TRAINING MANUAL

AFRICAN COTTON PROMOTION AND VALUE ADDITION

COTTON QUALITY MANAGEMENT TRAINING MANUAL

ITC
TRADE IMPACT FOR GOOD
50 YEARS
1964-2014

Report and pictures by: Marco Mtunga, ITC Consultant

FOR FURTHER INFORMATION PLEASE CONTACT:

Matthias Knappe
Programme Manager for Cotton, Textiles and Clothing
Sector Competitiveness
International Trade Centre
Palais des Nations
CH-1211 Geneva 10
Switzerland
Tel.: +41 22 730 01 11
E-mail: knappe@intracen.org

Background

Rampant cotton contamination has badly impaired the image and reputation of Tanzania cotton which now trades at discounts instead of getting premium it used to enjoy before liberalization. This works against the government efforts to alleviate poverty among cotton producers. From the engagement with ginnery operators and farmers, it has been established that, most of them are unaware of the danger caused by contamination in the cotton value chain. Farmers want a better return for their cotton but are not aware of the effects of adulteration on price. Most ginneries have no systematic approach to quality management. Despite the fact that some initiatives on managing contamination have started taking root at the ginneries, there is still a considerable work to be done. This calls for more inclusive approach to training of all stakeholders on cotton contamination.

This Cotton Quality Management Training Manual is a tool which will extensively be used to raise the awareness of all stakeholders along the value chain about the effects of contamination and provide guidelines on how the menace could be managed. It is anticipated that the knowledge to be gained from the training using this manual will change how cotton is produced, harvested, stored, transported, ginned and packaged which in turn will expand market access and improve the income of the resource poor farmer.

The work/mission described in this report was undertaken on behalf of the International Trade Centre (ITC). The International Trade Centre (ITC) is implementing a project on African Cotton Promotion and Value Addition (INT/75/33B) within the framework of the EU-funded Support Programme for the Consolidation of the Action Framework under the EU-Africa Partnership on Cotton, which aims at contributing to sustainable improvements of the competitiveness, value addition and viability of African cotton value chains.

About this Manual

The objective of this manual is to provide uniform, broad-based scientific and practical information on the production, harvesting, handling, transport and ginning of less contaminated cotton. This manual:

- Provides a teaching tool to train trainers who will be training various stakeholders on producing less contaminated cotton at all stages.
- Serves as a resource for ginning companies to establish a coherent approach to quality management system at their factories, thus enhancing self-regulation.
- Serves as a resource for regulators to create a level playing field by enforcing quality standards.

Use of this Manual

The information in this Manual includes:

- Introduction to cotton quality.
- Cotton Contamination.
- Good Agricultural and Marketing Practices.
- Good Manufacturing Practices.

Acknowledgements

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Contents

Acronyms

EDF	European Development Fund
HVI	High Volume Instrument
ICA	International Cotton Association
ITC	International Trade Centre
PP	Polypropylene
TQM	Total Quality Management

Important Definitions

Quality	The totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs.
Fiber strength	Is the force in grams required to break a one-tex bundle of fibers. A tex is equal to the weight in grams of 1,000m of fiber.
Micronaire	Refers to an airflow measurement that indicates fiber fineness and maturity.
Seed Cotton Ginning	Is the process of converting seed cotton into seed and lint.
Tanzania Grade	Grades of Tanzania cotton.
Universal Grades	Cotton grades used worldwide.
Cotton Contamination	Refers to presence of foreign material in cotton fibers.
Neps	Hopelessly entangled masses of fibres.
Trash	Referred to as non-lint of a cotton plant, commonly comprises fragments of leaves, bark and grass, as well as particles of sand and dust.
Preparation	Indicates the appearance of the cotton after ginning, as a consequence of the treatment which the cotton received during harvesting and ginning.

1. CHAPTER I - INTRODUCTION TO COTTON QUALITY

1.1. Introduction

Like all commodities, cotton is differentiated by quality parameters for the purposes of trade. Cotton fiber is the raw material for the textile manufacturer who transforms cotton into yarn and then into fabric for apparel, household goods, or industrial products. ISO defines quality as “the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs.” Good quality cotton is one that meets the needs and expectations of its customers: the spinners.

As cotton is a natural and seasonal product, characteristics such as its intrinsic quality (the fiber properties), cleanliness and contamination, as well as the cotton's homogeneity can vary greatly due to genetic, environmental, harvesting, and ginning factors. Such variability impacts processing performance, costs, quality, and utilization throughout the entire cotton textile chain, from the farm to the end-product. In contrast, all synthetic fibers within a given lot are identical and totally free of contamination.

Fiber properties primarily depend on the varieties grown, agro-climatic conditions, and crop management practices. Variety is the most important factor. Variety determines nearly all of the lint quality parameters and most of the agronomic ones. The environment restricts the varietal potentiality in the expression of fiber properties. Climatic conditions and cultural practices are critical for length parameters, maturity, and strength. Cotton fiber quality is at its best on the day the cotton boll opens. Nothing can be done afterwards to improve the quality of cotton but all subsequent operations can alter it for the worse.

Better fiber quality translates into better yarn quality and higher processing efficiency. Among the fiber properties, staple length has the greatest influence on spinning performance. Both fiber fineness and fibre strength are generally correlated with staple length.

MODULE 1: Quality Attributes and Cotton Classification

Learning outcome: Trainees to understand quality attributes of cotton and cotton classification.

Knowledge of cotton lint quality is essential for growers/ginners to successfully market their cotton. Cotton buyers and manufacturers make wide use of various fiber tests to determine the value and end usage of a particular bale or lot of cotton.

Cotton classing is the measuring and classification of cotton by its specific physical attributes. This information clarifies the actual value of cotton, helping its marketing. For the consumer of cotton, i.e., the spinning mills, the precise information about the cotton fibers purchased, enables optimizing its raw material selection and blending, which is necessary for producing a continuous level of yarn quality. Today, cotton is classed based on its measurements for fiber length, strength and length, micronaire (a measure of the cotton's fineness), color grade, color reflectance, color yellowness, and trash percent area.

In order to improve objectivity, cotton classing has largely moved from human senses (visual check by certified classers) to the utilization of high-volume, precision instruments which perform measurements of different parameters in a matter of second. The HVI system is supplemented by humans especially in assessing leaf and discount factors such as bark, grass and preparation.

