export market is not only a positive

outcome from the quality needs assessment but also provides normative guidance for West Texas to emphasize such market segment as E/M 1.

This study foresees potential quality improvement and the economic returns in the short run, without major changes that would affect the long-run quality of West Texas. In the long-run, the market situation would change and the economic values of market segments will change. Thus, another area for future research includes cost and benefit analysis associated with production and harvesting changes.

The usefulness of this study lies in its uniqueness in determining the market segments of cotton based on the quality demands by users. This frames those segments for positioning a regional cotton (West Texas cotton) relative to market segments determined from the results of the needs assessment. The application of needs assessment in the study of cotton marketing shows a practical method for a region to adapt to changing quality preferences. The results of the study can be used by West Texas cotton growers, seed producers, and textile mills that would benefit from improved responses to market needs.

Acknowledgements

The authors acknowledge the assistance of cooperating firms in providing data to the study. This research was supported by the Cotton Economics Research Institute at Texas Tech University.

References

Bowman, K.R., and D.E. Ethridge. "Characteristic Supplies and Demands in a Hedonic Framework: U.S. Market for Cotton Attributes." *American Journal of Agricultural Economics* 74 (1992):991-1002.

Chamberlin, Edward. *The Theory of Monopolistic Competition*. Cambridge, MA: Harvard University Press. 1933.

Chen, C., D.E. Ethridge, and S.M. Fletcher. "Textile manufacturers' market valuation of cotton fiber attributes." *Journal of Agricultural and Applied Economics* 29(1997):185–195.

Cleveland, O. "Shifting Demand." *Cotton Grower*. July 2003. Online: http://www.findarticles.com/p/articles/mi_qa3826/is_200307/ai_n9299746/print

Cotton Economics Research Institute, *Texas-Oklahoma Producer Cotton Market Summary,* Texas Tech University. Various marketing years.

Cotton Farming. "Round Table Focuses on Fiber's Future." February 2005. Online: http://www.cottonfarming.com/home/2005_FebCF-FiberSeminar.html

Cotton Farming. "Ginning For Overseas Markets." October 2005. Online: http://www.cottonfarming.com/home/2005_OctCF-Ginning.html

Cotton Farming. "Producers Push for Premiums." January 2005. Online: http://www.cottonfarming.com/home/2005_JanCF-ProducersPremiums.html

Cotton Incorporated. "Cotton Fiber Chart: Typical Cotton Properties for Selected Fabrics." 2005. Online: http://www.cottoninc.com/CottonFiberChart/?Pg=9

Cotton Incorporated. "2003 Final Crop Quality Summary." 2004. Online: http://www.cottoninc.com/CropQualitySummary/2003FinalCropQualitySummary/

Delta Farm Press. "Nature vs. Nurture Meet at UNR Cotton Harvest." August 2001. Online: http://deltafarmpress.com/mag/farming_nature_vs_nurture/index.html

Estur, Gerald. "Quality requirements on Export Markets for U.S. Cotton." *2004 Beltwide Cotton Conferences Proceedings*. Cotton Quality Measurements Conference, National Cotton Council, Memphis, TN. pp2306-2311. 2004. http://www.cotton.org/beltwide/proceedings/getPDF.cfm?year=2004&paper=J001.pdf

Felker, G. Stephen. "Fiber Quality and New Spinning Technology." *Proceedings of Beltwide Cotton Conference* 1 (2001):5-7.

Gibson, W. D. "Mill Experience with UNR Cotton." 1999 EFS Cotton Conference. 1999. Online:http://www.cottoninc.com/1999ConferencePresentations/MillExperienceWithUNRCotton/MillExperienceWithUNRCotton.pdf

Glade, E.H. Jr., M.D. Johnson, and L.A. Meyer. "Cotton Ginning Charges, Harvesting Practices, and Selected Marketing Costs 1994/95 Season." No. 918. ERS. USDA. Washington, DC. 1996.

Gordon, Stuart. "Cotton fiber Quality research Needs: The Australian Perspective." *Textile Institute 81st World Conference*, Melbourne, Australia. April 2001. Online:

http://www.tft.csiro.au/research/pdf/TI%20Conf%20-%20Cotton%20Fibre%20Quality%20Research%20Needs.pdf

Hollis, P. "Cotton Quality May Preserve Markets." *Southeast Farm Press*, August 2004. Online: http://southeastfarmpress.com/mag/farming_cotton_quality_may/

International Textile Manufacturers Federation (ITMF). *International Textile Machinery Shipments Statistics*. 2004.

