

Material Scenario

Cotton fiber that is grown, processed, and certified, according to organic standards. Unit processes for the production of cotton begin with the seed at field, cultivation, and ginning. Processing of cotton includes processes such as opening, cleaning, mixing, carding or combing, drawing, roving, spinning, and weaving or knitting the fabric.

Certified organic cotton is produced in accord with specific country-level or international organic agricultural standards, integrating ecological processes, maintaining local biodiversity, and avoiding the use of toxic and persistent synthetic pesticides and fertilizers as well as genetically modified seeds. Independent certification agencies accredited by organizations that maintain strict controls over certifiers are responsible for certifying organic cotton according to country specific standards. To maintain certification through processing to final product, the organic cotton must be kept separate from noncertified cotton and be traceable from the farm to the finished product (Textile Exchange, n.d.(b)).

Common Uses In Apparel And Footwear

Cotton is a widely used fiber with applications for nearly all types of apparel and selected types of footwear. It is widespread in men's, women's and children's clothing and used in uppers and shoelaces for footwear. In addition to its use in 100% cotton textiles, it is also blended in various combinations with polyester, spandex, rayon, and hemp as well as other fibers (Guruprasad, n.d.).

Alternative Textiles That May Be Substituted For Material

• Hemp • Linen • Modal • Polyester • Rayon • Tencel (Lyocell)

Life Cycle Description

Functional Unit

1 kilogram of woven or knit organic cotton greige fabric

System Boundary

Cradle to undyed fabric. The data presented within include all steps required to turn the raw material or initial stock into undyed knit or woven fabric, including transportation and energy inputs. Capital equipment, space conditioning, support personnel requirements, and miscellaneous materials comprising <1% by weight of net process inputs are excluded.

Allocation

Ginning of harvested cotton (known as seed cotton) produces one unit of higher economic value cotton fiber (lint) along with 1.4 units of substantially lower economic value cottonseed. Cotton combing prior to spinning creates a co-product – noils are short fibers that have an economic value that is about half that of cotton lint (Cotton Inc., 2012, p. 21). Stalks and gin waste are considered waste materials and are assigned no burden.

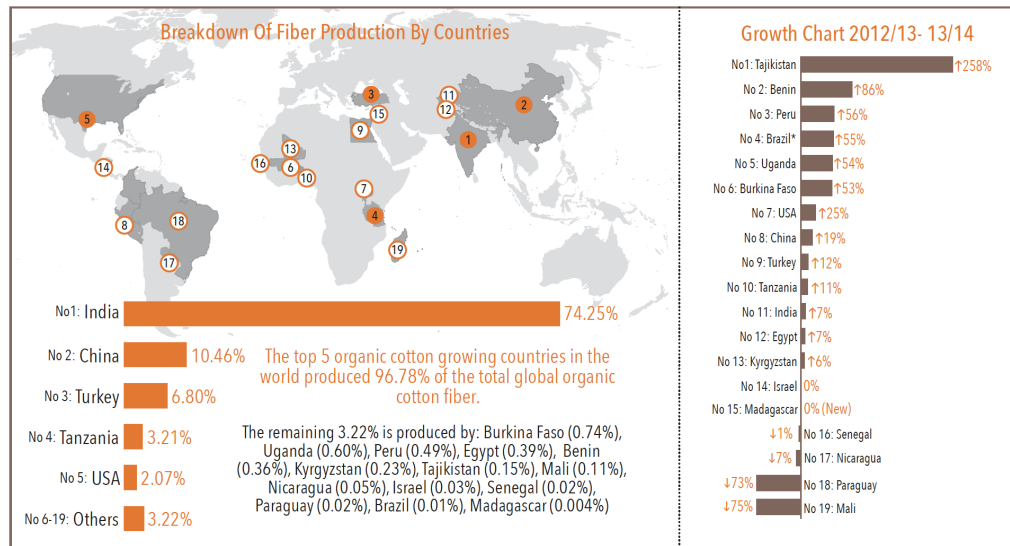
Unit Process Descriptions

Material Sourcing

Organic cotton growing differs in a number of critical aspects compared with methods for growing conventional cotton (Klonsky, 1995, p.2) – primarily in bringing a systems focus to farming through building soil health, the use of mixed cropping systems and crop rotation, and the avoidance of fossil fuel-based, toxic, and persistent agricultural chemicals and the use of genetically modified seed (Textile Exchange, 2010, p. 3, Guereña and Sullivan, 2003). Organic cotton fiber must be certified by an accredited independent organization as meeting country specific or international organic farm standards established by a recognized authoritative organization.

