Regime Proponent for Pricing Lint of Egyptian Cotton Varieties

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ABSTRACT

There are many potential quality combinations of fiber in Egyptian cotton and each quality can potentially have a different price thus cotton prices are not known with certainty (incorrect price) because of the diversity of quality attributes and end-uses, which leads to implications on both the operational and pricing efficiency of the cotton market. Also, incorrect price has implications for broader issues such as trade, international competitiveness and government policy. In practice, participants in the cotton market rely on pricing fiber quality that is generated externally (i.e., generated by someone else). Wherefore this paper presents a regime proponent for pricing Egyptian cotton lint quality accurately which leads to the efficient operation of the cotton industry.

***Key words*: Regime; Proponent; Pricing; Lint; Egyptian Cotton Varieties**

INTRODUCTION

The price of cotton variety depends on lint yield and quality, both of which are set by crop management practices in interaction with the growth environment. Fiber lint -in Egypt- is easily quantified in kentar per feddan, but fiber quality is a complex of both qualitative and quantitative properties like fiber length, length uniformity, fineness, maturity, strength, color, and trash content (area and count), hence improvements in fiber quality will best be achieved through optimization of the bulk fiber properties determined during cotton classing and through increasing fiber quality uniformity.

All segments of the cotton industry are directly or indirectly affected by cotton price, thus understanding of the role of price information to the cotton industry is not widespread, despite its relative importance. Cotton producers look at what they perceive the price to be at harvest in making decisions about which variety to plant, how much production inputs to apply. Textile mills use the prices of cotton to determine what types and how much cotton to purchase to produce given yarns and fabrics. Even support industries such as chemical and oil manufacturers, etc., are affected by the price of cotton, (Brown *et al,* 1995).

Grading the quality of cotton fibers by using High Volume Instrument, (HVI) being adopted in many countries that concerns planting cotton. HVI

has greatly increased the number of potential quality combinations that a bale or lot of cotton can have because of increasing the number of objective, reproducible quality designations that could given to each bale of cotton, and that's give increasing in measurement precision of cotton lint characteristics which should follow enhancing the efficiency of the marketing, (U.S. Dept. of Ag., 1992, 1993 and 1994). Knowledge of prices by buyers and sellers is essential for effective decision- making because of prices guide the production, marketing, and consumption of cotton. However, knowledge of the "structure" of the price (the general level of price and the differences for different qualities) is an integral part of the decision-making process, (Ethridge and Hudson, 1998).

Assuming the market is efficient in conveying price information; fiber prices (including price differentials for quality differences) are established at the fiber end-use point thus no single price can adequately reflect the market value of cotton since there are thousands of quality combinations for cotton fiber properties hence, the efficiency of textile production processes and the quality of final textile products also depend on fiber properties, (Chen *et al,* 1997).

In general, the objective of this paper is to demonstrate a proposed system for estimating an appreciation price of Egyptian cotton varieties by supplying market participants with more accurate information on fiber quality of which performs to improve the accuracy in pricing of different quality combinations of cotton fiber.

MATERIALS AND METHODS

The samples of four grades i.e. G/FG is Good to Fully Good, G is Good, FGF/G is Fully Good Fair to Good and FGF is Fully Good Fair of the Egyptian cotton varieties $Giza_{70}$, $Giza_{88}$, $Giza_{92}$, which belongs to extra long staple category. $Giza_{80}$, $Giza_{86}$ and $Giza_{90}$, which belongs to long staple category according to local practice in Egypt, taken from the successive season 2009 and were used as a material in the present paper.

Fiber upper half mean length (UHML) (m.m), uniformity index (UI%), short fiber index (SFI%), micronaire reading (MIC), fiber strength (FS) (g/tex), fiber elongation (FE %), fiber color included degree of reflectance (Rd%), brightness (+b) and trash content included Trash Area (TA), Trash Count (TC) were all determined on the (HVI) according to ASTM Designation, (D-4605-86-1776-98).

The cotton lint samples were spun into count 20 (Ne) carded ring yarn using the 3.6 twist multiplier.