Lancaster, Kelvin. J. *Modern Consumer Theory*. Aldershot, UK: Edward Elgar. 1991.

Larsen, Marianne N. "Quality Standard-Setting in the Global Cotton Chain and Cotton Sector Reforms in Sub-Saharan Africa." Working Paper Series on Globalisation and Economic Restructuring in Africa. No. xxiv. Institute of International Studies. August 2003.

Lyford, C.P., S. Jung, and D.E. Ethridge. "Mill-level Price Estimates for Cotton Quality." Paper presented at the Southern Agricultural Economics Association Annual Meeting, Tulsa, OK. February, 2004.

May, O. Lloyd. "Quality Improvement of Upland Cotton (Gossypium hirsutum L.)." *Journal of Crop Production* 5 (2002):371-394

Meredith, Jr., W.R. "Influence of Cotton Breeding on Yield and Fiber Quality Problems." 2005 EFS Cotton conference. 2005. Online: http://www.cottoninc.com/2005ConferencePresentations/GeorgiaCottonUpdateMeredith/GeorgiaCottonUpdateMeredith.pdf?CFID=94420&CFTOKEN=84146930

Mogahzy, El, and Yehia E. "Cotton Blending: How the EFS System Can Help in Producing Optimum Yarn Quality." 1998 EFS Cotton Conference. 1998. Online: http://www.cottoninc.com/1998EFSConferencePresentations/CottonBlendingHowEFSCanHelp/

Nelson, J., and Misra S. "Economic Comparison of Alternative Cotton Harvesting Systems." *Proceedings of Beltwide Cotton Conferences*. Cotton Quality Measurements Conference, National Cotton Council, Memphis, TN. pp277-284. 2000.

Perkins, Henry H., Don E. Ethridge, and Charles K. Bragg. "Fiber." In *Cotton.* R.J. Kohel and C.F. Lewis Ed. American Society of Agronomy, Inc.: Madison, WI. 1984.

Pitts, Robert A. and David Lei. *Strategic Management: Building and Sustaining Competitive Advantage*. 2nd Ed. Cincinnati, OH: South-Western College Publishing. 2000.

Ribera, L., J. Richardson, and, J. Outlaw. "Comparison of the Cotton Costs of Production in the Americas." *Proceedings of Beltwide Cotton Conferences*. Cotton Quality Measurements Conference, National Cotton Council, Memphis, TN. Pp302-305. 2006.

Robinson, Joan. *Economics of Imperfect Competition*. London: MacMillan. 1933.

Spencer, Bill. "Competing in a Global Market." *Cotton Grower*, July 2004. Online: http://www.utexas.edu/centers/nfic/natnews/2004/Aug.2004.nat.htm#COMPETING%20IN%20A%20GLOBAL%20MARKET

U.S. Department of Agriculture. *2004 Texas Custom Rates Statistics*. Compiled by National Agricultural Statistics Service, and Texas Field Office. 2004.

U.S. Department of Agriculture. "Characteristics and Production Costs of U.S. Cotton Farms." Economic research Service (ERS), Statistical Bulletin, No. 974-1. October 2001. Online: http://www.ers.usda.gov/briefing/ARMS/resourceregions/resourceregions.htm#nass

U.S. Department of Agriculture. "Cotton Varieties Planted." Agricultural Marketing Service (AMS), Memphis, TN. various years.

U.S. Department of Agriculture. "Cotton World Markets and Trade Part 1." Foreign Agricultural Service (FAS), Online FAS. October 1997. Online: http://www.fas.usda.gov/cotton/circular/1997/97-10/oct97cot1.htm

van der Sluijs, Marinus H.J., S.G. Gordon, and M.W. Prins. "Australian Cotton: How Good Is It Really?: A Report on the Quality Needs and Perceptions of Australian Cotton by Domestic and Overseas Spinning Mills." Australian Cotton CRC and The Cotton Textile Research Unit, CSIRO Textile and Fibre Technology, Geelong. April 2004.

van der Sluijs, Marinus H.J. *Quality Issues for Australian Cotton from the Mill Perspective*. CSIRO Textile and Fibre Technology. Belmont, Victoria. Australia. 2004. Online: http://www.tft.csiro.au/textile_news/2004_issue%2013/pdf/cotton.pdf