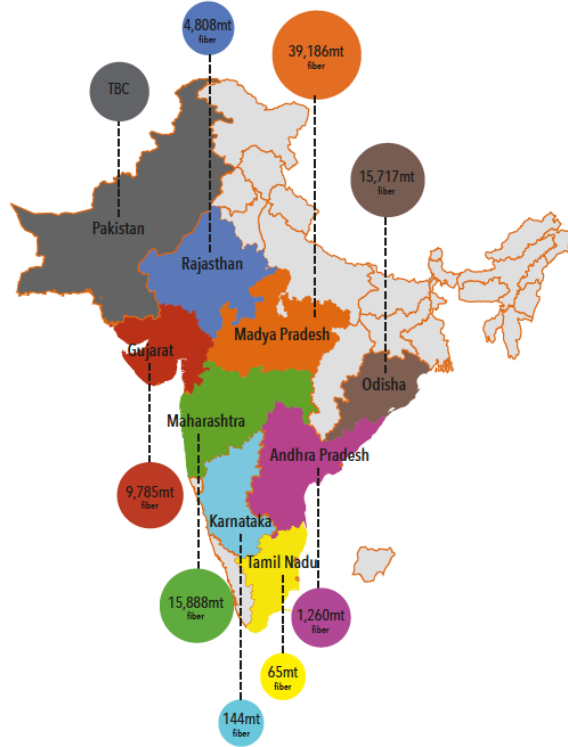
Global organic production for the 2013-2014 growing season covered 220,765 hectares of land, producing 116,974 metric tons of lint (Textile Exchange, 2015a, p.25). Cotton may be grown using organic methods in similar regions as conventional cotton crops where temperate to hot conditions with long growing seasons exist (Kadolph, 2007, p. 42). Nineteen countries worldwide produced organic cotton in 2013-14, although the top five producing countries accounted for 96% of total production, with India alone producing 74%, followed by, China, Turkey, Tanzania, and the U.S. at 10%, 7%, 3%, and 2% respectively (Textile Exchange, 2014, p.20).

Figure 1: Organic Cotton Global Production



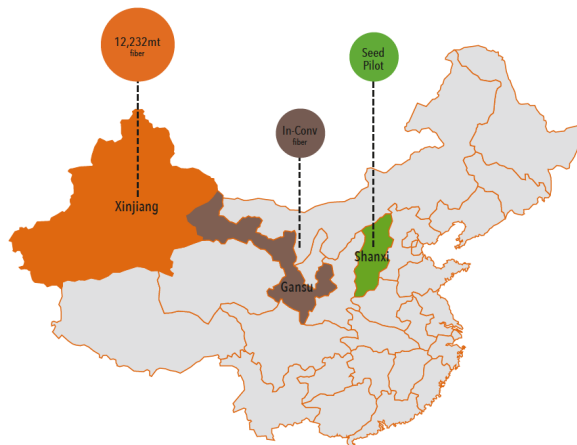
Source: Textile Exchange, 2015a, p. 26

Figure 2: India's Organic Cotton Production 2013-14 (Textile Exchange, 2015a)



India recorded 86,853 of fiber production in 2013/4, a growth of 7% from the previous year.

Figure 3: China's Organic Cotton Production 2013-14 (Textile Exchange, 2015a)



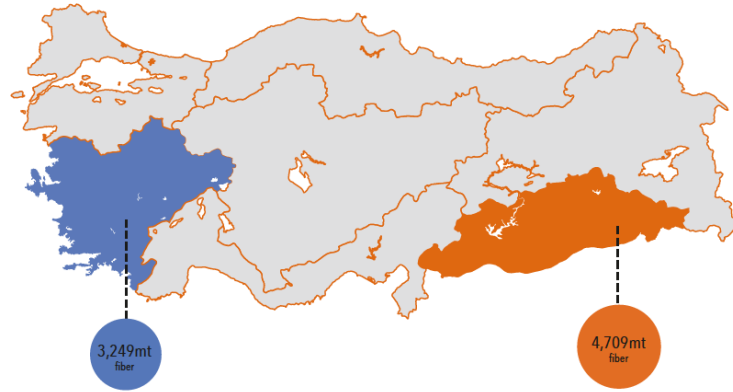
China recorded 12,232 of fiber production in 2013/4, a growth of 19% from the previous year.