1.1.1. Quality attributes

No.	Quality parameter	Notes
1.	Fiber length	is measured by passing a small tuft of parallel fibers through a sensing point of the HVI system. It may also be determined manually. Fiber length is a varietal characteristic that is influenced strongly by environmental conditions; it may be reduced by processing equipment, especially at low moistures. Length uniformity, which is typically 80 to 82 for upland cotton, is the ratio of the average or mean length of the fibers to their upper half mean length and is expressed as a percentage. If all fibers in a sample were the same length, the length-uniformity index would be 100.
2.	Micronaire	refers to an airflow measurement that indicates fiber fineness and maturity. Micronaire is determined by passing air compressed to a standard pressure and temperature through a cotton specimen of standard weight and standard volume. The volume of airflow through the specimen is expressed as the micronaire, which may be referred to as the mike reading or simply mike. Some fibers are extremely fine simply because they are immature. These fibers cause dyeing irregularities, increase manufacturing waste during picking and carding, and lower product appearance. Maturity, which is largely determined by growing conditions, can be defined as the relative wall thickness (i.e. the area of the cell wall to that of a circle with the same perimeter as the fibre, or the ratio of the cell wall thickness to the overall 'diameter' of the fibre). Fiber fineness is a varietal characteristic that is estimated by micronaire, which is also affected by growing conditions in the latter stages of fiber development. Favorable growing conditions result in fully mature fibers and higher micronaire readings.
3.	Strength	Fiber strength is determined by the HVI system on the same tuft of fiber used for the length measurement. Results are reported in grams per tex. A tex is equal to the weight in grams of 1,000 m of fiber. Fiber strength is an important factor in determining yarn strength. HVI machinery determines fiber strength in a manner similar to the Stelometer or "1/8 gauge" used by conventional systems. The measurement is made on the same sample that is tested for length. Descriptive designations are similar to those used for 1/8-inch gauge strength, but strictly comparable. The following chart shows the strength readings and descriptive terms for HVI measurements. Strength 1/8-inch gauge Rating (grams/tex) Very Low 20 & below Low 21-23 Average 24-26 High 27-29 Very High 30 & above
4.	Color	Cotton is generally white when the boll opens, but continued exposure to weathering and micro-organisms can cause the cotton to lose its brightness and to become darker. Cotton may also become discoloured or spotted by the action of insects, fungi, plant diseases and soil stains, or when killed by frost or drought. Reducing sugars and storage under high humidity conditions can cause yellowing. Colour is generally measured by instrument, in terms of its greyness, reflectance or brightness (Rd) and yellowness (+b)
		Grayness (measured in Rd): Grayness (or percent reflectance) indicates the lightness or darkness of the sample. Cotton Rd values are usually within the 48 to 82 range. Normally, opened cotton will have an Rd of 70 or higher.
		Yellowness (measured in +b): Yellowness indicates the amount of yellow coloration in the sample and is usually within the 5 to 17 range. Normally, opened cotton will have a +b of 9.0 or lower. The various combinations of grayness and yellowness can be converted into color values based on the Rd and +b values using a "colorimeter" chart.

No.	Quality parameter	Notes
5.	Trash	Trash, often referred to as non-lint, commonly comprises fragments of leaves, bark and grass, as well as particles of sand and dust. The levels of such contaminants are determined by growing, harvesting and ginning conditions. The trash content measured by the HVI system is determined by scanning the sample surface and recording the particles present. Results are reported as the percentage of the sample surface covered by non-lint particles. The maximum is less than 5.0%.
6.	Preparation	This property, which indicates the appearance of the cotton after ginning, as a consequence of the treatment which the cotton received during harvesting and ginning, cannot, as yet, be measured by instrument. Preparation can have an effect on processing waste and yarn quality.
7.	Elongation	Generally fibre elongation (extension at break) is measured at the same time as fibre strength, it being determined by genetic and environmental factors. An increase in elongation is associated with an increase in yarn and greige fabric elongation and nep formation, the relationship between yarn elongation and fibre elongation being a function of fibre length and yarn twist and linear density. Yarn elongation significantly affects weaving efficiency. An increase in fibre elongation can sometimes reduce spinning end-breakage and yarn strength. A level above 7% is desirable.
8.	Neps	Neps is defined as 'hopelessly entangled masses of fibres'. Neps consist of either an entanglement (cluster) of fibres (typically 16 fibres), with or without foreign matter (e.g. trash or seed coat fragments) as a core. Although neps are related to fibre properties, such as maturity (including maturity distribution and 'dead' fibres), harvesting, ginning and mechanical treatment conditions in the spinning mill significantly affect nep levels. Neps lead to yarn and fabric imperfections and unevenness, and also to spinning end-breakages. They are responsible for up to 50% of yarn imperfections, seed coat fragments being particularly problematic.

Table 1: Higher Grades Preferred Fiber Properties

Classing grade	Strict Middling White (21-2)
Staple length	≥ 1-1/8 inches (1.13 inches / 28.6 mm)
Micronaire	3.8 - 4.2
Strength	≥ 30 grams per tex
Color	White
Reflectance	Rd ≥ 75
Yellowness	+b < 9
Length uniformity ratio	≥ 83%
Short fiber content	≤ 5%
Elongation	≥ 6%
Maturity	88%
Fineness	≤ 180 millitex (µg/m)
Neps	< 200 / gram

MODULE 2: Quality Management, Standards and Grading

Learning outcome: Trainees to understand the meaning of quality management and cotton grade standards.

1.1.2. Quality management

Quality Management is the act of overseeing all activities and tasks needed to maintain a desired level of excellence. This includes creating and implementing quality planning and assurance, as well as quality control and quality improvement. It is also referred to as total quality management (TQM). While quality control and quality assurance departments have been around for a long time, the concept of quality management is relatively new. In a sense, it is a "first cause" approach to quality assurance, as it approaches the issue of quality from many different angles.

Quality management therefore uses quality assurance and control of processes as well as products to achieve more consistent quality. Quality management is a recent phenomenon. Advanced civilizations that supported the arts and crafts allowed clients to choose goods meeting higher quality standards than normal goods. This craft based approach to quality and the practices used were major inputs when quality management was created as a management science. Customers recognize that quality is an important attribute in products and services. Suppliers recognize that quality can be an important differentiator between their own offerings and those of competitors (quality differentiation is also called the quality gap).

There are many methods for quality improvement. These cover product improvement, process improvement and people based improvement. Some of the common differentiators between success and failure include commitment, knowledge and expertise to guide improvement, scope of change/improvement desired and adoption to enterprise cultures. It is important not to underestimate the people factors, such as culture, in selecting a quality improvement approach. Any improvement (change) takes time to implement, gain acceptance and stabilize as accepted practice. Improvements that change the culture take longer as they have to overcome greater resistance to change.

1.1.3. Cotton grade standards

The purpose of cotton grade standards is to create a universal system for measuring cotton fiber and product quality. Standards are a business tool and in many cases, standards are strategic for developing new global markets. Standards are used to facilitate trade by assigning to the products a value that is globally recognized. Through standardazation of measurement, trade can be globally conducted transparently as the unit of measurement is known world-wide.

1.1.4. Grade of cotton produced

Tanzania cotton is sold on basis of grade, together with the corresponding staple length known as Type. Basic selling grade is Gany as adopted by the International Cotton Association (ICA).

There are 7 grades out of which 5 are physical and 2 are descriptive.

Table 1. Tanzania Cotton Grades as compared to Universal Grades

Tanzania Grade	Universal grades	White	Light spotted	Spotted	Tinged	Yellow stained
Tang	Good middling	11-1	12	13		
Gany + ½	Strict middling	21-2	22	23	24	25
Gany	Middling	31-3	32	33	34	35
Gany - ¼	Strict low middling	41-4	42	43	44	
Gany - ½	Low middling	51-5	52	53	54	
Gany - ¾	Strict Good Ordinary	61-6	62	63		
Yika	Good Ordinary	71-7				
Undergrade (UG)	Below grade (BG)	81	82	83	84	85

2. CHAPTER II - COTTON CONTAMINATION

2.1. Introduction

Contamination is one of the most serious problems affecting cotton fibres. Right from cultivation to harvesting, foreign matter finds its way into the cotton first and eventually into the cotton yarn itself after passing through the various spinning processes. Opening and cleaning processes are intended to eliminate fibre contamination with deleterious effect as soon as possible in the process of the fibres. However, certain contaminants consist of fibre like material that behaves very much like cotton fibres. Embedded in cotton, these contaminant particles affect both the process performance and the product quality. Contamination of raw cotton takes place at every step in the value chain i.e. from the farm, storage, transportation and ginning.

