The Egyptian Cotton and Textile Industry: The Last Chance of Survival

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Introduction

As a starting point, I am very optimistic that the Egyptian cotton and textile industry is taking positive steps toward improving the industry. I have been very critic in the past of the decline in the cotton and textile industry and the millions of dollars losses of the industry. I have also been critic of the decline in the Egyptian cotton production. My criticism has always been based on data and information from unbiased international sources. On the other hand, I do not have any interest whatsoever in making business in Egypt and most of my company's business is abroad in countries like Vietnam, Bangladesh, Turkey, Pakistan, Australia, Brazil, Azerbaijan, and of course U.S.A.

The last few years have witnessed many positive changes in the Egyptian economy. These changes are likely to result in significant progresses in the Egyptian economy. Key achievements such as the liquidation of the Egyptian currency, the increase in foreign investments in Egypt, the increase in exports, the increase in tax revenues, and the government energy subsidy reforms will result in substantial economic growth in the years to come. However, many challenges are still ahead before Egypt assumes its top deserving position in the world's economy. Undoubtedly, more social reform is needed, and this will not happen only by the government feeding and caring for people but more importantly by people feeding and caring for themselves through working and making better living. The responsibility of the government in this regard will be to provide adequate education, affordable healthcare and job opportunities. This is where the Egyptian cotton and textile industry can greatly assist. The potential for a tremendous growth in this industry stems from two critical factors: the geographic access of Egypt to Africa, Europe and Asia, and the high percent of younger generation. However, having seen previous efforts over the last twenty years, one cannot jump into a conclusion of the outcomes of these efforts.

In recent years, I had the opportunity to evaluate models of the cotton and textile industry in five different countries and participate in their developments. We worked with countries such as Vietnam and Bangladesh that do not produce cotton, yet they assume the top of the chart of exporting textile products. Vietnam consumed 7.6 million cotton bales and Bangladesh consumed 8.4 million cotton bales in 2019. We worked with countries that produce significant amount of cotton, consume all their cotton domestically, and import more cotton to meet the domestic and export demand such as Turkey and Pakistan. In 2019, Turkey produced 4.1 million cotton bales, imported 3 million bales, and consumed all this cotton for domestic and export of textiles. Pakistan produced 8 million cotton bales and imported nearly 3 million bales to meet its cotton consumption demand, which reached nearly 11 million bales in 2019. We also worked with countries that have revived their cotton production after many years of decline and increased it by over 450% only in the last 5 years such as Azerbaijan.

In comparison with the above models, Egypt provides a unique model. The Egyptian cotton needs no introduction to the world as it is perceived by the whole world as the highest quality Extra-Long-Staple (ELS) cotton in the world. Yet, the production of this cotton declined from over 0.5 million bales in 2014 to 170,000 bales in 2016; up to 0.5 million bales and in 2018 down to 350,000 bales in 2019. This was a direct result of the change in the cotton harvested area from 157,000 HA in 2014, to only 55,000 HA in 2016; up again to 141,000 HA in 2018; then down to 100,000 HA in 2019. This inconsistent trend makes it very difficult to asses whether the Egyptian cotton production is on the rise or in a downward pattern. Yet, based on the data available since 2014, there seems to be a strategy of the Egyptian cotton production in view of the magnitude of export, the amount of imported cotton, and the domestic consumption. Since 2014, the production of the Egyptian cotton has been directly proportional to cotton export (correlation of 0.690) and inversely proportional to the import of foreign cotton in Egypt (correlation of -0.702). This means that the higher export of Egyptian cotton, the higher the cotton production, and the more foreign cotton imported to Egypt the lower the Egyptian cotton production. More interestingly, the production of Egyptian cotton is directly proportional to the domestic consumption of the Egyptian textile industry (correlation of 0.732). Obviously, the limited data and number of years do not provide enough indication on what will happen in the near future, but the hope is that the data reflect policies and strategies and not random changes.

Over the last 40 years, many attempts have been made to modernize the Egyptian textile industry and many confusing policies have been established to deal with the Egyptian cotton which was once the biggest source of national income in Egypt and it was called “the white gold” to turn into a disastrous performance leading to a major decline in the value and the income of the Egyptian farmer and contribute directly or indirectly to the collapse of the Egyptian textile industry. Assuming that there was indeed a new strategy over the last four years to deal with the Egyptian cotton and in light of the huge recent investments in the Egyptian textile industry, two questions remained to be answered: (1) What is the future of the Egyptian cotton in this strategy? and (2) What are the types of foreign cotton that should be imported for the Egyptian textile industry? I am sure the Egyptian authorities have addressed these two questions in developing their new strategies. However, I had no access to any information in this regard. Therefore, I will make my modest contribution in addressing these two critical questions.

What is the future of the Egyptian Cotton?

As indicated above, the Egyptian cotton needs no introduction to the world as it is perceived by the whole world as the highest quality Extra-Long-Staple (ELS) cotton in the world. Given the limited production of the Egyptian cotton and the small total amount of ELS cotton produced around the world, there should be a significant market for the Egyptian cotton. The world still and will continue use a significant amount of fine and high-quality textiles at significantly high prices. A 600 to 1000 thread-count bed sheet set made from 100% authentic Egyptian cotton still a hot value in the textile market. Many fine dresses made from Egyptian cottons are sold around the world with prices reaching several hundreds and even thousands.

Theoretically, the Egyptian cotton needs no branding as it is self-branded in terms of its inherent quality. In the early 1970s, when Egypt was producing 2.2 million Egyptian cotton bales, it was using 1.0 million bales domestically, and exporting 1.2 million bales. This was the era of intelligent agricultural and industrial strategies supported by top economic experts. All this happened while Egypt was in the middle of a war with Israel. In a recent move by the Egyptian authority, a new branding strategy was developed for the sake of protecting the name and reputation of Egyptian Cotton^{TM}. This is a positive step to restore consumer and retailer confidence in the Egyptian cotton. This issue bring me to discuss what it means to market and brand a cotton in today's world market, which is one of the major activities that my company has done in different cotton-producing countries.