Figure 4: Turkey's Organic Cotton Production 2013-14 (Textile Exchange, 2015a)

258 Farmers | 4,140 ha Land | 7,958 mt Fiber

Fiber Yield: \approx 1,928 kg/ha | Fiber Length: L, M | Fiber: \approx USD 1.60 - 2.15 /kg

1,430 ha Land In-Conversion 2015/16-17/18 | 2012/13-13/14 Growth: \uparrow 12% | Estimates for 2014/15: Growth

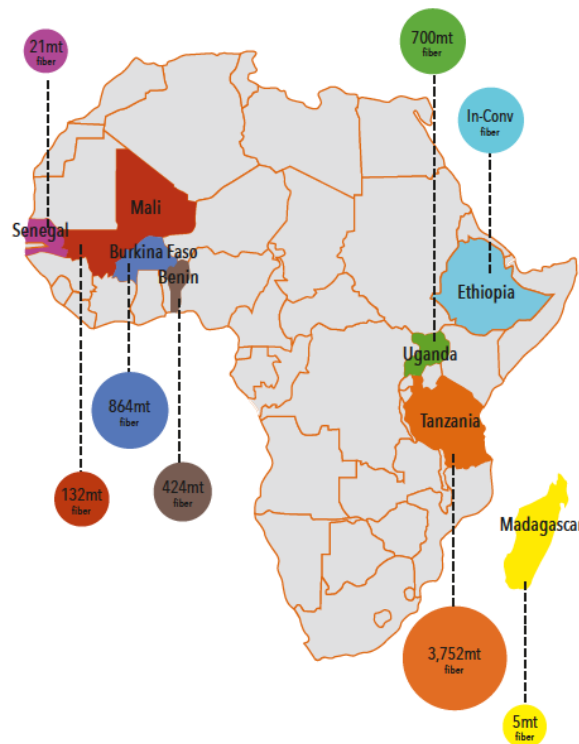


Turkey recorded 7,958 of fiber production in 2013/4, a growth of 12% from the previous year.

Figure 5: Tanzania's Organic Cotton Production 2013-14 (Textile Exchange, 2015a)

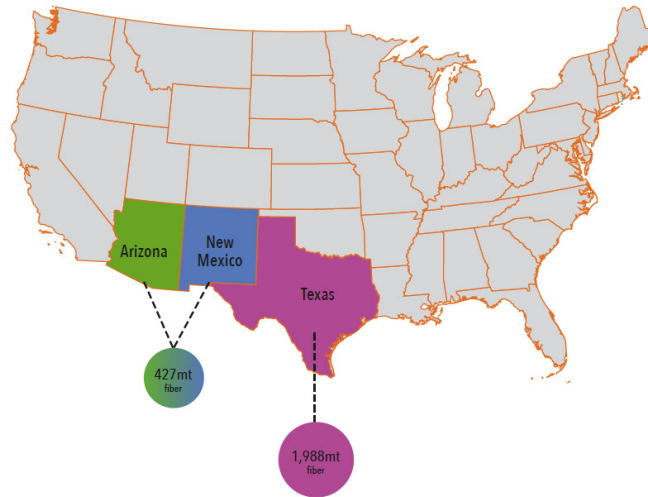
4,179 Farmers | 17,218 ha Land | 3,752 mt Fiber | Fiber Yield: \approx 317 kg/ha | Fiber Length: M

Seed Cotton: \approx USD 0.43 - 0.46/kg | 2012/13-13/14 Growth: \uparrow 11% | Estimates for 2014/15: Growth



Tanzania recorded 3,752 of fiber production in 2013/4, a growth of 11% from the previous year.