At the farm level, the source of non-cotton material is in the handling and the type of bags used by pickers. The use of polypropylene bags for picking and sisal strings to tie the bags contributes to the contamination of the crop. Early morning picking cotton before dew dry-up, addition of water and sand at storage in order to increase weight, use of worn-out jute bags during transportation and selling of un-graded cotton directly also compromise the quality of the crop.

At the ginning level, whole seeds, seed coat fragments, oil and grease are undesirable contaminants. Occasionally, machine parts, pieces of bale ties and other objects are found pressed inside cotton bales. Such materials can seriously damage mill equipment and unnecessarily inflate operational cost; they may also be a cause of fire.

Contamination by foreign matter is more serious with handpicked cotton. Seed cotton picked by hand is cleaner, and the fiber obtained has fewer neps and a lower short fiber content than cotton picked by machine. Cotton picked by machine must be cleaned more vigorously because it has more plant residues. Handpicked cotton should therefore normally be purchased at a premium over machine-picked cotton. However, handpicked seed cotton often gets contaminated during picking, storage, handling, or transport, and the presence of foreign matter in the fiber offsets the theoretical advantage conferred by manual picking. As contamination of raw cotton by foreign matter is the main concern for quality yarn and fabric producers, spinners tend to prefer machine-picked cotton to handpicked cotton. As a result, handpicked cotton has lost its advantage over the past 25 years and now trades at a discount to machine picked cotton. Some quality-conscious mills even refuse on principle to buy any manually harvested cotton to avoid the risk of quality claims downstream.

Cotton prices are not solely determined by intrinsic fiber properties. The cleanliness of lint refers specifically to the presence of vegetal matter other than lint (trash), while contamination refers to the presence of non-plant matter (foreign matter). Both cleanliness and contamination depend on harvesting methods, handling, storage, transport, and ginning practices. In contrast, chemical fibers are totally free of contamination.

Contamination of lint by non-vegetable foreign matter is the most serious problem confronting cotton spinners around the world. Foreign matter, short fiber content and contamination are the outcome of growing, harvesting, and ginning practices. Fibrous neps and seed coat fragments result from ginning and are dependent to cotton variety. In contrast, synthetic fibers are totally free of contamination. Contaminated cotton causes disruptions in the spinning process which increases the cost of spinning and reduces the quality of yarn and end-products. With modern automated high speed textile machinery, foreign matter cannot be spotted until yarn or fabric is dyed and there are no cost-effective means of removing contamination. As a result, contamination leads to the downgrading of end products or even to the rejection of an entire lot.

Cotton that is contaminated, or that is suspected of being contaminated because of the origin, can only be sold at substantial discount to compensate the user for inspecting and cleaning the cotton before spinning. Price differentials for cotton with the same fiber characteristics range from 5% to 30 %, depending on their degree of perceived contamination by extraneous matter, stickiness, and seed coat fragments. These discounts are usually applied indiscriminately to all cotton originating from an area or a country considered to be affected by contamination.

MODULE 1: Sources of Contamination

Learning outcome: Trainees to understand the sources of contamination

Table 2. Classification of sources of contamination.

White contaminants	Alien fibers	Colored objects	Oily substances	Dense objects
White plastic fabric	Hair	Colored cotton fabric	Sticks/twigs	Metal pieces
White plastic strings	Feather	Colored cotton yarn	Leaves	Paper
White/transparent Plastic film	Colored cotton fibers	Jute fabric	Oily/Rusty/Black cotton clumps	Stand, stones
	Jute yarn	Coir yarn	Stamp colored/Yellow cotton clumps	Leather bits
	Colored plastic fibers	Colored plastic fabric	Tar/Grease-affected cotton clumps	Wooden pieces
		Colored plastic string, film		

Colored polypropylene

Mint wrappers, bird feathers, jute strings, cables wires

Various contaminants

Various product wrappers

Polythene contaminants

Various contaminants including sisal ropes

MODULE 2: Effects of Contamination

Learning outcome: Trainees to understand the magnitude of the effects of contamination along the value chain.

The effects of contamination:

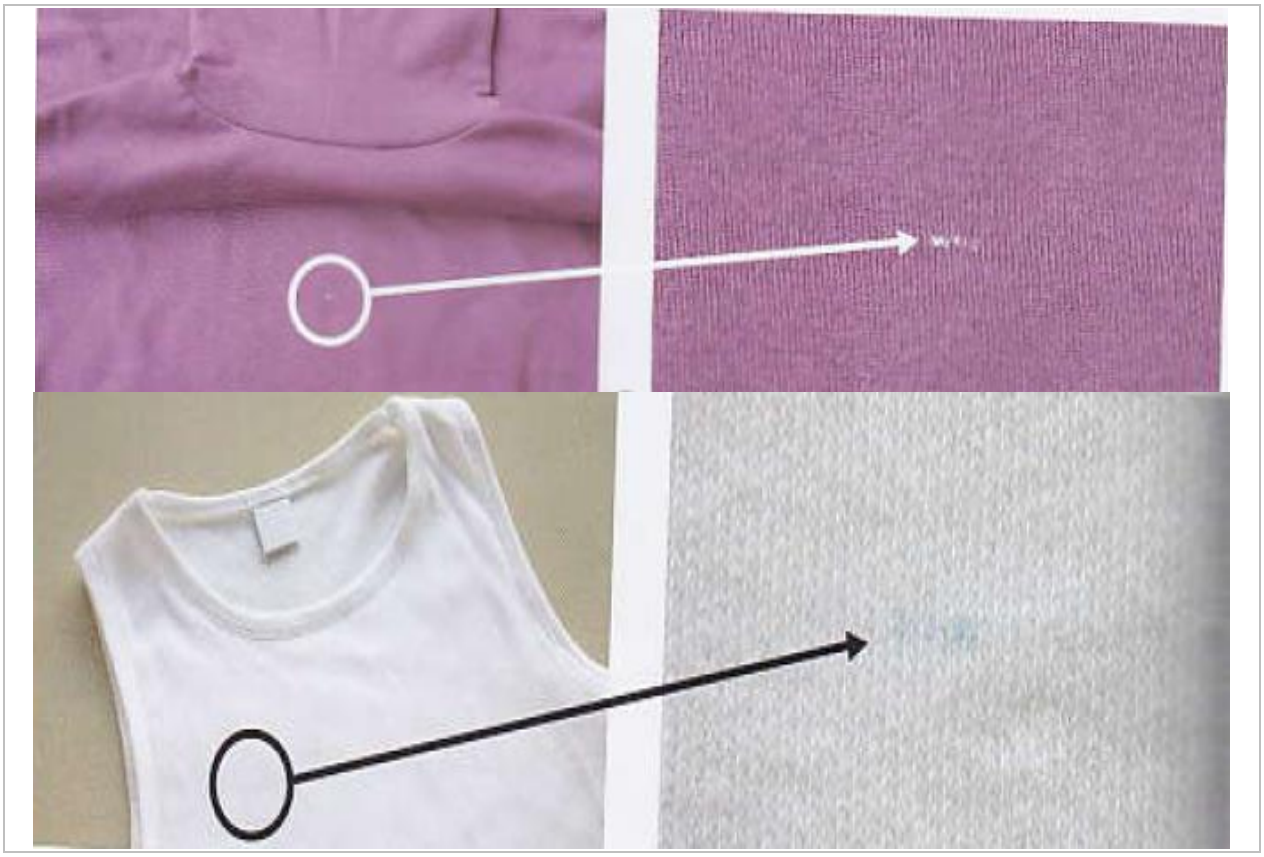
- It causes waste of fabrics due to defects in dyeing.
- Contamination by leftover embedded pieces in yarn, even after cleaning affects the quality and value of the yarn.
- Contaminants such as stones, metal pieces, etc. cause disturbance to material flow especially in spinning preparatory process which affect production as well as quality of the process.
- Contamination with metal pieces can be a fire hazard and can lead to severe machine and material losses.
- Cotton contamination causes irreparable harm to the relationship between growers, ginners, merchants, spinner and textile and clothing mills.
- It delays the shipment of garments due to rejection and re-production.
- Fabric appearance produced with contaminated yarn will be poor and prone to rejection.