Appendix

Suppose that there are two separate markets: one is the extant primary market and the other is an alternative submarket with different segment requirements. Let's say the extant market is the low-end coarse-count market and the alternative market is the high-end segment. Suppose that the supply of the product to be sold is fixed and that the cost of transferring the supply from the extant market to the alternative market is zero. Assume that there are two groups of buyers with different price elasticities of demand[24]. Define market 1 as the extant low-end market and market 2 as the high-end market segment to be specified within the extant market. Hence, the low-end market (market 1) is more price elastic in demand than the high-end market (market 2). Let total revenue (TR) function as $TR = R_1(Q_1) + R_2(Q_2)$, where R_i (i =1, 2) represents the revenue function of the i-th (i=1 or 2) market and each revenue function implies heterogeneous demand structures in each market. Let total cost (TC) function

[24] This is a plausible assumption because West Texas is currently serving low-end cotton market and the demand is considered as more price elastic than that of high-end market. It is common for most products with hierarchical vertical differentiation such as the quality spectrum of a product.

be $TC = C(Q)$ where $Q = Q_1 + Q_2$. One cost function is postulated because a representative farm produces cotton for both markets. Assume that costs of serving both markets are same[25]. Hence, the profit function is

$$\pi = TR - TC = R_1(Q_1) + R_2(Q_2) - C(Q).$$

Or,

$$\pi = P_1(Q_1)Q_1 + P_2(Q_2)Q_2 - C(Q_1 + Q_2), \text{ since } R_i = P_i \cdot Q_i \text{ where } i = 1, 2.$$

Now partial derivatives with respect to the choice variables, Q_1 and Q_2, respectively, will be,

$$\pi_1 = \frac{\partial \pi}{\partial Q_1} = P_1(Q_1) + Q_1 \frac{\partial P_1}{\partial Q_1} - C'(Q_1 + Q_2) = 0, \text{ since } \frac{\partial (Q_1 + Q_2)}{\partial Q_1} = 1$$

$$\pi_2 = \frac{\partial \pi}{\partial Q_2} = P_2(Q_2) + Q_2 \frac{\partial P_2}{\partial Q_2} - C'(Q_1 + Q_2) = 0, \text{ since } \frac{\partial (Q_1 + Q_2)}{\partial Q_2} = 1.$$

This represents the relationship of marginal revenue (MR) and marginal cost (MC) for profit maximization. Specifically, the level of Q for each market (Q_1 and Q_2) should be chosen such that the marginal cost (MC) of the total output should be equal to the marginal revenue (MR) in each market ($MC(Q) = MR_1(Q_1) = MR_2(Q_2)$). That is,

$$MR_i \equiv \frac{dR_i}{dQ_i} = P_i(Q_i) + Q_i \frac{dP_i}{dQ_i} = C'(Q_1 + Q_2) = \frac{dC_i}{dQ_i} \equiv MC_i.$$

For profit maximization, MC is fixed between the two markets, although the MR is different[26].
To find out how MR in any market is specifically related to the price of the separate market segments, the marginal revenue function is decomposed as,

$$MR_i = \frac{dR_i}{dQ_i} = P_i \frac{dQ_i}{dQ_i} + Q_i \frac{dP_i}{dQ_i} = P_i \left(1 + \frac{dP_i}{dQ_i} \frac{Q_i}{P_i}\right) = P_i \left(1 + \frac{1}{\varepsilon_{di}}\right)$$

where ε_{di}, the point elasticity of demand in the *i*-th market, is normally negative. Since the marginal revenue for each market should be equated to the marginal cost of total output by the first-order condition, the relationship between the two marginal revenues can be expressed as,

$$MR_1 = P_1 \left(1 + \frac{1}{\varepsilon_{d1}}\right) = MC_1 = MC_2 = P_2 \left(1 + \frac{1}{\varepsilon_{d2}}\right) = MR_2.$$

This implies that the revenues are constant at the optimum, even if a monopolistic firm sells one less unit in market 1 (or the extant market) and one more unit in market 2 (or alternative submarket), since the MR_i=MC where i =1, 2. Since the assumption is made for market 1 with higher elasticity of demand, its price level (P_1) should be lower than that (P_2) for market 2 in order for $MR_1 = MC_1 = MC_2 = MR_2$. Thus, it is possible to differentiate the price of each market, when two separate markets are served by a firm with market segmentation. This is an example of price discrimination with market segmentation by a firm or an industry to extend its extant market to additional submarket without changing its quantity of total supply, instead, pricing differently from or higher than the base price by sorting out premium products to serve high end market segments. This would entail the choice of output for which MC=MR in each of the markets.