Figure 6: U.S. Organic Cotton Production 2013-14 (Textile Exchange, 2015a)



The U.S. recorded 2,415mt of fiber production in 2013/4, a growth of 25% from the previous year.

Organic methods seek to establish a self-regulating farm ecosystem that uses on-farm inputs such as green manure, biomass, organic fertilizers and botanical preparations, while minimizing the use of external resources (Textile Exchange, 2010, p. 3). In lieu of using synthetic agri-chemicals to control pests, biological and cultural controls are used based on an understanding of local ecology and adjusting product to complement natural systems (Guerena and Sullivan, 2003). Where external resources are required, such as B.t. sprays, or elemental sulfur, they must be approved for organic farming use.

Seed cotton may not be treated with any synthetic chemicals, but may utilize biological fungicides, a polymer coating, and calcium carbonate to protect the seeds (Blackburn, 2009, p. 252).

Successful organic production rests on creating and maintaining soil health and fertility to support desired cotton yields. The organic production system strives to minimize external inputs and to make use of farm-own resources (e.g. animal and green manures, biomass, organic fertilizers, and botanical preparations for pest control) thus preventing toxic exposure to humans and bioaccumulation in the environment. Crop rotation and the use of cover crops such as legumes, grains, and grasses are planted to replenish soil nitrogen and reduce nutrient loss (Rangarajan, n.d.). Manure fertilizers, particularly from poultry, provide additional nitrogen for organic production (Blackburn, 2009, p. 244).

Organic cotton can only be certified if conventional chemical pesticides and fertilizers have not been used for three consecutive years on the land where the crop is grown (Blackburn, 2009, p. 233).

Conversion from conventional chemical-dependent methods to organic may result in initial reduced yields, as farmers must gain knowledge and experience in organic methods that replace typical agri-chemicals (Textile Exchange, 2014, p. 9). Though a yield gap may occur the first year of organic production, yields are found to increase over time and with improved management (Forster, 2013, p.7).

Processing Cotton Lint Into Spun Yarn

Certification of organic cotton requires that the cotton be tracked from the field through all subsequent manufacturing steps and be processed on machines that are either thoroughly cleaned prior to be used for organic cotton or used exclusively for organic cotton to ensure segregation from conventional cotton and any associated contaminants (Blackburn, 2009, p. 263). Organic cotton must also be stored separately if conventional cotton is processed on a site. Initial quantities of cotton produced on a machine that has been cleaned following use with conventional cotton cannot be certified due to the chance of contamination (Blackburn, 2009, p. 264).

Certified organic cotton fiber may be used to manufacture a textile with the same processes and chemical inputs as noncertified fiber; the resulting textiles and products can claim organic fiber content through Textile Exchange's Organic Content Standard (OCS).

Organic certification is available for post-harvest processing and textile manufacturing using the Global Organic Textile Standard (GOTS), which addresses social and environmental issues in textiles made with at least 70% certified organic natural fibers. GOTS covers chemical inputs, management policies and procedures, social criteria, technical performance qualities, and residues in textiles. Independent certification is required (GOTS, 2014).

Cotton lint, conventional or organic, must be cleaned of dirt and plant matter, and must first be opened from the packed bale. This process loosens the fibers and blends fibers from multiple bales. Very short fibers, debris, and other detritus are removed during this stage. After the fibers are prepared, they are carded to align and remove remaining contaminants and turned into slivers (Kadolph, 2007, p. 182). The slivers are then drawn through consecutive rollers that improve the alignment of the fibers. Long-staple fibers undergo a combing process, which removes short fibers and further improves the uniformity of the sliver. Drawing occurs before and twice after the combing process (Kadolph, 2007, p. 183).

Spinning may be done on rings, open-ended rotors or via a few other methods. Ring-spun cotton is the most common form of transforming parallel fibers into yarn. They are drawn into strands and twisted to improve tensile strength (Kadolph, 2007, p. 185). Open-end spinning is the other major spinning method.

Textile Construction

Spun yarn can either be woven or knit into a textile.

Woven textiles are produced on looms that combine warp yarns with filling yarns to produce a stable fabric. The type of loom used in the weaving process determines the environmental impacts: water-jet looms have high water usage, though it is reclaimed, but the fabric must be dried before storage, increasing energy consumption (Kadolph, 2007, p. 221).