- Dyeing of contaminated fabric is different and this leads to uneven fabric coloration.

2.1.1. Contamination in garments

Why polypropylene (PP) is most harmful contaminant of cotton

Among cotton contaminants, polypropylene is the most dangerous one. Cotton is a cellulosic fiber which easily dyes with reactive dye stuff. But polypropylene is a manmade fiber and isn't dyeable. During the dyeing process of the fabric, whether in light or deep color, polypropylene remains undyed. Color polypropylene is thus easily visible in white cotton or light color fabric and white polypropylene is visible in deep color fabric as shown in the following pictures:



2.1.2. Contaminants and their effects and ways to address the problem

Table 3. Contaminants and their effects

Source of contamination	Effect	Remedies
Strings/fabrics of jute/hessian cloth.	Increased end-breakage rate at ring/rotor. Poor yarn appearance. Different results in the fabric dye.	Avoid use of hessian cloth and jute for transport at farms and ginning. Use of cotton cloth for bales.
Strings/fabrics of cotton.	Poor quality yarn/cloth	Manual picking, automatic transportation, training
Strings/fabrics of woven plastics/plastic film.	Differential dye pick-up. Very Poor quality yarn/cloth. Damaged to machinery	Avoid use of plastic material, better housekeeping and practices
Organic matter, leaves, feather, paper, leather etc.	Increased waste at spinning Damage to machinery	Use of pre-cleaner at ginning Use of gravity trap. Better housekeeping.

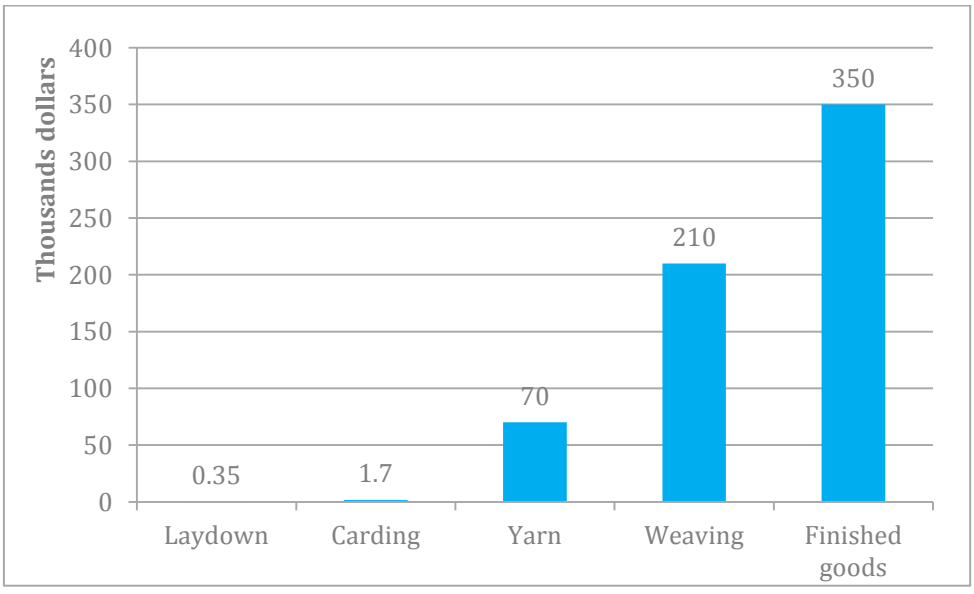
Source of contamination	Effect	Remedies
Inorganic matter 1. Sand dust 2. Metal/wire	Increased waste at spinning Damage to machinery	Use of pre-cleaner at ginning, Use of metal detector, Better housekeeping.
Oily matter 1. Stamp color 2. Grease/oil	Marks yarn/fabric appearance	Avoid use of stamp color Better house keeping
Hair-	Increased end-breaks at ring rotor Poor yarn/fabric appearance	Use of caps Automatic transportation Education/training
Stones	Damage to machinery	Better housekeeping and practices
Seed coats	Increased waste at spinning Poor yarn/fabric appearance	Use pre-cleaner and post cleaner at ginning
Pouches	Damage to machinery part	Better practices Education/ training

MODULE 3: Cost of Managing Contamination at a Textile Mill

Learning outcome: Trainees to understand the cost incurred from contamination and the need to control it.

The increasing demand for contamination-free yarns has led to the invention of contamination detection machines developed by manufacturers like Jossi Vision-Shield, Barco, Loptex, Tatsumi, Securomat, Vetal, Sieger etc. for detecting and removing contamination at the blow room stage. Beside the above mentioned, manufacturers, Loepfe and Uster, manufacturers of electronic yarn clearers have come up with equipment capable of detecting contamination other than that of white colour. This equipment is installed before the Autoconer machine by quality conscious spinning mills. All this machinery calls for huge investments from the textile industry that is already working with very low margins. A rough estimate of investments in such equipment already installed in spinning mills all over the world exceeds 200 million USD. In spite of equipping mills with these devices all over the world, contamination still persists in the final yarn, even though a large number of personnel are engaged to manually segregate contamination.

Figure 1. cost of contamination cleaning through the various stages of processing



Source : National Cotton Council -1990

Figures show the seriousness of the problem. The cost incurred due to contaminants in one bale of cotton increases exponentially as the cost progresses to the finished products. Early detection results in relatively low cost at laydown (USD 350) whereas if not detected early the increase in dollars lost is much higher at the finished goods stage.