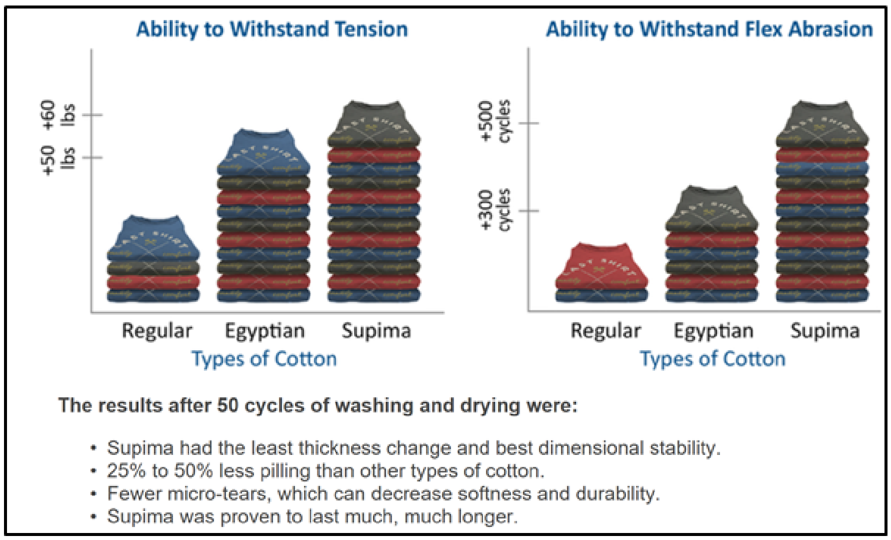
Marketing and branding cotton should be based on three-way strategy:

1. **Market Strategy:** Market analysis to determine the potential of utilizing Egyptian cotton both in the domestic and international market
2. **Cotton-Production Strategy:** Focus on cotton production from planting to harvesting and ginning with a great emphasis on fiber quality and sustainability
3. **Cotton-Performance Strategy:** ELS cotton should not only be represented in terms of its inherent characteristics as consumers and retailers would not really care about these characteristics. More importantly, it should be represented in terms of the quality and performance of the textile products made from the cotton.

My focus in this article is on the third strategy. Some of the good signs in the last two years is the renewed concern of the Ministry of Trade and Industry about reviving the identity of the Egyptian cotton and assuring its world's trademark. The Ministry also indicated that there will be a great deal of emphasis on the textile products made from Egyptian cotton. These concerns are not new and many ministries in the past have expressed the same concerns. I hope this time, true actions can be taken based on a reliable and integrated strategy that ties cotton production with marketing and utilization of the Egyptian cotton. Obviously, attempting to protect the Egyptian cotton from fiber-identity theft is important but it will weigh nothing if the performance of end product made from 100% authentic Egyptian cotton is poor or not up to the world's standards. The false belief that merely protecting the identity and authenticity of cotton will result in solving the Egyptian cotton problem represents a true narrow-minded thinking by people who know very little about textiles. My experience with fiber-identity theft based on extensive research in this area suggests that no matter how much effort we make in the DNA field, **the ultimate true identity theft can only be detected through basic physical testing of fibers extracted from textile products**. This is not to doubt DNA efforts but rather to point out the critical importance of fiber characteristics in producing high-quality textile products.

In 2001, my company participated in a large study sponsored by Supima Association in the U.S.A. for the purpose of comparing different types of cotton including ELS and Upland cotton. This was a very unique study as it was based on surveying the retail market and collecting commercial textile products (bed sheets and knit and woven dresses) made from different cotton types and under the exact same product specifications. Detailed analyses were made on these products to assure comparability and fiber authenticity using both physical testing and DNA, all performed by independent laboratories that were never told about sample identity. The key parameter in this study was the durability of textiles after repeated washing and drying. As it is well known, products such as bed sheets used by hotels can deteriorate rapidly and in a short period of time due to the frequent and repeated use. This was a study based on inductive reasoning; meaning, instead of making expectations or conducting laboratory work to produce samples, we went straight to comparable textile products available in the market and performed detailed analysis of their durability specifications such as tensile, tear, and bursting strength and breaking elongation, dimensional stability, and surface characteristics (abrasion resistance, pilling resistance, etc.). Validation of the results of the study was also made using independent judges.

The results of the above study were consistently in favor of the Supima cotton. This was not only by our judgment but more importantly by the independent panel which represented textile experts and consumers of textile products using the textile samples used in the study. The point here is that although cotton type and fiber properties are critical factors in making textiles, optimum transformation of fibers into textile products and careful dyeing and finishing represent the key to reflect the merits of good fiber properties in any textile product; it is the "know-how."



The point of the above discussion is that although fiber type and fiber properties are important, today's textile machinery, particularly in the spinning segment, are not so kind or gentle. The high speeds of todays technology cause a great deal of harm to fibers and the spinner is struggling with the trade-off between high speeds and high production rates at the expense of waste reaching in some cases to up to 30%, and low-speed/low production rates and high cost to produce good quality. The inverse relationship between cost and quality is still alive and well in the spinning segment of the industry and process optimization is the key for better performance starting with the strategy of fiber selection and blending and ending with processing optimizations in spinning preparation.

Another important aspect of branding stems from the fact that cotton types are hardly used in a standalone approach. They are often blended with other cottons. During my work with Manufatura di Leganon in Italy, we were blending Egyptian cotton with Supima cotton and other ELS cotton such as Peruvian Pima and Chinese ELS cottons. The Chinese ELS cotton was by all means the worst in quality; it was also very harsh and difficult to process. Yet, Manufatura di Leganon was able to produce top quality yarn from this cotton through adequate blending and optimization techniques.

Another unpopular issue that the Egyptian cotton and textile industry must be prepared to face in the near future is blending ELS cotton with medium-staple upland-like cotton to produce intermediate quality products at the lowest cost possible. This approach has become a reality and my company is currently helping two companies around the world making successful blending from ELS and upland-like cotton. This approach will make fiber-identity theft irrelevant as the ultimate goal will be the quality and performance of end product at the right price. Keep in mind that there is a new generation buying textile products and fast fashion is at its peak. This means that products will become obsolete way before they depreciate and the view of quality will be for a product to perform so well within a short lifespan before it is quickly thrown away and replaced by another product.

Upland-Like Cotton

Upland-like cotton (G. hirsutum) represents about 90% of the cotton produced around the world. It is typically of much shorter staple length (22 to 27 mm) than the Long-Staple (LS) or Extra Long-Staple (ELS cotton (> 32 mm), which represents less than 4% of the total cotton production. Upland cotton also exhibits lower fiber strength (23-33 g/tex) than ELS cotton (35-45 g/tex). Unlike the limited market niche for ELS cotton (e.g. fine thread-count bed sheets and top-quality luxurious clothing), upland-like cotton is used for all other cotton textile products. Upland-like cotton can also be produced at much higher yield and significantly lower cost than ELS cotton.