Yarn skein strength (lea product) was measured according to ASTM Designation, (D- 1578-67, 1998).

All fiber tests were made at the laboratories of the Cotton Research Institute (CRI), Giza, Egypt under controlled atmospheric conditions.

As for the statistical procedures, the correlation and regression analysis were used according to Draper and Smith, 1966.

Analytic Hierarchy Process (AHP) was used to deal with the data obtained according to Saaty, 1980, 1983, 1990 and 1994 and Majumdar *et al,* 2004 and 2005.

RESULTS AND DISCUSSION:

Growers produce cotton, textile manufacturers use cotton, and the market value provides the time and form that appropriate for the product quality cotton, thus cotton production, marketing, and textile manufacturing are interrelated activities, (chen *et al* 1997), therefore, this paper provide an explanation for cotton varieties price differences according to their fiber quality differences manifested through the market value that included the most important characteristics of fiber placed in equation by using analytic hierarchy process. Furthermore, that market value should reflect achievable level of end-product quality (skein strength) in order to participate in make rational decisions like marketing, pricing and manufacturing.

Hierarchy formulation for Market Value Analytic Hierarchy Process (MV_{AHP}):

The reason for Analytic Hierarchy Process (AHP)'s popularity lies in the fact that it can handle the objective (market value) as well as subjective factors (fiber properties), Majumdar *et al* 2005.

Figure 1 shows the hierarchy that used for determining the market value in level 1 (the top of hierarchy) of the Egyptian cotton which should reflect an accurate base for pricing and also achievable level of end-uses quality (skein strength). The hierarchy also can handle the criteria (level 2) and sub-criteria (level 3) weights as follow, criteria that competent the market value can be classified in the second level of the hierarchy under five headings namely, trash properties, color properties, length properties, tensile properties and finally fineness properties. Sub-criteria are placed in the third level of the hierarchy and describing them as follows, trash properties divided into trash area (TA) and trash count (TC), color properties divided into two sub-criteria, degree of reflectance (Rd%) and brightness (+b). The relevant sub-criteria to be considered here of each of length properties are upper half mean length (UHML), uniformity index (UI%), short fiber index (SFI%), and tensile properties are fiber strength (FS) and fiber elongation (FE). Fineness (FF) is solely represented by the

micronaire value. The Egyptian cotton varieties will place at the lowest level of the hierarchy as alternatives for determining the market value.

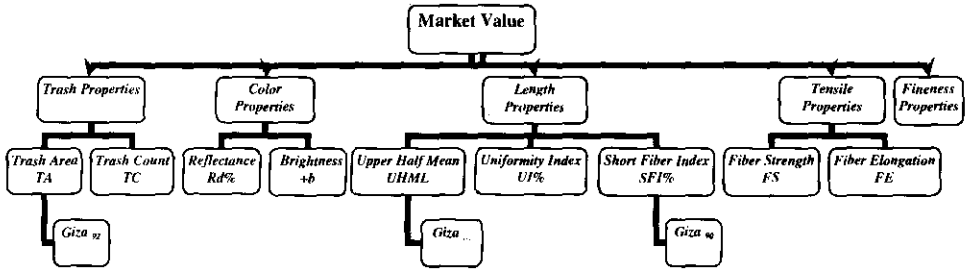

Figure (1): Hierarchical structure of cotton market value.

Formation of a pair-wise comparison matrix which is the heart of the Analytic Hierarchy Process (AHP):

Criteria weights can be determined in rational data according to Saaty's scale and this requires formulating matrix for the five criteria trash, color, length, tensile and fineness properties and the results are shown at Table 1.Table 1 clarified that, Trash properties essentially predominate over the fineness, while it contributed equally with color properties and intermediately over length and tensile properties when compromise is needed for determining market value of a cotton, same trend was in color properties except it was intermediately over fineness properties. The dominance of tensile properties contributed equally to length properties, while the same two criteria's (length and tensile) demonstrate a moderate preponderance over the fineness, (saaty, 1990).