Table 4. Cost of sorting contaminants at a Textile Mill

Cost area	Cost/100 Kg cotton	Cost/Kg Cotton	Cost / Kg cotton (US$Cent)
Labor Bill	400	4.00	5.00
GI Wire	30	0.30	0.38
Bale Press cost	5	0.05	0.06
Carrying Cost	20	0.20	0.25
Fixed Cost	60	0.60	0.75
Total	**275**	**2.75**	**6.44**

Source: Square Textile Mills, Bangladesh

2.1.3. Cost incurred for sorting contaminants at a textile mill before mixing

- Develop additional floor space for manual sorting of contamination.
- Engage trained people to sort contaminants by distributing 100kg of cotton per person.
- Procure canvas bags for contaminants collection.
- Re-baling by bale press machine for feeding cotton to auto plucking.

2.1.4. Sorting contaminants at a textile mill

Sorting contaminants at a textile mill

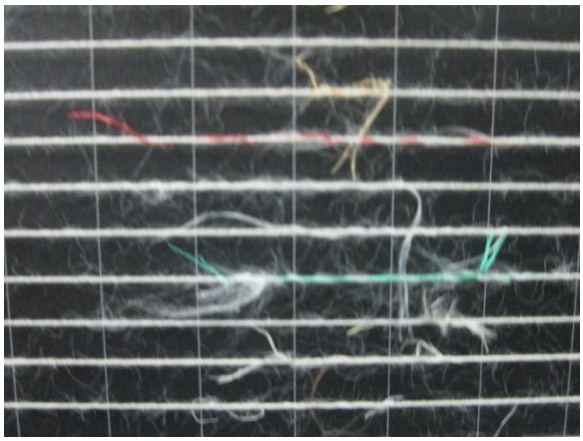
Sorted cotton with contamination

Pressing of sorted cotton

Sorting contaminants at lay-down

Contamination Cleaning Machine

Yarn clearer



Yarn clearer

Yarn Clearer decreases machine efficiency and causes productivity loss in the process of clearing contamination.

3. CHAPTER III - GOOD AGRICULTURAL AND MARKETING PRACTICES

3.1. Introduction

In pursuit of producing good quality cotton, it is highly recommended that players along the value chain increasingly use good agricultural and marketing practices. This will ensure that the quality of the produce from the farm, during harvesting, transportation and storage is preserved.

The following modules will provide guidelines on what is required to produce good quality cotton as well as providing a list of things that should be avoided in order to achieve the objective.

MODULE 1: Do's and Don'ts in Crop Husbandry Harvesting, Storage and Transportation

Learning outcome: Trainees to understand the correct procedures for producing less contaminated cotton during farming, harvesting, storage and transportation

Contamination of cotton occurs at different stages throughout the value chain. The following measures are required to be observed in order to obtain good quality cotton.

Do's:

Crop Husbandry

- Select good quality seed variety.
- Dress the seed with appropriate fungicides to control seed borne diseases.
- Plant at the optimal planting window to allow full crop maturity.
- Weed the crop timely.
- Employ Integrated Pest Management to control pest damage.

Harvesting

- Before harvesting, inspect the field for materials that could be blown by wind and contaminate the heap of harvested cotton.
- Harvest cotton once the bolls are fully ripe and open. Cotton quality deteriorates when it is harvested late.
- Picking should only start after morning dewdrops have evaporated.
- Picking should be done only after at least 50% of the bolls in the field have opened.
- While picking cotton, pickers should form a line and advance forward together so that they will remain alert and could be well supervised.
- Start picking from the bottom of the cotton plant to avoid deposition of dry leaf bits on the bolls when the plant.
- Gather the insect-infested, stained and hard locks as well as locks picked up from the ground in a separate bag, to maintain purity.
- Cotton pickers should cover their heads with cloth to prevent cotton being contaminated with hair.
- Seed cotton collection point during harvesting should be well prepared to avoid its soiling.

- Cotton pickers should be paid wages on a per-shift basis and not on the basis of the weight of produce collected.
- Pack cotton in cotton packing bags ready for transportation from farm to home for storage.
- Store cotton at a place free from contaminants.
- Grade cotton into grade A and B.
- Pack cotton for transportation to the buying post in cotton packing bags.

Don'ts:

- While harvesting cotton, do not pick up leaves, stem bits, twigs, bracts, etc
- Avoid mixing seed cotton of different grade or from different pickings to maintain the grade of cotton
- Do not add water, sand, fertilizer and or any other extraneous material than cotton.
- Do not use polypropylene bags during harvesting and transporting cotton.
- Do not store firecrackers near seed cotton to prevent fire.

During Transportation from farm to Home house

Do's:

- Clean the handcart/bullock cart/tractor trolley before loading seed cotton.
- Cover the cotton loaded in handcart/tractor from all sides with cotton cloth or canvas while transporting cotton to home house.
- Different grades must be segregated while transporting cotton from the field to the farmer's house for storage.

Don'ts:

- Do not permit workers to sit or lie down on seed cotton heaps during transport.
- Do not carry any other material in the cart/trolley that can contaminate cotton.

During Storage

Do's

- Storage space for seed cotton should be clean and dry. If cemented floor is not available, cover the surface with cotton cloth.
- Seed cotton heaped in the house should be covered with cotton cloth to avoid contaminants.

Don'ts

- Do not store wet seed cotton in a closed room/godown as microbes might develop leading to fiber damage and discoloration.
- Do not permit combing of hair, as falling hair will contaminate cotton.
- Do not allow workers to lie down on heaps of seed cotton as worn out clothes and hair will cause contamination to cotton.

- Different grades of cotton and cotton from different districts should not be mixed together as doing so will reduce quality and bring down price.

During Transportation to Buying Post

Do's

- Cotton should be placed in clean trolley/bullock carts.
- While loading cotton in the trolley/bullock carts, immature, rotten and damaged seed cotton should be picked out.
- Only one grade should be loaded in one trolley so that purity is maintained.
- Load cotton of single picking in the trolley at one time. Cotton of last picking should be kept separately.
- Cotton should be covered with cotton cloth during transportation.

MODULE 2: (i) Pre-Requisites for Low Cotton Contamination Marketing

Learning outcome: Trainees to understand the requirements of obtaining less contaminated cotton during marketing.

The following are pre-requisites for ensuring clean cotton is brought and procured at the buying post.

Table 5. Pre-requisites for low cotton contamination

S/N	Criteria/Pre-requisite	Importance
1.	Presence of Fumigation Certificate	To control vectors
2.	Warehouse condition	To ensure the warehouse has a cement floor
3.	Presence of calibrated weighing scale	To ensure proper weighing of cotton from farmers to discourage adulteration
4.	Presence of cotton packing bags for seed cotton transportation	To prohibit usage of un-recommended packaging material
5.	Presence of firefighting equipment	Fire risk aversion strategy
6.	Presence of cotton cords for tying seed cotton bags ready for transportation	To prohibit usage of un-recommended tying ropes
7.	Presence of grade standard box	To ensure that the cotton purchased is graded
8.	Presence of price banner by grade	To reward quality
9.	Presence of warehouse to segregate seed cotton by grade	To avoid mixing of different grades
10.	Marking buying post as a 'polypropylene contamination free' area	To prohibit usage of polypropylene at the buying post compound
11.	Presence of a Grader at the buying post	To ensure grading delivered seed cotton

MODULE 2: (ii) Do's and Dont's at Buying Post

Learning outcome: Trainees to understand the correct procedures for procurement of cleaner seed cotton.