[25] Even if the supply of cotton quality is different and turns out to be classed as high or low quality cotton, the cost of production ex ante is fixed in the aggregate. Only after classed, the markets for each bale can be designated according to the quality demand of cotton.
[26] As assumed, there is no cost of transferring the supply from the extant low-end market to the high-end submarket, and there is a single cost function serving each market.

Appendix Table 1. Three Types of Spinning[27]

Ring Spinning: over 60% of world's short-staple spinning; about 33% of U.S. spinning

- The oldest type of spinning techniques used today since 19th century
- The process of inserting twist by means of a rotating spindle
- A comparatively expensive process due to slower speed, in spite of better yarn quality
- The only system that can produce yarn at virtually any count from 4's to 240's
- The power of ring spinning lies in its unsurpassed yarn quality and in its diversity
- The primary reason for the survival of ring spinning may be particularly due to an era in which product-range flexibility has become a significant economic benefit factor
- Such diversity is not a result of the spinning design only but also (and often of more importance) a result of the art of fiber selection. Thus, fiber selection is very important

Rotor Spinning (Open-end Spinning): about 30% of world's spinning; about 40% of U.S.

- Rotor spinning inserts twists by means of a rotating conical receptacle into which the fiber is admitted
- Air current and centrifugal force carry fibers to the perimeter of the rotor where they are evenly distributed in a small group
- Very efficient and cost-saving spinning because no need for making a roving
- Speed of processing (3-5 times faster) and yarn uniformity is better than ring spinning
- Considerably weaker and often considered to have a harsh feel
- Low micronaire and high strength cotton fiber is required
- Major problem: dust and trash that accumulate in rotor groves and interfere with spinning

Air jet (Vortex) Spinning: less than 10% of world's spinning; about 24% of U.S. spinning

- The fundamental difference between air-jet spinning and rotor-spinning is that air-jet spinning is a false-twist method. While rotor-spinning requires a complete separation of fibers, and ring-spinning requires a complete continuity of fiber flow, air-jet spinning exhibits an intermediate feature in which only a partial separation of fibers is required for the consolidation mechanism
- Similar to rotor spinning, the input strand in air-jet spinning is a drawn sliver that may be carded or combed. The coherence mechanism in air-jet spinning is achieved by blowing out compressed air through air nozzle holes of about 0.4mm diameter to form an air vortex. Thus, air-jet spinning is often called vortex. Vortex spins at more than 300 meters per minute compared to about 30 meters per minute for ring spinning. Hence, it has very high productivity

[27] Various sources are used such as van der Sluijs (2004), Mogahzy and Yehia E (1998) and Felker (2001). In addition an online information is used from: http://www.icac.org/cotton_info/publications/samples/cotton _facts

Appendix Table 2. Importance of Fiber Quality Characteristics by Spinning Types

Source	Ring	Rotor	Air Jet
May* (2002)	1) Length 2) Strength 3) Fineness	1) Strength 2) Fineness 3) Length 4) Cleanliness	1) Length 2) Cleanliness 3) Fineness 4) Strength
Cotton Inc.	1) Strength and Elongation 2) Length and Uniformity 3) Short fiber content 4) Fiber-to-fiber friction (wax content) 5) Fineness 6) Stickiness 7) Trash content	1) Strength 2) Fineness 3) Short fiber content 4) Length Uniformity 5) Trash content/ Cleanness	1) Length and Uniformity 2) Short fiber content 3) Bending resistance 4) Trash content 5) Fiber-to-fiber friction (wax content)

* May (2002) and others such as Mogahzy and Yehia (1998), Estur (2004), Gordon (2001) and van der Sluijs (2004).

Summary of Quality Requirements by Spinning Technologies

1. Ring spinning requires a minimum fiber length (of 35-36 or 1.10-1.12 inches) and length uniformity (of min. 81), strength (of min. 26.5-28), and fineness (e.g. micronaire 4.2-4.4 with little variability) to a lesser extent. Fiber fineness determines how many fibers are present in the cross-section of a yarn of given thickness and it influences spinning limit and productivity and the strength, evenness, and fullness of yarn[28].
2. Rotor spinning or open-end spinning requires high fiber strength (of min. 26.5) along with fineness (with micronaire 3.5-4.9, or 3.8-4.2 with premium), and length (of min. 34 or 1.05-1.07 inches) to somewhat lesser importance.
3. Air jet spinning requires high fiber length and uniformity along with fineness (about the same micronaire range as ring), and to a lesser degree strength. According to Southeast Farm Press (2001), "Vortex (new spinning technology of air jet type) spinning requires such extremely high quality fiber to perform that it requires the mill to go into the segment of the marketplace and bid for that cotton." This technology removes short fibers less than on half inch in length with a narrower and lower micronaire range than traditional base micronaire range of 3.5-4.9[29].