$$\begin{Bmatrix} 1 & 1 & 2 & 2 & 5 \\ 1 & 1 & 2 & 2 & 4 \\ 1/2 & 1/2 & 1 & 1 & 3 \\ 1/2 & 1/2 & 1 & 1 & 3 \\ 1/5 & 1/4 & 1/3 & 1/3 & 1 \end{Bmatrix}$$

The five criteria pair-wise comparison matrix

Measurement of the consistency:

Calculating the normalized geometric mean (NGM) or weight vector according to, Majumdar *et al* 2004 and 2005, then measure the consistency of judgment by multiplying the pair-wise comparison matrix of the five criteria and weight vector (NGM) to obtain the product as follows:

$$\begin{Bmatrix} 1 & 1 & 2 & 2 & 5 \\ 1 & 1 & 2 & 2 & 4 \\ 1/2 & 1/2 & 1 & 1 & 3 \\ 1/2 & 1/2 & 1 & 1 & 3 \\ 1/5 & 1/4 & 1/3 & 1/3 & 1 \end{Bmatrix} * \begin{Bmatrix} 0.314 \\ 0.300 \\ 0.163 \\ 0.163 \\ 0.061 \end{Bmatrix} = \begin{Bmatrix} 1.569 \\ 1.508 \\ 0.815 \\ 0.815 \\ 0.307 \end{Bmatrix}$$

$$\lambda \max(\text{eigen vector}) = \left(\frac{1.569}{0.314} + \frac{1.508}{0.300} + \frac{0.815}{0.163} + \frac{0.815}{0.163} + \frac{0.307}{0.061} \right) \div 5 = 5.018$$

$$\text{Consistency Index } (CI) = \frac{5.018 - 5}{5 - 1} = 0.004$$

The random consistency index (RCI) according to saaty, 1980.

RCI values for different numbers of alternative (M)									
M	1	2	3	4	5	6	7	8	9
RCI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

$$\text{Consistency Ratio } (CR) = \frac{\text{Consistency Index } (CI)}{\text{Random Consistency Index(RCI)}} = \frac{0.004}{1.12} = 0.004 < 0.1 \, Acceptable$$

If the value of CR is 0.1 or less, then the judgment is consistent and acceptable. Otherwise we have to make some changes in the entry of the pair-wise comparison matrix, (satty, 1990).

By regarding column (NGM) in Table 1 we find that, trash properties denotes the most dominant effect on market value of Egyptian cotton with relative weight 0.314, while color properties ranked second by relative weight 0.300. Tensile and length properties were in equal effect on market value where given relative weight 0.163, while fineness was in marginal effect (0.061) on market value of Egyptian cotton.

Account the sub-criteria weights (global weight):

This step is concerned with finding the relative weights (global weight) of various sub-criteria described in level 3 at Figure 1 with respect to the corresponding criteria described at the same figure in level 2. The pair-wise comparison matrices between the sub-criteria are which made according to catty's scale and their global weights are shown in Table 1.

Calculating global weights of each of sub-criteria (TA- TC- Rd%- +b- FS- FE- UHML- UI%- SFI) with respect to corresponding criteria, respectively trash, color, tensile and length properties, by multiplying the weight vector (NGM) of sub-criterion and the weight vector (NGM) of corresponding criterion with respect to the objective (market value).

For example, the global weight of trash area (TA) is 0.667 x 0.314 = 0.209, therefore, the global weights for the rest of sub-criteria respectively, TC = 0.104, Rd% = 0.250, +b = 0.050, FS = 0.142, FE = 0.020, UHML = 0.127, UI = 0.018, SFI = 0.018. As mentioned previously fiber fineness (FF) is solely represented by the micronaire value (mic), so it's global weight 0.061.

Global weights of sub-criteria at Table 1 clarifies that the Rd%, TA, FS and UHML plays an exceptionally important role in determining market value of the Egyptian cotton confirms this their relative weights respectively (0.250, 0.209, 0.142 and 0.127) in comparison with either sub-criteria TC, FF, +b, FE, UI and SFI, with relative weight, respectively, as follows (0.104, 0.061, 0.050, 0.020, 0.018 and 0.018).