In order to ensure that the buying post procures cotton of required good quality, the following needs to be observed:

At Buying Post

Do's

- Keep buying post and its surroundings clean.
- Cotton arriving at the buying post should be offloaded only on cemented surface or on cotton cloth/tarpaulin.
- Ensure that offloading area is away from trees to avoid contamination with leaves and bird nuisance.
- Pack seed cotton in cotton packaging while transporting it to the ginnery.
- Use cotton cords for tying seed cotton bags.

Don'ts

- Never unload cotton on bare ground, as otherwise cotton will get contaminated with soil.
- Do not mix cotton of different grades.
- Do not expose seed cotton to elements of nature like sun, wind and rain.
- Do not allow cattle and other animals to move around seed cotton heaps.
- Do not allow people to sit and relax on seed cotton heaps.
- Do not throw empty packets of tobacco, chewing gum, etc. on seed cotton heaps.
- Never use sisal and jute ropes for tying seed cotton bags.
- Never receive cotton packaged in polypropylene bags.

MODULE 3: Bad and Good Practices Observed at Buying Posts

Learning outcome: Trainees to understand the bad and good practices observed at buying posts and consequently abandoning the bad procedures.

This module intends to inform the farmers, cotton buyers and agents of the fact that, at present bad and good procedures are being practiced. In order to achieve the objective of producing good quality cotton at all stages of the value chain, all people involved in delivering and procuring of cotton (seed and lint) are strongly advised to abandon bad practices and adopt good agricultural practices and marketing.

Bad Practices at Farm and Buying Post

Polypropylene bags inside a buying post

Sisal ropes used for tying seed cotton bags

Seed cotton collected from the farm is transported to the buying posts on ox-driven carts. But quality is compromised with Polypropylene cloth coverings and jute bags on top of the heap

Polypropylene canvas commonly used at buying post

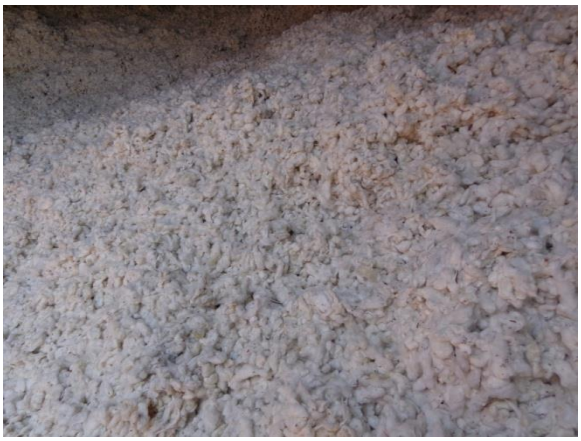
Seed cotton is also transported to the buying posts on bicycles in Polypropylene bags and tied using Polypropylene strings

Good Practices at Farm and Buying Post

Despite the challenges of contamination, there are a number of initiatives being employed to contain this problem.

	
A good buying post displays grading boxes outside with A + B grades and with clear indication of the current price per kilogram of seed cotton. This is in line with regulations by the Tanzania Cotton Board	Presence of sample box at buying post

	
The right picking bags made from cotton material	Ox-carts are used to transport seed cotton. A better option than delivering cotton packed in polypropylene bags

	
Non-contract farming	Contract farming cotton

4. CHAPTER IV - GOOD MANUFACTURING PRACTICES

4.1. Introduction

The ginnery is a place where quality can be affected if no proper procedures are put in place. Good Manufacturing Practices refer to a set of procedures to be followed by ginnery operators in order to produce a good quality product.

The modules below provide an introduction to practices which ginners are required to follow with the aim of producing less contaminated cotton. The modules are not exhaustive but will serve as a strong foundation for good ginning.

MODULE 1: Pre-Requisites for Low Contamination Ginning

Learning outcome: Trainees to understand the necessary conditions for a ginnery to produce less contaminated cotton.

Before obtaining a ginning license, the ginner is advised to fulfil the following pre-requisites:

Table 6. Pre-requisites to getting ginning license

No.	Criteria/Pre-requisite	Importance
1.	Presence of Quality Management Systems and Processes	To facilitate a coherent approach to quality management
2.	Presence of Quality Management Department/Unit	To provide adequate follow-up on all quality issues
3.	Warehousing to segregate seed cotton by grade	To avoid mixing of grades
4.	Warehousing to segregate seed cotton by district	To avoid mixing of cotton from different growing environments
5.	Demarcation of seed store and ginnery compound	To prevent polypropylene entering the ginning compound
6	Demarcation of Oil mill and ginnery compound	To prohibit oil entering into the ginning compound
7.	training of gin fitters	To allow proper settings of ginning machinery as well as adequate maintenance
8.	Presence of cotton packaging material for bales	To prohibit usage of un-recommended packaging material
9.	Presence of cotton bags for packing seed cotton from buying posts	To prohibit usage of un-recommended packaging material
10.	Presence of cotton cords for tying seed cotton packing bags	To prohibit usage of un-recommended tying ropes
11.	Presence of cotton cords for tying bale cover	To prohibit usage of un-recommended tying ropes
12.	Uniforms for employees	To prevent employees to be source of contamination
13.	Presence of containers for the collection of contaminants	To prohibit usage of polypropylene bags in the ginning hall
14.	Presence of ginnery maintenance box/container for keeping bolts and nuts during gin maintenance	To avoid bolts and nuts to contaminate lint
15.	Results of ginning outturn test	To measure ginning efficiency and assess the degree of professionalism at gin setting
16.	Fumigation certificate	To control vectors
17.	Firefighting equipment	Risk aversion measure
18.	State of seed cotton offloading area	To prohibit contamination in the ginnery compound

No.	Criteria/Pre-requisite	Importance
19.	Marking of ginnery compound as a 'Polypropylene free' area	To prohibit usage of polypropylene in the ginnery compound
20.	Weighing bridge calibration certificate	To ensure weighing of cotton from agents and farmers is done correctly and discourage adulteration
21.	Ginnery maintenance record	To ensure ginnery maintenance is done regularly using genuine spare parts
22.	Ginnery employees undergo a TCB contamination training and get a certificate	To ensure ginnery employees are trained on contamination reduction by TCB

MODULE 2. Do's and Don'ts at Ginneries

Learning outcome: Trainees to understand the correct procedures to run their ginneries in order to produce good quality lint.