Knitting is done by machines that loop yarns together to create a more flexible textile. Knitting requires significantly less energy than weaving, with a 20-fold decrease in energy demand (van der Velden, 2013, p. 347). Vibration, lint, noise and energy are all lower on knitting machines than for weaving looms (Kadolph, 2007, p. 270). Knitting oils are added to fabric to improve machine efficiency; the oils are scoured during the dyeing and finishing process (Blackburn, 2009, p.265).

Textiles that are GOTS certified have limits on the chemicals used for sizing of weaving yarns; size is then removed during the dyeing and finishing process (Blackburn, 2009, p. 265). Projectile looms are low energy, accounting for half as much energy as rapier looms, and a third as much as air-jet looms (Kadolph, 2007, p. 221).

Process Inputs



Energy

Organic cotton fiber uses a global average of 5.8 MJ non-renewable energy/kg lint (Textile Exchange, 2014, p.42). The PED (potential energy demand) for conventional cotton (Cotton Inc., 2012) is ca. 15,000 MJ/1,000 kg lint cotton (value assessed in this study for organic cotton: ca. 5800 MJ). This results in a reduced primary energy demand (non renewable) of 62%. As in the case for GWP, avoiding the use of mineral fertilizer reduces the use of non-renewable fossil energy, since mineral fertilizers are petroleum-derived and carry a high PED.

Cotton from cradle-to-gate (up to undyed woven fabric) requires various energies depending on fineness of yarn: between 450 MJ/kg for 70 dtex (63 denier) yarn to 150 MJ/kg for 300 dtex yarn (270 denier) (van der Velden, 2013, p. 350).



Soil

Cotton can be grown in many soils, but deep medium to heavy soils are best, and soil should retain water well (Kooistra, 2006, p.5).

Planted area of organic cotton in 2013-2014 was 220,765 hectares of land. Organic cotton farmers employ a wide range of techniques to conserve soils and water, improve soil fertility, and deter pests. Popular techniques for improving soil fertility include crop rotation and composting. The most popular crop varieties grown in rotation with, or alongside, cotton are cereals and grains followed by legumes and pulses, all of which provide soil fertility as well as a source of carbohydrate, oil, and protein to organic farming households (Textile Exchange, 2015b, p. 14 & 27).

Although tilling may be used to control weeds in lieu of synthetic herbicides as well as for incorporating organic fertilizers and manure into soil, the potential impacts of tillage on soil erosion may be minimized and even eliminated by appropriate use of many of the above mentioned strategies (Guerena and Sullivan, 2003, p. 3).

Depending on the strategies a farmer may use, organic cotton may be planted less densely to encourage plant growth and beneficial co-species, as well as to discourage pests; conversely, denser plantings may help shade out weeds (Blackburn, 2009, p. 253). Fertility is improved by planting cover crops following the harvest (Rangarajan, n.d.).

To maintain organic certification, cotton and all farm system crops must be grown without the use of prohibited farm chemicals; and a three year transition period must be met before the land can be certified as organic (Blackburn, 2009, p. 251).



Water

Cotton requires approximately 700 to 1300 mm of water depending on climate and length of the growing period (FAO, n.d.). Defined as marketable crop yield over evapotranspiration, cotton has one of the lowest CWPs of any agricultural crop. Cotton's water requirements can be met by a combination of precipitation, irrigation, and/or soil moisture. Growing cotton in regions with substantial precipitation, increasing soil fertility, and controlling soil evaporation help reduce or even eliminate the use of irrigation.

Total water consumption for organic cotton is 14,073 liters/kg lint; irrigation (blue) water consumption (the impact category with a high environmental relevance) for organic cotton is 182 liters/kg lint, which is significantly less than that of conventional cotton at 2,120 liters/ kg lint (Textile Exchange, 2014, p. 40).

Organic cotton is mostly rain-fed (Kooistra, 2006, p. xii; Textile Exchange, 2014a, p. 40), estimated that about 75-80% of production (Textile Exchange, 2013, p. 34).

Water use is limited to approximately 50 liters/kg fabric in the later stages of the cradle-to-gate life cycle (Textile Exchange, 2012, p. 89). Water may be used to humidify mills, apply sizing, and in water-jet looms.