The above brief comparison between upland-like cotton and ELS cotton leaves no doubt that the true potential market for the Egyptian (ELS) cotton should consist of three different channels:

(a) To export to other countries that can make top-quality fabrics and garments from Egyptian (ELS) cotton
(b) To domestically produce top-quality fabrics and garments from Egyptian (ELS) cotton
(c) To invite foreign investors and expertise to Egypt who can produce top-quality fabrics and garments from Egyptian (ELS) cotton

From an economic viewpoint, the most feasible channel is to export Egyptian ELS cotton at premium prices and flood the domestic market with upland-like cotton to meet both domestic and export demands of cotton textile products. This upland cotton can either be imported (the most feasible approach) or grown in Egypt (long-term approach with unpredictable outcomes). The traditional fear of growing upland-like cotton in Egypt has been primarily due to its influence on the traditional reputation of the Egyptian cotton being one of the highest-quality cottons in the world and the fear of mixing ELS and Upland-like cottons in Egypt. These factors may lead to a new textile industry in Egypt relying almost totally on imported Upland-like cotton to produce textiles for domestic use and export. Although, this is relatively a new approach in Egypt, many private companies have been importing foreign cottons to produce textiles domestically. This section is to provide key guidelines to these companies on the best ways to select foreign upland cotton.

Egyptian textile companies importing foreign Upland-Like cottons should keep in mind the following points:

1. For cost and supply reasons, a company cannot rely on only one type of cotton for a long period of time. This means that cottons of different origins must be purchased
2. Although cotton blending is the oldest practice in the textile industry, it has been restricted to blending different varieties of the same type of cotton
3. The new worldwide trend is to blend cottons of different origins. This requires special experience and many experimentations to reach optimum blending performance. In the last three years, 80% of my company's activities around the world was assisting spinning companies in the area of cotton fiber selection and blending of different cotton origins. Currently, my company is involved in a large project sponsored by the Cotton Council International of the U.S.A. in which many cottons of different origins are being blended together at different proportions to establish guidelines of optimum blending for ring-spun, compact, open-end spun, and air-jet yarns.

It is critical to know that blending of cottons of different origins is fundamentally different than blending of cotton varieties within the same type of cotton. Cottons of different origins are very different in their **"processing propensity"** by virtue of the many factors such as different surface characteristics and different resilience. This point is summarized in Figures 1 and 2 in which cottons of different origins are compared. The cottons compared in these figures exhibit the same standard HVI fiber properties. Again, elaboration on the causes of these differences are outside the scope of this article but the point is clear that blending cottons of different origins should not only be based on the standard HVI fiber properties but more importantly on other key factors such as: (a) Growing area, (b) Harvesting method (hand-picked or mechanically-picked), (c) Type of mechanical harvesting (spindle-picking or stripper picking), and (d) type of ginning (roller ginning or saw-ginning). These factors make blending of cottons of different origins highly nonlinear and very careful blending analysis must be made to optimize the cost and quality.

The U.S. upland cotton has no place in the Egyptian market!!!. This is a puzzle that I cannot understand although I have been told about many irrelevant reasons. Mark my words, I do not see a prospered future of the Egyptian textile exports both marketing-wise or quality-wise, without the use of U.S. cotton. The reality is the U.S. cotton is the most reliable cotton in the world. It is the most tested cotton in the world as since 2000 more than 260 million U.S. cotton bales were exported abroad and used by many countries around the world with virtually no compnaits. It is the only cotton in the world that is 100% tested and can be guaranteed for given fiber properties using the "Green-Card" system. The quality of the U.S. cotton is absolutely uncontested. While many cottons around the world are restricted to coarse micronaire range, which means lower spinnability limits, the U.S. cotton has the widest range of all fiber properties. To give you a simple example, in 2018 alone, there was more than 5 million U.S. cotton bales exhibiting top fiber properties of upland-like cottons: Micronaire of 3.8 to 5.5; fiber length of 1.15 to 1.3 inch; uniformity of 80% to 87%; fiber strength of above 30 g/tex; color Rd of above 70; and +b below 9.5. Despite the fact that U.S. cotton is saw-ginned, there is nearly 7 million U.S. cotton bales of less than 9% short-fiber content; over 5 million bales of neps/g below 250; and 12 million cotton bales of less than 0.5% trash area. Approximately, 90% of the U.S. cotton is contamination free.

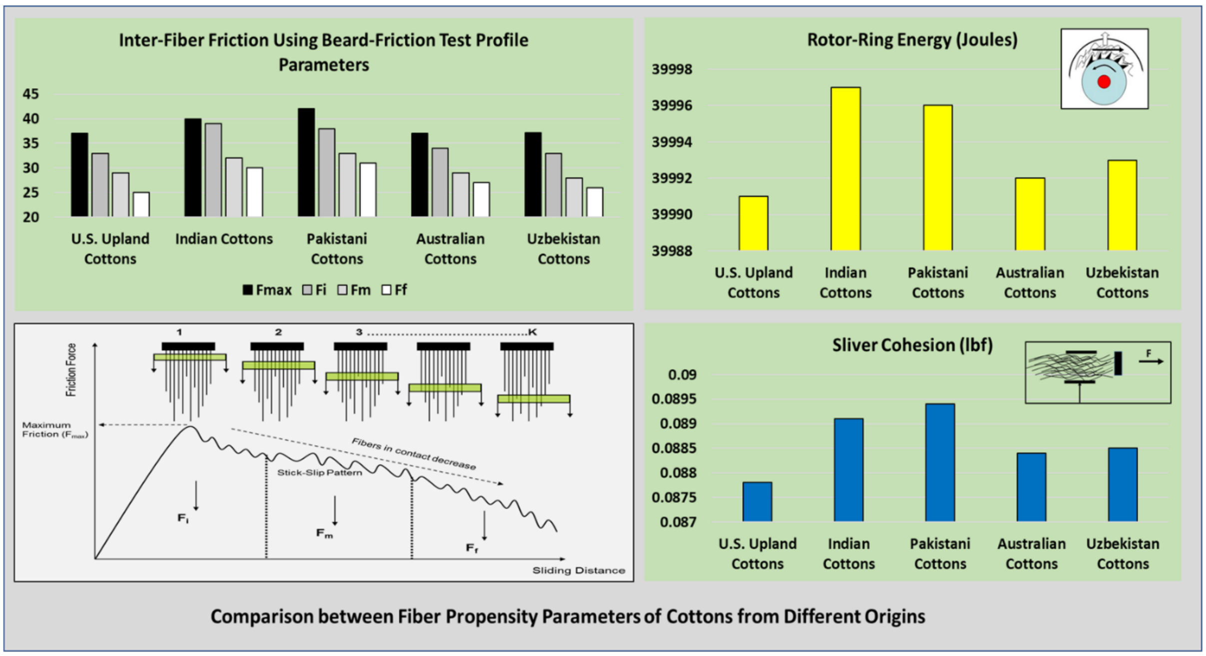
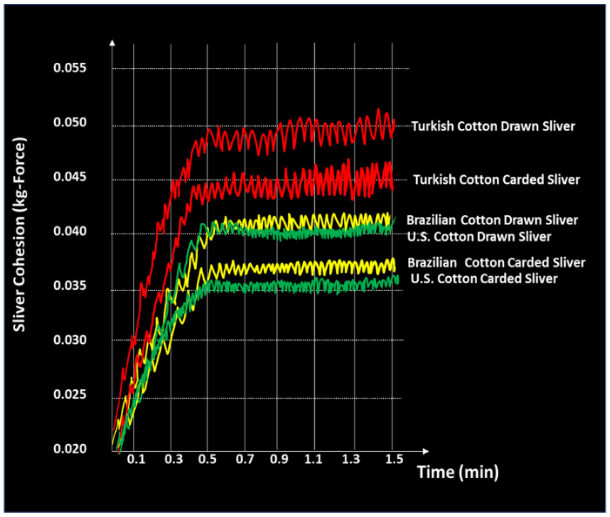
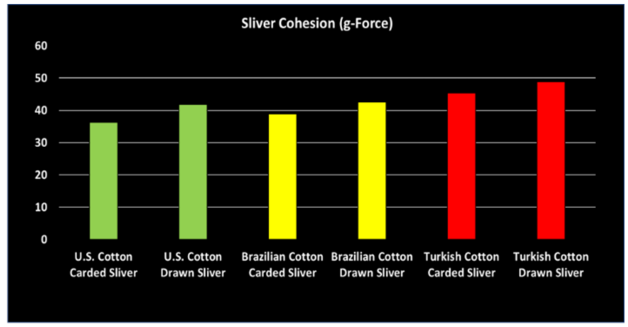