In order to ensure the ginnery produces good quality lint, the following are important procedures that need to be implemented:

Do's

- Ginneries should insist that cotton arriving at their premises in carts, tractors, trucks is fully covered with cloth to protect the cotton from rain, sun, dust and airborne impurities.
- Keep factories clean; provide rubbish bins at different locations.
- Bags should be opened by un-sewing instead of cutting twine into small pieces.
- Stack seed cotton on clean roofed, well ventilated godown.
- Provide all workers with white cotton clothing to wear to avoid contamination from worn out clothes.
- Dry seed cotton in the sun to limit moisture content to within 7-9 percent.
- Install seed cotton pre-cleaner to remove immature bolls and foreign matter.
- Install pneumatic conveyer with stone catcher to transfer seed cotton to gins.
- Instruct workers to remove all foreign matter during feeding, if seed cotton is fed to gins manually.
- Use grease instead of oil in gearboxes to prevent contamination with oil.
- Maintain proper overlap settings and ensure periodic grooving of leather roller to avoid seed cut to get good quality of lint.
- Ensure good housekeeping in ginneries to avert contamination.
- Remove metal wire, bolts, machine parts, leather pieces, spilt oil, cleaning cloths etc. to prevent their entry into seed cotton/lint.
- Use cotton cloth for wrapping pressed bales and ensure that all sides are fully covered.
- Bale specifications should preferably be written/printed on a cloth label to be attached to the bale cover.
- Store bales in a covered godown to prevent it from exposure to rain, dust, etc.

- Develop and implement a comprehensive gin maintenance program that is continually documented and communicated. The maintenance program must include off-season repair, in-season preventive maintenance, and problem repair and documentation. Prime time should be programmed (typically one hour per 12-hour shift) for routine maintenance to include clean-up of facilities and machines. Use maintenance checklist for routine maintenance. Formal reviews should be conducted annually.
- Develop specific job description for each employee, and make sure that it is available in the appropriate language.
- Ensure that all gin machines operate at the correct speeds, settings and capacities.
- Whenever possible, utilize new, proven technology that is supported by independent, unbiased, and published scientific reports.
- Use feedback from merchants, textile mills, and other customers to refine and improve gin operations.
- Ginner should create awareness about 'Contamination' among their workers for taking proper care and remove visible contamination.

Don'ts

- Never stack cotton on bare ground to prevent it from getting contaminated by soil and other impurities.
- Do not use jute bags and jute twines for bale packaging.
- Don't allow polypropylene in the ginning compound.
- Do not allow eating of food near seed cotton heap.
- Do not keep inflammable material inside the factory.

MODULE 3: Bad and Good Practices at Ginneries

Learning outcome: Trainees to understand the bad and good procedures practiced at ginneries and consequently adopt the good practices.

Lack of a coherent quality management system has caused adoption of procedures by ginners that act as a precursor to cotton contamination. This module seeks to raise awareness of ginnery operators in relation to bad and good practices. After acquiring the right knowledge, ginnery owners should abandon the bad practices and adopt good manufacturing practices.

4.1.1. Bad practices observed at ginneries

Worn out canvas at offloading area

Polypropylene string tying malfunctioning gin

Insufficient number of workers engaged in segregating contaminants at the feeding point

Cotton handlers using inappropriate materials for transporting seed cotton

Jute bags are used to transport cotton and PP coloured strings are used to tie the bags

Brooms, brushes and plastic bags amidst seed cotton contribute to contamination

	
Torn clothing worn by cotton handlers causes threads to drop in the heap which mixes with the cotton and causes contamination	worn-out jute bags used to transport cotton, cause threads to drop in the heap
	
Polypropylene in the ginning hall	Polypropylene used to cover bales
	
Polypropylene used for collection of contaminants	Polypropylene used for packaging seeds can easily contaminate lint if the ginning hall is not separated from seed store

Polypropylenes are everywhere in the ginnery compound

Polypropylenes are everywhere in the ginnery compound

Polypropylene in the ginning hall

Sisal ropes used for tying seed cotton bags

Grooves made on worn-out leather-clad rollers for double roller machines inside the ginnery result in pieces of remnants to mix with the cotton and cause contamination

Double roller gins are old and not well maintained

A jute bag is seen stuck in a DR machine during the ginning process. This will contaminate cotton quality. Cotton seeds are not properly being separated from the lint due to poor maintenance

Presence of sand in seed cotton during the ginning process

Some ginneries use cotton fabrics to cover bales, but are unaware that jute strings used for tying cause contamination

Steel wires should not be used for bailing. Cotton is sensitive to contamination by rust. Moreover, steel straps could cause fires in a spinning factory when opened by force

4.1.2. Good practices observed at the ginnery

Seed cotton received in bulk to allow for full inspection

Cotton grading is done to separate A from B grade. After the cotton parameters are defined, the seed cotton is brought to the storage go-down and qualified for ginning

Raw cotton pre-cleaner and lint cleaner machines are installed at the ginnery. Pre-cleaners remove impurities from seed cotton and lint cleaners reduce trash and contaminants and improve fibre quality

Sorting of contaminants at feeding point reduces contamination

Women cotton workers wear hip bags and segregate contaminants at the feeding point.
Quality trainer suggests that workers who pick contaminants should work closely with gin feeders. This way they can effectively reduce contamination before seed cotton goes through the suction system to the gin stands

Women workers use a locally-made sand screen to sift sand from raw cotton before ginning. Contaminants are also removed in the process

A mechanical sand screen is used to sift the sand from the seed cotton. The sand is collected and weighed to determine the price paid to the farmer

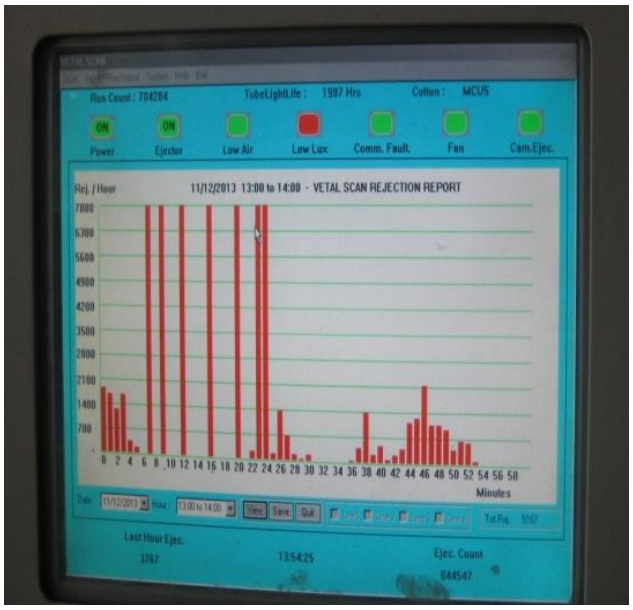
Mechanical feeding minimizes the human factor thus reducing contamination