[28] It should be noted that micronaire as a fiber quality characteristic indicates the fiber fineness and maturity but it does not directly evaluate fineness separately. Thus, micronaire value does not always represent the actual fineness of the fibers. The micronaire range is from Felker (2001).
[29] "Cotton Quality May Preserve Markets" (*Southeast Farm press*, August 18, 2004). http://www.findarticles.com/p/articles/mi_m0HEV/is_20_31/ai_n6160319/print

Appendix Table 3. Cotton Type vs. Textile End Products

	Fabric Type	Upper Half Mean Length (inch)	Strength (GPT)	Micronaire
▲▲▲ Higher-end Product	Sewing Thread	Over 1.10	26-32	3.7-4.2
	Shirting	1.10-1.18	26-32	3.7-4.4
	Combed Sheets (sheeting)	1.07-1.16	24-32	3.8-4.6
	Fine Knits (double knit)	1.06-1.16	24-32	3.4-4.6
	Velvets	1.06-1.16	24-32	3.7-4.9
	Sheer (home furnishings)	1.06-1.16	24-32	3.5-4.9
	Corduroy, Velveteen	1.06-1.14	24-32	3.8-5.5
	Knits (single knit)	1.04-1.14	24-32	3.5-4.9
	Twill	1.03-1.12	24-32	3.5-4.9
	Heavy Home Furnishing	0.95-1.10	24-30	3.2-5.0
	Rugs/Carpets	0.95-1.08	24-30	5.0 & higher
	Toweling	0.93-1.10	24-30	3.5-5.5
	Denim	0.92-1.10	24-30	3.0-5.0
▼▼▼ Lower-end Product	Heavy Canvas	0.92-1.10	24-30	3.0-5.0

Note: Based on the type of textile products at mills, the cotton quality requirements for such quality characteristics as length, strength and micronaire are provided. This shows the quality threshold levels defined by textile products[30]. Such fine textile products as shirting and knit goods use longer cotton fiber than lower-end textile products such as denim and heavy canvas.
Source: Cotton Incorporated (2005).

[30] Fiber length is viewed as the premier fiber quality because staple length is closely correlated with processing efficiency and the quality of the yarn produced (Perkins et al., p850, 1984).

Appendix Table 4. Quality Requirements and Share by Market Segments

Minimum/ Average Quality Requirements by Market Segment

Segment	SJV		ST		EM 1		EM 2		WT	
Character	Min	AVG	Min	AVG	Min	AVG	Min	AVG	Min	AVG
C1	3	2	4	3	4	3	4	4	5	Per Recap
C2	1	1	1	1	1	1	1	1	2	
Leaf	3	2	3	3	3	3	4	3	5	
Length	36	37	36	37	35	36	32	34	31	
Strength	29	31	28	29	26.5	28	26.5	28	25	
Micronaire	3.7-4.2		4.1-4.7		3.8-4.6		3.5-4.9		3.0-5.2	
Uniformity	82	82	81	82	81	82	80	81	79	

Market Share of West Texas Cotton by Segment (Lubbock Classing Office)

Segment		SJV		ST		EM 1		EM 2		WT	
Year	No.	Min	AVG	Min	AVG	Min	AVG	Min	AVG	Min	AVG
2001/02	lot [a]	0	0	0	0	0	0	0	0	3602	3602
	bale[b]	0	0	0	0	0	0	0	0	312918	312918
2002/03	lot	0	0	0	0	0	0	0	0	2946	2946
	bale	0	0	0	0	0	0	0	0	404622	404622
2003/04	lot	0	0	4	0	20	0	41	19	2881	2927
	bale	0	0	397	0	3348	0	4842	2685	326364	332256
2004/05	lot	0	0	0	0	0	0	0	0	5329	5329
	bale	0	0	0	0	0	0	0	0	647362	647362
2005/06	lot	4	0	26	1	372	1	1675	307	4575	4266
	bale	325	0	3224	1	54266	1	237854	41970	365823	619520
	%	**0.05%**	**0%**	**0.50%**	**0%**	**8%**	**0%**	**36%**	**6%**	**55%**	**94%**

Note: [a] refers to the number of lots satisfying the minimum or average requirements.
[b] refers to the number of bales meeting the requirements.
Source: Cotton Economics Research Institute, Texas Tech University.