Figure 1. Processing Propensity of Different Cottons (By Inter-fiber friction, and energy)-Elmogahzy 2014





Cotton	Sliver Cohesion (g-Force)
U.S. Cotton Carded Sliver	36.28
U.S. Cotton Drawn Sliver	41.75
Brazilian Cotton Carded Sliver	38.92
Brazilian Cotton Drawn Sliver	42.56
Turkish Cotton Carded Sliver	45.35
Turkish Cotton Drawn Sliver	48.82

Figure 2. Processing Propensity of Different Cottons (By Sliver Cohesion)-Elmogahzy 2019

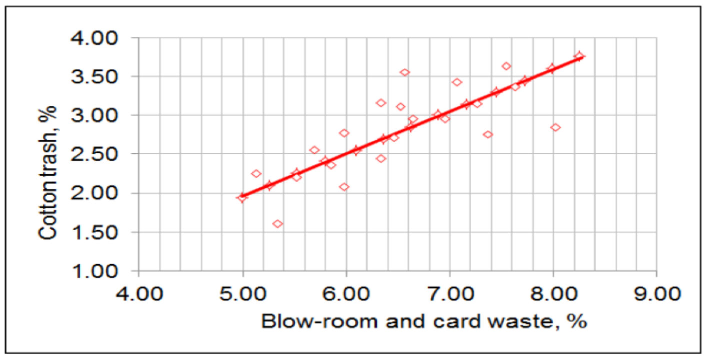
The Egyptian spinners must understand that the price of cotton is not the only factor to use in purchasing cotton. A cheap low-quality cotton could mean a substantial cost increase in manufacturing the cotton either through high opening and cleaning waste or due to high comber noil. In addition, cheap cotton will certainly yield low-quality yarn.

The Value of an Upland-Cotton Bale

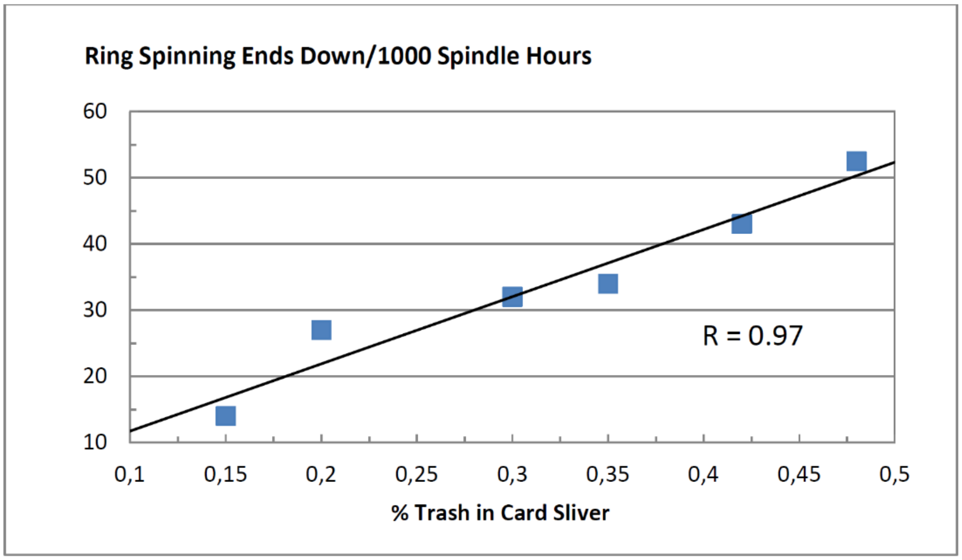
The value of a cotton bale begins with the selection of seeds or cotton genetic variety. This is what determines the yield and the fiber length produced. Variation in fiber maturity is largely due to environmental effects (soil type, insect pressure, weather, growing area and season length). The harvesting and ginning method will influence the so-called induced fiber parameters such as trash content, fiber neps, seed coat neps, short-fiber content, and contamination.

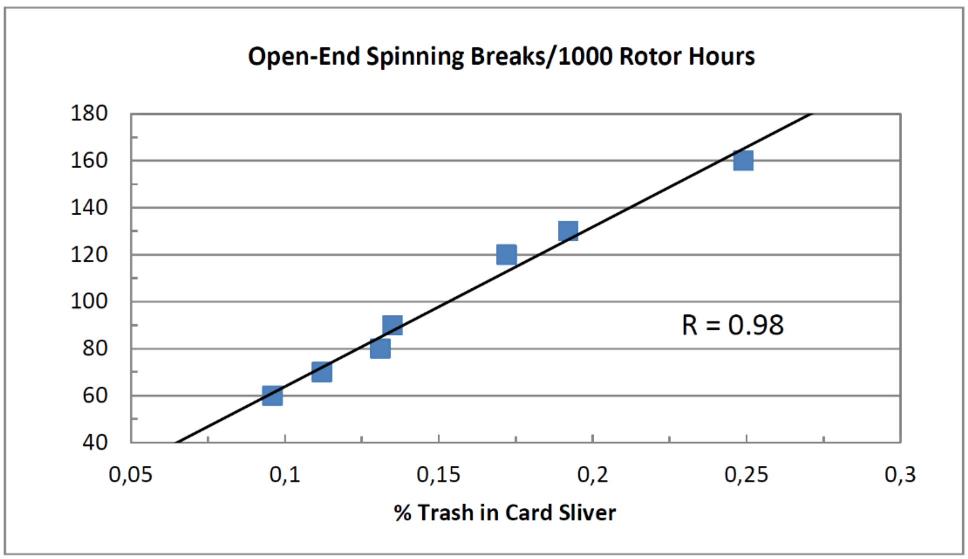
Trash Content in the Cotton Bale

High trash content in a bale of cotton leads to higher waste in spinning (waste being not only trash but also good fibers). Trash content in the cotton bale is largely removed during spinning preparation, but this comes at the expense of losing good fibers. The higher trash content in the bale of cotton, the higher the waste of good fibers. What should be known is that only 4% to 5% trash content in a bale of cotton could result in 10% to 25% waste of good fibers during spinning.