Market value (MV_{AHP}) of the Egyptian cotton:

Formulation of that present equation which reflects market value of a cotton through proposed an numerical expression which includes the most important fiber properties was based on regression analysis between fiber properties which taken in consideration degree of reflectance (Rd%), brightness (+b), trash area (TA), trash count (TC), fiber strength (FS), fiber elongation (FE), upper half mean length (UHML), uniformity index (UI%), short fiber index (SFI%), fiber fineness (mic) and carded ring skein strength at count 20 Ne.

Regression analysis indicates that, positive sign regression coefficients with skein strength was belong to fiber properties (Rd, FS, UHML, mic and +b), wherefore, that fiber properties represented the numerator of the market value equation. By contrast, the denumerator of the equation included fiber properties (TA, FE, SFI, TC and UI) that had negative sign regression coefficient with skein strength.

$$MV_{AHP}=\frac{Rd^{0.250}*FS^{0.142}*UHML^{0.127}*mic^{0.061}*+b^{0.050}}{TA^{0.209}*FE^{0.020}*SFI^{0.018}*TC^{0.104}*UI^{0.018}}$$

The consequent of the market value (MV_{AHP}) equation represents a numerical base for pricing cotton lint in confirm with the most important fiber properties as shown in Table 2. Also, that market value reflects achievable level of end-use quality represented in the value of the correlation (0.7) between carded ring skein strength at count 20 (Ne) and values of the market value (MV_{AHP}). But the price is controlled by other factors not less important than the quality as pointed out Estur, 2008, Brown and Ethridge, 1995 that the price of the domestic market and export of cotton lint is primarily linked to the quality of fiber properties as well as

the non-quality factors such as the way it is marketed according to market mechanisms of supply and domestic and foreign demand, also government support for the cotton crop.

Table 3 clarifies that; Egyptian cotton verities are classified under two heading white colored cotton i.e. $Giza_{70}$, $Giza_{86}$ and $Giza_{92}$, creamy colored cotton i.e. $Giza_{80}$, $Giza_{88}$ and $Giza_{90}$. According to MV_{AHP}, each variety will be exhibit in the form of average, max and minimum of numerical market value (MV_{AHP}). In exchange for the average market value of each of variety will have the base price, followed by premium and discount of its base price in conformity with Increase or lack of market value (MV_{AHP}).

With regard to Table 3 we will find the average of market value (MV_{AHP}) which belongs to $Giza_{80}$ (4.32) is lower than market value of $Giza_{90}$ (5.14) as shown in Table 3, although both varieties creamy colored and belongs to long staple cotton category. The difference in average clarifies trash properties (TA and TC) in grades of variety $Giza_{80}$ which is higher than those in variety $Giza_{90}$ as shown in Table 2. The same interpretation applies to averages market value (MV_{AHP}) of varieties $Giza_{86}$ (5.97) which belong to long staple category and $Giza_{92}$ (5.81) which belong to extra long staple category despite marginal difference between averages market value (MV_{AHP}) of varieties $Giza_{86}$ and $Giza_{92}$.

Finally, determining the base price of each variety will be linked to each of fiber quality that represented by market value (MV_{AHP}) in numerical expression through importance (power values) of ten fiber properties and non-quality factors as we mentioned previously, such as needs of the market system as well as government support for the cotton crop, and then increase or decrease the base price accordingly to increase or decrease the MV_{AHP}, taking into consideration the non-quality factors.