Proper baling straps are used at the bale press

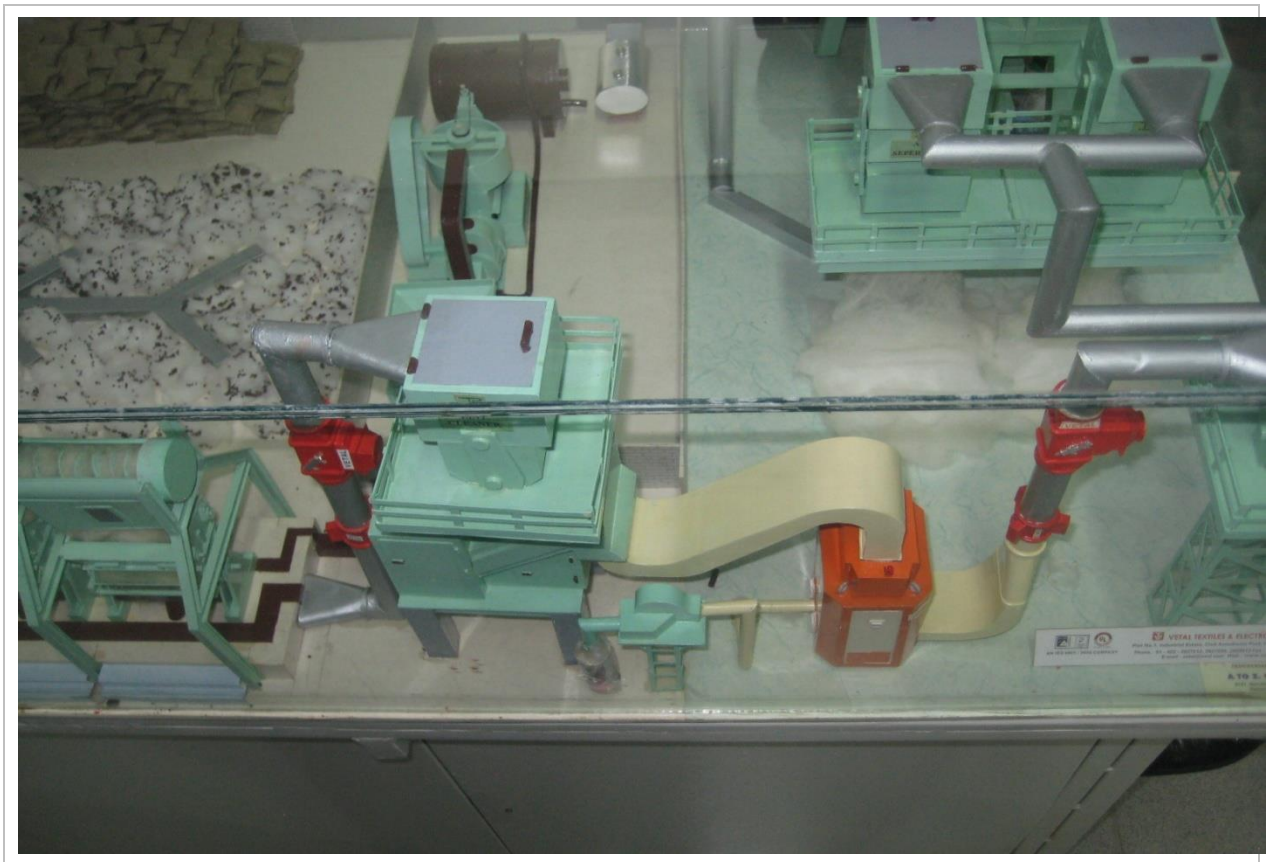
A complete bale is broken on a weekly basis and women check for contaminants

Packaging bales using cotton material is the best option

Installation of both pre and post cleaners reduce contamination



Contamination Cleaning Machines: the machine is suitable for both ginning and textile mills. The machine, when in operation, generates automatic contaminants rejection reports



Ginnery layout showing the position of the contamination cleaning machine

REFERENCES

Baffles John, (2004), *Growers and Ginners can reduce contamination*. 27th International Cotton Conference, Bremen, p. 119-136

Gerald Estur, (2008), *Quality and marketing of cotton lint in Africa*. World Bank African Region working paper series No.121.

International Cotton Advisory Committee, (2001), *Impact of ginning on fiber quality. Best Ginning Practices.*

International Trade Centre UNCTAD/WTO, (2007), *Cotton Exporter's Guide*.

Keith, L.E. (2001), *Cotton contamination* CCN-01-4b.

Madhuri V.K , **Shah H.R,** (2013), *Cotton contamination - its sources and remedial measures*.

Patodia B.K, (2003), *Contamination – a pain in the neck of spinners*. Proceedings of Plenary Meeting of the International Cotton Advisory Committee, Gdansk - Poland, 2003.

Schindler, C.P. (2005), The International Textile Manufacturers Federation*, Cotton contamination survey*, Proceedings of International Cotton Conference, Bremen, 2005, p. 45 – 66.

Appendix 1:

Buying Post Quality Control Checklist

Company_____

Date_____

S/N	Checking Point	Status	Action Taken/ Remarks
1.	Number of farmers who delivered their seed cotton in Polypropylene bags		
2.	Types of contaminants detected by grader during inspection of seed cotton		
3.	Number of polypropylene strings detected during inspection of seed cotton by grader		
4.	Number of other contaminants detected during inspection by grader		
5.	Procurement of seed cotton by grade		
6.	Number of bags of seed cotton rejected for poor quality		
7.	General assessment of quality of cotton		
8.	Presence of cotton cords for tying packing bags ready for transportation		
9.	Presence of cotton packing bags and their condition		
10.	Percentage of seed cotton moisture		
11.	Status of the weighing scale		
12.	Reported discrepancy of seed cotton weight between the buying post and the ginnery		
13.	Status of the vehicle transporting seed cotton to the ginnery		

Grader _____ **Buying Post Head** _____

Appendix 2:

Ginnery Quality Management Checklist

Name of the Ginnery_____

Date _____

S/ N	Checking Point	1st Shift	2nd Shift	3rd Shift	Remarks
A.	**Seed Cotton Storage Area:**				
1.	Number of PP bags observed				
2.	Number of pp strings observed				
3.	Type of other contaminants observed				
4.	Number of other contaminants observed				
5.	Condition of seed cotton unloading area				
6.	Seed cotton packing bags condition				
7.	Seed cotton transporting vehicle condition.				
8.	Number of sisal/jute/nylon ropes used to tie seed cotton bags				
9.	State of workers' uniforms				
B.	**Seed Cotton Feeding Area:**				
1.	Number of contaminants on seed cotton feeding floor				
2.	Number of workers sorting contaminants				
3.	Number of pp strings obtained				
4.	Number of other contaminants obtained				
5.	Type of other contaminants obtained				
6.	General Assessment of seed cotton quality				

S/N	Checking Point	1st Shift	2nd Shift	3rd Shift	Remarks
7.	Type and condition of container used for collection of contaminants				
8.	Is the rule of First in First out (FIFO) for ginning seed cotton observed?				
C.	**Ginning Section**				
1.	General cleanliness of the ginning hall floor				
2.	General cleanliness of gin stands				
3.	Number of workers sorting contaminants				
4.	Number of pp strings obtained before baling				
5.	Number of other contaminants obtained before baling				
6.	Type of other contaminants obtained				
7.	Type and condition of container used for collection of contaminants				
8.	Marking showing ginning hall free from polypropylene and other contaminants				
9.	State of workers' uniforms				
10.	Number and Type of contaminants obtained after break-opening of the bale				
11.	Presence of gin maintenance box/container for keeping bolts and nuts during maintenance				
12.	Type of cord used for tying bale cover				
13.	Percentage of fibre moisture				
14.	State of hydraulic equipment. Check for oil leaks which may contaminate lint				

Supervisor _____ **Ginnery Manager** _____

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International Trade Centre

Street address: ITC,
54-56, rue de Montbrillant,
1202 Geneva, Switzerland

Postal address: ITC,
Palais des Nations,
1211 Geneva 10, Switzerland

Telephone: +41-22 730 0111
Fax: +41-22 733 4439
E-mail: itcreg@intracen.org
Internet: www.intracen.org

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