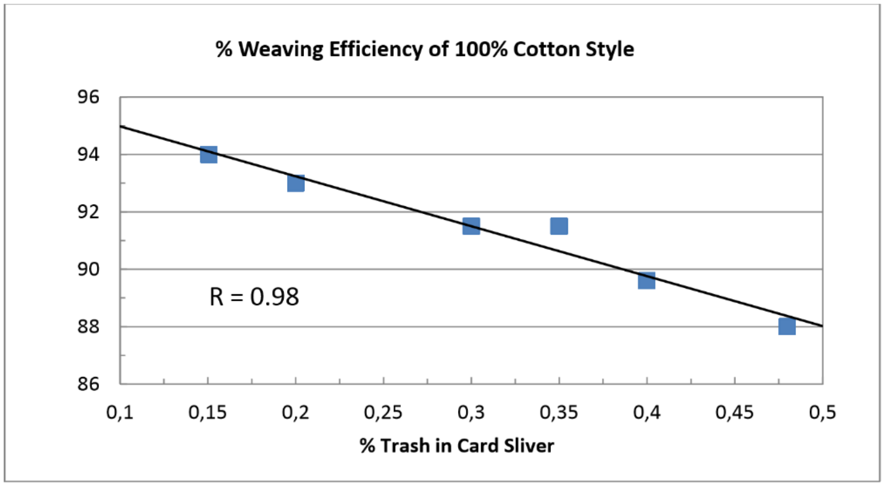


High trash content in the bale of cotton leads to low spinning efficiency. Actual mill studies revealed that 4% to 5% trash content in a bale of cotton could result in a drop in spinning efficiency by 1% to 3%. This means lower production and increase in the cost of yarn manufacturing.





High trash content in the bale of cotton leads to low weaving and knitting efficiency. Previous studies revealed that 4% to 5% trash content in a bale of cotton could result in a decrease in weaving and knitting efficiency by 3% to 8%. This means lower production and increase in the cost of fabric manufacturing.

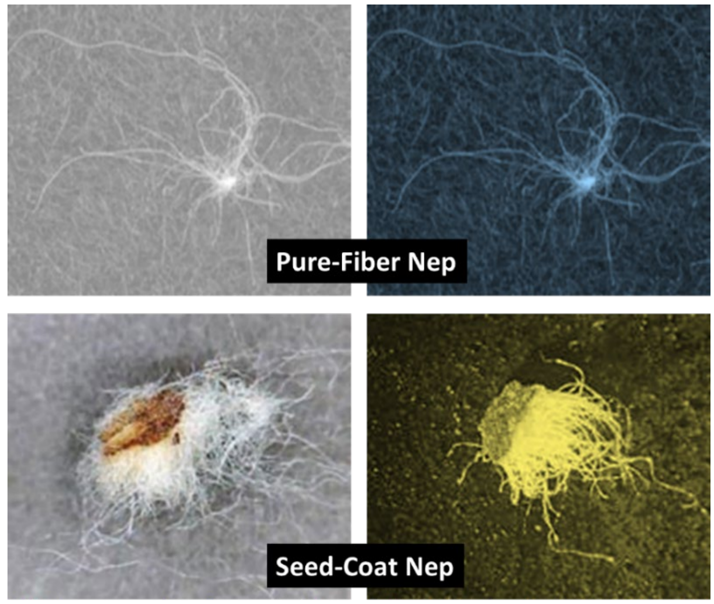


Today, the world spinners understand that cottons of different origins will have different trash content and based on this understanding some cottons are preferred over others (see Examples below, https://cottonusa.org/uploads/documents/WhitePaper_MillStudy2.0_ENG.pdf). It will be important, therefore, to investigate the performance of Egyptian cotton in comparison with cottons of different origins which is outside the scope of this report. Gin-factory personnel must make all efforts to reduce trash content in the bale of cotton they produce. However, this must come at minimum fiber neps and minimum fiber damage as discussed below.

	100% U.S. cotton	100% Indian cotton	AUS/Uzbek/ Pakistan cotton
Initial Trash Content/g	44.8	71.8	76.7
Reduction in trash content upon opening and cleaning	20%	11%	14%
Trash after opening and cleaning/g	35.8	63.9	66.0
Reduction in trash during carding	89%	88%	85%
Trash after carding/g	3.9	7.7	9.9
Reduction in trash during combing	75%	75%	75%
Trash after combing/g	1.0	1.9	2.5

Fiber Neps Content in the Cotton Bale

Neps, seedcoat neps, and white specks are all entangled and knotted fibers that are formed during cotton harvesting or in the ginning process. Microscopic observations of neps indicate that the number of fibers forming a single nep may range from 5 to 20 fibers knotted together. The following types of neps may be observed in a bale of cotton:



- **Pure fiber neps (or mechanical neps):** these are neps consisting only of fibers entangled together. This type of neps is very common and it represents the majority of neps in most cottons. They are mechanically created during harvesting and in the lint-cleaning process after ginning.
- **Biological neps:** these are serious neps and they may consist of a cluster of immature fibers or fibers entangled with non-fiber materials such as seed coat fragments, leaves, or stem material. These are also caused by mechanical means during seed-cotton cleaning before ginning or due to seed damage during ginning.

Pure fiber neps (or mechanical neps) typically consist of long and fine fibers. Normally, long and fine fibers are more flexible, and they have more tendency to curl and entangle together than short and coarse fibers. Light dense pure fiber neps may be straightened during carding particularly at low carding speeds. Biological neps are more serious than pure fiber neps because they are more difficult to disentangle, and they tend to be progressively fragmented into smaller and smaller neps during spinning preparation.