Table (1): Pair-wise comparison matrices of the five criteria and its sub-criteria

Pair-wise comparison matrix of the five criteria related to market value

Criteria	Trash	Color	Tensile	Length	Fineness	Normalized Geometric Mean (NGM)
Trash	1	1	2	2	5	0.314
Color	1	1	2	2	4	0.300
Tensile	½	½	1	1	3	0.163
Length	½	½	1	1	3	0.163
Fineness	1/5	¼	⅓	⅓	1	0.061
Consistency Ratio (CR) = 0.004						

Sub-criteria pair-wise comparison matrix related to trash properties

Sub-criteria	Trash Area (TA)	Trash Count (TC)	NGM	Global weight
Trash Area (TA)	1	2	0.667	0.209
Trash Count (TC)	0.5	1	0.333	0.104
Consistency Ratio (CR) = 0				

Sub-criteria pair-wise comparison matrix related to color properties

Sub-criteria	Reflectance (Rd %)	Brightness(+b)	NGM	Global weight
Reflectance (Rd %)	1	5	0.833	0.250
Brightness (+b)	0.2	1	0.167	0.050
Consistency Ratio (CR) = 0				

Sub-criteria pair-wise comparison matrix related to tensile properties

Sub-criteria	Fiber strength(FS)	Fiber elongation(FE)	NGM	Global weight
Fiber strength(FS)	1	7	0.875	0.142
Fiber elongation(FE)	0.14	1	0.125	0.020
Consistency Ratio (CR) = 0				

Sub-criteria pair-wise comparison matrix related to length properties

Sub-criteria	Upper Half Mean Length (UHML)	Uniformity Index (UI %)	Short fiber Index (SFI)	NGM	Global weight
Upper Half Mean Length (UHML)	1	7	7	0.778	0.127
Uniformity Index (UI %)	0.14	1	1	0.111	0.018
Short Fiber Index (SFI)	0.14	1	1	0.111	0.018
Consistency Ratio (CR) = 0					

Saaty's scale, 1990 which defines and explains the fundamental relational scale for pair-wise comparisons

Intensity of importance on an absolute scale	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective.
3	Moderate importance of one over another	Experience and judgment slightly favor one activity over another.
5	Essential or strong importance	Experience and judgment strongly favor one activity over another.
7	Very strong importance	An activity is strongly favored and its dominance is demonstrated in practice.
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation.
2,4,6,8	Intermediate values between two adjacent judgment	When compromise is needed.
Reciprocals	If activity p has one of the above numbers assigned to it when compared with activity q, then q has the reciprocal value when compared with p.	

Table (2): Cotton fiber properties and the market value (MV_{AHP}) of four grades of Egyptian cotton varieties

Variety	Grade	Fiber properties										MV_{AHP}
		Rd %	FS	UH ML	TC	Mic	+b	TA	FE	SFI	UI	
Giza 92	G/FG	75.6	49.0	33.5	23.00	3.9	7.7	0.35	6.8	6.1	86.5	7.47
	G	74.6	47.2	33.0	60.75	3.8	7.6	0.96	6.5	6.2	85.3	5.38
	FGF/G	74.0	46.4	32.8	65.50	3.8	8.1	0.96	6.4	6.2	85.6	5.33
	FGF	73.7	43.4	32.8	67.50	3.8	8.4	1.17	6.4	6.3	86.3	5.05
Giza 70	G/FG	75.3	48.8	35.1	27.75	4.3	7.7	0.51	6.6	5.9	87.2	6.82
	G	70.7	45.7	34.4	92.50	4.3	7.9	1.43	6.7	6.0	87.6	4.72
	FGF/G	70.2	44.3	34.2	101.75	4.0	7.7	1.62	6.5	6.1	86.7	4.50
	FGF	70.4	44.1	33.9	101.50	3.9	8.3	1.71	6.8	6.4	86.3	4.45
Giza 88	G/FG	67.7	49.2	35.3	21.25	4.3	11.7	0.26	6.2	6.1	87.2	8.05
	G	67.1	50.5	35.7	37.50	4.1	11.7	0.62	6.5	6.1	87.0	6.33
	FGF/G	66.0	47.0	34.0	73.75	3.6	11.4	1.15	6.6	6.2	86.4	5.03
	FGF	64.4	42.9	33.9	70.00	3.3	11.7	1.11	6.7	6.4	85.5	4.97
Giza 86	G/FG	77.5	46.0	33.2	15.75	4.8	8.2	0.40	6.8	5.9	87.2	7.63
	G	75.0	44.6	32.7	26.75	4.7	8.1	0.58	6.8	5.9	86.2	6.56
	FGF/G	72.9	43.9	32.2	55.75	4.5	8.1	1.27	7.1	6.3	86.1	5.08
	FGF	70.1	41.1	31.0	85.75	3.6	8.8	1.38	7.1	6.5	84.0	4.62
Giza 80	G/FG	66.2	38.2	30.8	50.25	4.6	12.2	0.45	7.5	6.9	84.9	6.19
	G	60.8	35.0	30.6	145.75	4.4	11.5	1.85	7.6	6.1	83.7	3.97
	FGF/G	60.9	33.7	29.7	146.00	4.3	11.8	2.20	7.9	6.3	80.0	3.79
	FGF	60.6	32.6	29.1	213.75	3.9	11.7	3.03	8.2	8.1	80.9	3.34
Giza 90	G/FG	67.7	33.0	28.7	22.25	4.3	11.7	0.23	7.8	6.9	83.1	7.50
	G	65.1	33.0	28.3	52.75	4.2	11.5	0.90	7.6	7.1	82.0	5.09
	FGF/G	64.5	32.5	27.9	103.25	4.0	11.4	1.21	7.9	7.2	82.1	4.42
	FGF	60.5	29.7	27.8	177.50	3.7	11.5	2.23	7.4	7.8	81.3	3.56