Fiber neps and seedcoat neps are formed initially during mechanical harvesting and they continue to increase during ginning. It should also be pointed out that all cotton bales, manually harvested, mechanically harvested, saw-ginned, or roller-ginned will have fiber neps. This is because the equipment required to gin and clean cotton will inevitably result in some fiber entanglement causing neps to occur. The amount of neps per bale will vary depending on the methods of fiber production. Manually-harvested cotton will have less neps than mechanically-harvested cotton, stripper-harvested cotton will have slightly higher neps than spindle-harvested cotton due to the need for more cleaning, and saw-gin cotton will have higher neps than roller-gin cotton. Thus, the existence of neps in a cotton bale is inevitable. In a best-case scenario, a cotton bale will have about 100 to 200 pure fiber neps per gram. This represents less than 8% of the cotton worldwide. A manageable average nep level in a bale is from 200 to 350 neps/g. A high nep level is from 350 to 500 neps/g. With regard to seed-coat neps, up to 10 neps per gram is considered a best-case scenario, 11-20 is low, 21-30 is medium, 31-45 is high, and > 46 is very high.

Saw ginning will typically yield 5% to 10% more neps than roller ginning. However, the most critical process in causing fiber neps is the "Lint-Cleaning Process," which is the process following the gin stand. The effect of intense lint cleaning during ginning was discussed in many mill studies. It is critical that gin-factory personnel be aware of the impact of lint-cleaning on nep content in the bale of cotton. This requires optimization of a number of factors including: speed of lint cleaning units, roller settings, and the number of lint cleaners. Ginners should perform experimentation in the gin factories (both roller and saw gin factories) to produce minimum nep content. This has been a part of the activities that my company did in Azerbaijan and Turkey over the last 3 years to improve the quality of their cottons.

The effect of neps on yarn cost is twofold: (1) neps must be largely removed before yarns can be produced, (2) residual neps can be detrimental to the appearance and the value of yarn. The removal of neps represents a significant added-cost of yarn manufacturing since they may require more frequent wiring of carding machines, or higher comber noils during combing. In a mill using 100,000 bales annually for combed ring-spun yarn, a 1% to 2% less comber noil could mean a saving of about $1 million per year. The residual neps can be as low as 30 neps per gram in carded yarns and as low as 8 or 10 neps per gram in combed yarns. These values can be translated to up to 3000 neps/1000 meter in carded yarns, and up to 400 neps per 1000 meter of combed yarns (with finer yarns having more neps/1000 m). Neps of large sizes (> 2000 μm) that manage to survive into the yarn can result in poor yarn appearance and they can appear in the finished fabrics in the form of undyed dark dots (white specks) particularly if they constitute dead or immature fibers.

Again, the Egyptian cotton production industry should know that worldwide spinners are fully aware of the fact that cottons of different origins will have different levels of neps (see Figure below) and based on this knowledge they would prefer one cotton over another.

	100% U.S. cotton	100% Indian cotton	AUS/Uzbek/ Pakistan cotton
Starting neps/g	229	163	228
Increase during opening and cleaning/g	64 (29%)	152 (93%)	166 (73%)
Carding nep removal/g	237 (81%)	227 (72%)	284 (72%)
Combining nep removal/g	38 (67%)	55 (63%)	68 (66%)
Combed sliver neps/g	18	33	38
Ending vs. starting neps/g	8%	20%	17%
Combed sliver seed coat neps/g	2	3.5	8

Short-Fiber Content in the Cotton Bale

The fiber length in the cotton bale is normally 2 to 5% shorter than the length of fiber in the field. This is because raw cotton is likely to be slightly damaged during harvesting and severely damaged during ginning. Again, saw ginning will cause more damage to fiber length than roller ginning (about 1% to 3% more short fiber content). A short fiber is a fiber that has less than 12 mm staple length. This is typically a useless fiber and it is often removed as waste in the spinning process. A high-value cotton bale should have staple length above 29 mm, length uniformity above 82%, and short fiber content (by weight) of less than 9%. In the marketplace, staple length makes a difference in the value of a cotton bale, with longer fiber being of higher value. However, short-fiber content is not used in determining the value of a cotton bale in the marketplace. Virtually, all spinners measure short-fiber content in the cotton bales and they are becoming aware of cotton origins that exhibit low short fiber content (see Example below). It should be noted that short-fiber content in the spinning mill is measured by number not by weight. This can only be achieved using AFIS testing; a short fiber content of 8% by weight (about 40 kg short fibers per bale) would mean about 22% short-fiber content by number (this will amounts to millions of fibers of length less than 12 mm).

	100% U.S. cotton	100% Indian cotton	AUS/Uzbek/ Pakistan cotton
Initial SFC (%)	23.7%	24.8%	26.0%
Change in opening and cleaning	+2%	+13%	+2%
SFC after opening and cleaning	24.2%	28.0%	26.5%
Change in carding	-1%	-4%	-2%
SFC after carding	23.9%	26.9%	26.0%
Change in combing	-63%	-56%	-46%
Final SFC (%)	8.9%	11.8%	14.0%

The most critical process that affect short fiber content during ginning is the "Lint-Cleaning Process." It is critical that gin-factory personnel be aware of the impact of lint-cleaning on fiber damage and short fiber content in the bale of cotton. This requires optimization of a number of factors including speed of lint cleaning units, roller settings, and the number of lint cleaners.

Contamination in the Cotton Bale

As indicated earlier, cotton price in the marketplace has been determined based on universal classing parameters in which cotton color grade and staple length are the primary factors; cleaner, whiter, and longer fibers are normally valued at higher price with premiums and discounts associated with exceeding some thresholds. Cotton export, on the other hand, is largely determined by the "**COTTON REPUTATION**." This is a critical point of quality and added-value awareness. For example, the top export cotton in the world are Australian cotton, American cotton, and Brazilian cotton. These cottons are all mechanically harvested and saw ginned, but they have one good feature in common, which is "**MINIMUM CONTAMINATION**." When contamination is an issue, cotton reputation is tarnished, and export will only be driven by lower prices. This is the case of the West-African cotton, Turkish cotton, Indian cotton, and Pakistani cotton despite the fact that most of these cottons are roller ginned.

My company's evaluation of gin factories in countries such as Mali, Azerbaijan, and Turkey clearly revealed many potential sources of lint cotton contamination. These sources were not a result of any deliberate actions by factory personnel but rather from the lack of awareness of the seriousness of cotton contamination. The best way to handle contamination is through a prevention plan from harvesting to bale pressing. A gin factory should set **"ZERO-CONTAMINATION"** as a primary strategy and later as an exporting promotional tool. Ginners must do their part with respect to contamination. In addition, gin factories should establish "**A CONTAMINATION-AWARENESS AND ACTION GUIDELINES**."

Key Ginning Guidelines

The ginning process consists of a combination of thermal, aerodynamic and mechanical processes. The design of a gin process will depend on many key factors including: (a) the cotton variety, (b) the harvesting method, (c) the status of the seed cotton arriving the gin, (d) gin turn out, (e) labor cost, (f) energy cost, (g) the intended quality of lint cotton, and (h) the value of the cotton bale.

Cotton Variety

Traditionally, Extra-Long Staple (ELS) cotton has been roller ginned and Upland-like cotton has been saw-ginned. However, many countries producing upland-like cotton have been using roller-ginning for the purpose of producing higher-quality cotton. Countries like Turkey, West Africa, and Azerbaijan have used roller ginning for their upland-like cotton for many years producing cottons of higher staple length, better length uniformity, lower short-fiber content, and lower neps.

The difference between roller ginning and saw ginning is summarized in the following points:

1. Roller ginning is a much gentler type of ginning, which treats cotton fibers less harshly than saw ginning. Therefore, roller ginning results in longer and more uniform staple length, with fewer short fibers and neps.
2. Roller ginning has higher lint turn-out (percentage of weight of lint in bales per weight of seed cotton in modules). There is about 1–4% difference depending on the machine type and the quality of seed cotton.
3. For the same grade of raw cotton and same seed-cotton preparation, roller ginned fiber contains more trash and dust than saw ginned fiber and has a rougher appearance which can lead to inferior color grades.
4. Traditional roller gins are slower than saw gins, resulting in lower ginning rates and consequently higher ginning costs. Nevertheless, roller-ginned cotton can be associated with premium in price (roughly, 2 cents per pound). This will depend on how you market your cotton.

The choice between roller ginning and saw ginning is a decision that should be based on economic and quality considerations. However, most decisions are primary based on economic reasons. Some of the factors influencing this choice between roller ginning and saw ginning are as follows:

I. The decision to switch from saw-ginning to roller-ginning has been totally based on fiber quality since roller ginning low production and high cost must be offset by premium per pound paid for cotton fiber quality.

II. The decision to switch from roller-ginning to saw-ginning has been driven by (a) the high production rate, which can lead to lower cost, (b) the quality and grade of raw cotton (most mechanically-harvested cotton is saw ginned), and (c) most importantly, the capital cost, which has been restrictive for the introduction of high-productivity saw gins in countries where production was low and scattered.

III. The minimal capital cost of setting up a ginnery is substantially higher for saw gins than for roller gins. This can be a very costly investment, particularly in countries where cotton production is not consistent from one year to another as in case of Egypt.

IV. The choice between more or less labor-intensive options depends on the availability of labor and its cost relative to energy costs.

V. Roller gins are generally the preserve of smaller companies, although numerous stands can be linked together and the supply of cotton automated.

VI. Altogether, higher maintenance, labor and energy costs for roller gins are largely offset by the saving on seed cotton (due to higher turn-out), and the total variable costs are 1.5 to 2 cents/kg higher in saw ginning.

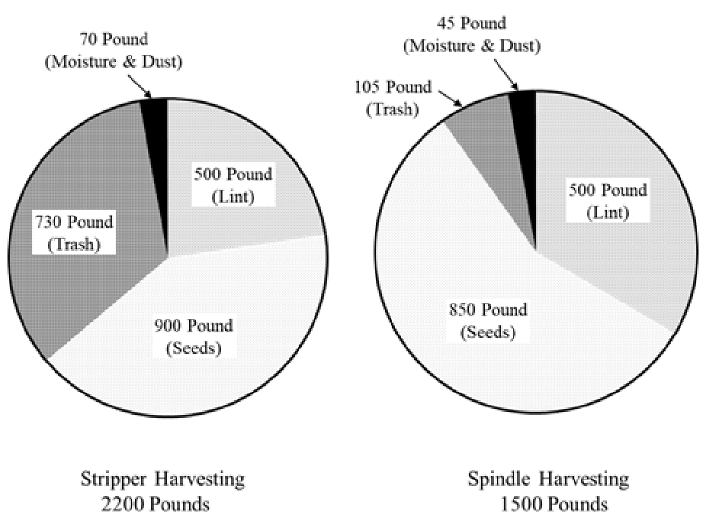
The Harvesting Method

In general, there are two main types of harvesting: manual and mechanical harvesting. Manual harvesting is the oldest technique of cotton picking. Many countries around the World still use this type of harvesting. Typically, seed cotton is hand picked out of the bolls and put into a long sack which is hung over the picker's shoulder and dragged along the ground. Mechanical harvesting is done using machines that are non-selective since they pick cotton along with leaf, stems, trash, and dust.

The common experience suggests that hand-picked cotton is far superior than mechanically harvested cotton. This is because hand-picked cotton is very selective, and it targets only the cotton boll. The main requirement of hand-picking is the opening of bolls, which results in the high preservation of natural cotton fiber properties and yield. However, the problem with hand-picking of cotton is that it is less efficient and requires intense labor. Hand-picked cotton is also often associated with high contamination due to the lack of awareness by cotton picker of maintaining a pure cotton.

Mechanical harvesting has been used for many years to reduce labor and increase the harvesting rate. Two methods of mechanical harvesting are used: stripper harvesting and spindle harvesting. In the context of cotton quality, the main difference between the two types of mechanical harvesting is the yield and the amount of trash and dust produced by each method. Typically, stripper harvesting gathers much more trash with the seed cotton than spindle picking. As a worst-case scenario, approximately 2200 pounds of seed cotton are harvested using a brush stripper to obtain a 500-pound of cotton lint (the typical weight of a cotton bale). In spindle harvesting, only 1500 pounds of seed cotton is typically harvested to obtain a 500-pound bale of lint. This substantial difference between the two types of harvesting is quite reflected in the amount of trash picked with the seed cotton in each method.

The Figure below shows the distribution of different material picked in each method of harvesting. Using this worst-case scenario, the amount of trash arrived at the gin with a stripper-harvested cotton will be about 33% of the total material, and that with a spindle-harvested cotton will only be about 7%. This difference means that if a strict-low middling cotton of about 3% trash content (in the lint bale) is to be obtained, the ginning will have to take out about 715 pounds trash from the stripper-harvested cotton, and about only 90 pounds trash from the spindle-harvested cotton.