G/FG: Good to Fully Good, **G:** Good, **FGF/G:** Fully Good Fair to Good and **FGF:** Fully Good Fair.

Table (3): Proposed pricing system of Egyptian cotton varieties as well as their market value (MV_{AHP})

White colored cotton								
	Giza 70			Giza 86			Giza 92	
	MV_{AHP}			MV_{AHP}			MV_{AHP}	
Max.	6.82	Premium	**Max.**	7.63	Premium	**Max.**	7.47	Premium
Avg.	5.12	Base price	**Avg.**	5.97	Base price	**Avg.**	5.81	Base price
Min.	4.45	Discount	**Min.**	4.62	Discount	**Min.**	5.05	Discount
Creamy colored cotton								
	Giza 80			Giza 88			Giza 90	
	MV_{AHP}			MV_{AHP}			MV_{AHP}	
Max.	6.19	Premium	**Max.**	8.05	Premium	**Max.**	7.50	Premium
Avg.	4.32	Base price	**Avg.**	6.09	Base price	**Avg.**	5.14	Base price
Min.	3.34	Discount	**Min.**	4.97	Discount	**Min.**	3.56	Discount

Max. = Maximum, Avg. = Average and Min. = Minimum.

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الملخص العربى

نظام مقترح لتسعير تيلة أصناف القطن المصرى

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لايرتبط سعر القطن الشعر بجودة ألياف فقط ولكن يرتبط بعوامل أخرى تتعلق بآليات سوق القطن من عرض وطلب وطريقة التسويق لمحصول القطن سواء على المستوى المحلى أو المستوى العالمى. من ناحية خواص الألياف وتصنيعها، فإن الإختلاف فى الصفات وكذلك نوعية المنتج النهائى يؤدى للإختلاف فى التحديد الفعلى لسعر القطن، وهذا الإختلاف فى السعر يؤدى الى عدم معرفة السعر الحقيقى (القيمة التسويقية) لهذه الألياف، كما أن تسعير هذه الألياف أو تحديد القيمة التسويقية لها والذى يتم بواسطة أكثر من جهة معنية بمحصول القطن. ولذلك تظهر أهمية وجود نظام موحد لتسعير أصناف القطن بدقة بحيث يقوم هذا النظام على أهم صفات الألياف التى تؤثر فى جودتة شعر القطن.

ونظراً لما سبق فإن هذا البحث يقدم نظام مقترح لتسعير أصناف القطن المصرى على أساس القيمة التسويقية لكل صنف معبراً عنها رقمياً متضمنة أهم صفات ألياف القطن، مع الوضع فى الإعتبار عند وضع السعر آليات السوق وطريقة الدعم الحكومى لمحصول القطن وكذلك باقى العوامل الأخرى غير المتعلقة .