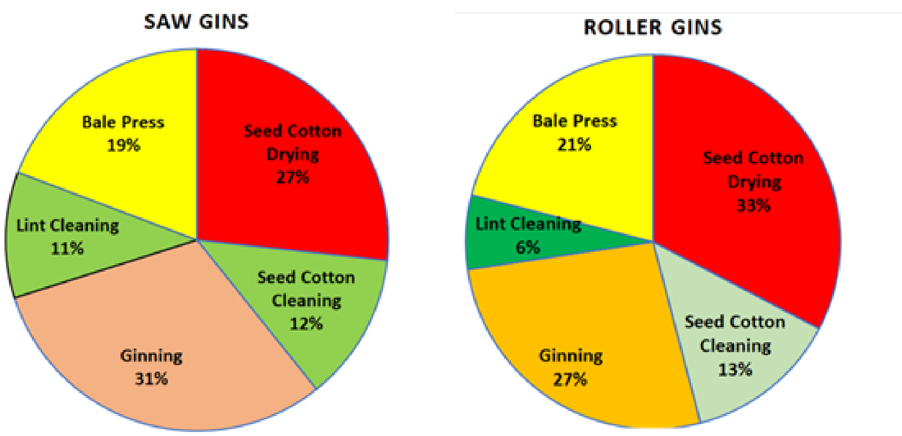
Distribution of Different Materials Picked in Stripper and Spindle Harvesting [Data from Bragg et al, 1993]

Another issue of mechanical harvesting is the need to artificially induce cotton growth using the so-called defoliation process, which is a chemical treatment intended to expedite the growth. This process results in the shedding of the leaf canopy or foliage, prior to harvesting which allows for earlier and more efficient harvesting and eliminates material that would otherwise contaminate and stain cotton fibers. Cotton defoliation is a critical process that must be timed and applied very carefully. the type of defoliation product used does not have a significant effect on fiber quality, but the scheduling of defoliation can influence fiber quality. Typically, there are three methods to determine the timing for defoliation: (a) percentage of open bolls - with crops safely defoliated after 60-65% of the bolls are open, (b) nodes above cracked boll (NACB) - in most circumstances 4 NACB equates to 60% open bolls, and (c) boll cutting - bolls being mature if they become difficult to cut with a knife. In general, defoliating too early lowers yield and micronaire and increases the number of immature bolls at harvest, resulting in increased neps in the ginned lint. Defoliating too late increases the likelihood of boll rot, lint damage and loss due to weathering.

The above points are very important particularly for spinners buying mechanically-harvested cotton. They should expect lower quality from stripper-harvested cotton than spindle-harvested cotton due to the need to over clean stripper-harvested cotton in the gin factory. This typically leads to higher short fiber content, more neps, and more micro-trash. They also should know about the history of the harvested cotton particularly with regard to defoliation.

Energy Consumption and Labor Cost

As it is well-known, the primary function of the ginning process is to separate cotton lint from seeds. This function is achieved at the gin stand (roller or saw gin). However, raw cotton and lint cotton must undergo other processes before a bale of cotton is finally produced. Raw cotton must undergo drying and cleaning prior to ginning, and ginned cotton must undergo lint-cleaning after ginning. Bale-press is also a critical process in ginning. Based on previous observations by my company in many gin factories, common values of the percent of energy consumptions by different processes are as shown in the Figure below. **<u>This is a critical Figure that must be produced as a part of improving the ginning industry in Egypt</u>.**



Common Relative Contribution to Energy Consumption by Different Stages of Processing During Cotton Ginning

- As can be seen in the Figure above, the three major processes encountering the highest energy consumption are: (1) raw cotton drying, (2) the gin stand, and (3) bale press. These three processes consume about 80% of the total energy. One critical area to reduce cost is the drying process. **<u>The use of enclosed tower drier can save a great deal of energy cost</u>**.
- For the same rate of production in Kg cotton per hour, saw ginning will consume 4% to 6% more energy than roller ginning but with appropriate drying systems, this energy consumption can be offset.
- For the same raw cotton grade, raw cotton cleaning is often similar in both saw ginning and roller ginning. As a result, the energy consumption of raw cotton cleaning is normally

the same. However, using excessive raw cotton cleaning can result in higher energy consumption.

- At the same rate of production, lint cleaning in saw ginning normally consumes higher energy than in roller ginning because of the better quality of lint cotton produced from roller ginning.

The above points are critical in deciding which direction to follow in modernizing the gin factory in Egypt since the total cost of ginning is largely divided between labor and energy.

Labor cost is another critical factor that must be taken into consideration in optimizing the ginning process. Typically, gin labor are divided into permanent labor and seasonal labor. This issue is more critical in high-labor cost countries.

Closing Remarks

In this article, I tried to cover as much as I can within the space available. In closing this article, it will be important to indicate that there are certainly promising steps in improving the Egyptian cotton and textile industry. The move to develop Egypt's biggest textiles Sadat's City is a very positive move and it should increase efficiency and provide needed logistical approaches for the industry. The use of foreign textile expertise and foreign investments is also a positive step toward improving the Egyptian cotton and textile industry. Unfortunately, I do not have all the details to assess these investments due to the old-fashion Egyptian approach of lack of transparency either to cover up problems or avoid criticism. I am sure all of this will change when new younger generation leads the industry which I believe it should be done as soon as possible. Indeed, with the current huge new investments in the industry it will be a great risk to keep the leadership that has caused the disastrous performance over the last 20 years in place and we all should remember Albert Einstein quote that "insanity is doing the same thing over and over and expecting different results." To me it is the same thing as relying on the same people who caused the failure thinking that they can be successful. Egypt can no longer afford any risk in this industry and if accountability for failure was not imposed then the least the government can do is to give the current leadership of the industry a permanent rest and give the opportunity to a new younger leadership.

I totally agree with the idea of bringing Chinese and Indian expertise to help and invest in the Egyptian cotton and textile industry. The Chinese involvement in the Sadat City project is a positive sign provided that mutual benefits can be achieved, and more Egyptian labor can be used in this industry. Our experience in Vietnam clearly showed that the Chinese investment there has resulted in a win-win outcome to both the Vietnamese and Chinese textile industries. The labor cost in China has reached a point that migration of the industry abroad supervised by Chinese expertise has become necessary, not only to reduce cost but, more importantly, to open new markets to the Chinese industry. The only concern with this move is the typical Chinese model in which the Egyptian authorities must work under the total guidance of the Chinese expertise. In other words, Egypt will become a follower not a leader in this development. However, this situation will be much better than the past miserable situation in Egypt which has led to a total collapse of the industry.

Ultimately, government-control of the Egyptian textile industry must give way to private ownership. This issue was clearly addressed in a recent Harvard Business study which clearly indicated that the dominant share of government-owned companies of the textile industry into the 21st century is unusual by global standards. The study used China as an example who opened-up its previously nationalized textile companies to the private sector from 1978 onward in order to boost competition. I am sure the top authority in Egypt understands all these issues. The fact is that machinery and technology have not become obsolete over a year or two; instead this has occurred over many years under the watch of the current industry's leadership. A good private management will either stop the bleeding from the first drop, restructure the industry in a stepwise approach to accommodate the decline, or implement new strategies to save the industry. None of these approaches has been taken in the past and top authorities who are still in their position were watching the decline and providing explanations to save their positions and not to save the industry.