Chemical

Synthetic (fossil fuel-based) chemicals and toxic and persistent chemicals are prohibited in organic farming. Pests are controlled through appropriate crop rotation, carefully selected plant varieties, increased monitoring, beneficial insects, bio- and mineral-based pesticides, constructed traps, trap crops, and selective hand removal (Textile Exchange, 2008, p.6, p.1). Rates of use vary depending on local conditions, farmer knowledge, skill, and access to training. Bio and certain mineral-based substances are allowed. In very limited cases, select synthetic chemicals may be used if approved by the certifying organization (Blackburn, 2009, p. 232).

Defoliant commonly used to prepare cotton bolls for mechanical harvest are mostly synthetic and thus unavailable for organic cotton. Alternatives to chemicals include thermal defoliation, controlling water applications in low precipitation regions, and waiting for frost in temperate climates (Blackburn, 2009, p. 262).

Organic farming aims to create self-stabilizing agro-ecosystems with the help of suitable crop rotations, mixed cropping systems, choice of adapted varieties, and application of organic fertilizers and manures. Pest outbreaks are to some degree minimized by the ecological balance maintained by the organic system or through the use of trap crops. Further, native plants are often used for farm borders, preserving populations of local species. This results in increased biodiversity, soil fertility and, in some cases, habitat restoration. In addition, as genetically modified organisms are banned, continuation of indigenous species is more likely, and the lack of chemicals reduces the risk of harm to biodiversity.

Cotton yarns are usually sized before weaving to reduce lint releases and damage to the resulting textile. Knit textiles use little or no lubricating compounds as they do not abrade during the process (Kadolph, 2007, p. 221). Processing following GOTS limits the use of size to bio-based materials.

Global Organic Textile Standard produces a Positive List that details approved chemical inputs for organic production (GOTS, 2014, p. 12).



Physical

The physical inputs into cotton cultivation are the seed used to sow each year's new crop, seeds for cover and trap crops, beneficial insects, and, in the case of surface drip irrigated cotton, regular replacement of polyethylene tubing (Cotton Inc., n.d.). Compressed air is used in mills.

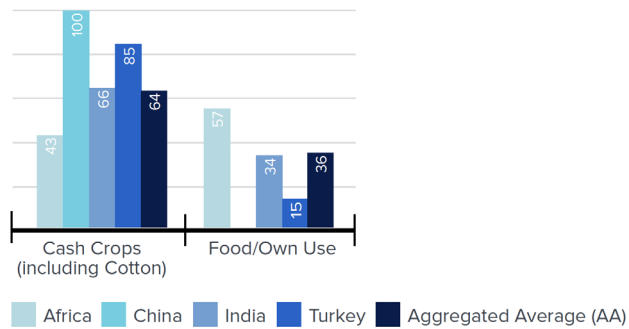


Land-use Intensity

About 3% of the global agricultural acreage is dedicated to cotton cultivation (Cotton Inc., 2012, p. 5). While intensification of cotton crops has resulted in decreased land-use intensity, decades of intensive farming and the use of chemical fertilizers and pesticides have taken their toll on soils. An estimated 4-5% of arable land has been abandoned due to intense cultivation, especially of cotton.

World cultivation and harvests for all cotton in 2013-2014 crop year was estimated at 33.1 million hectares (USDA, 2014a, p. 2). Organic production in 2013-2014 crop year (the most recent publically available data) was 220,765 ha (Textile Exchange, 2015a, p. 25).

Figure 7: Crops Grown Alongside Organic Cotton (Textile Exchange, 2015b, p. 19)



From the recent Organic Cotton Sustainability Assessment Tool (OC-SAT) (Textile Exchange, 2015b, p. 19) findings the findings showed that farmers grew a variety of crops alongside organic cotton. This finding indicated the diversity of land-use and the greater acreage of organic production (if all crops were accounted for). On average, the percentage of land dedicated to cash crops (including cotton) on organic farms was 64% and for household use was 36% (Textile Exchange, 2015b).

Process Outputs



Co-products And By-Products

Seed cotton is the economically important product for the cotton and textile industry. However, organic rotation crops such as sesame, wheat and soya, are also important to the farmer and may be high value input to the food industry. Organic cottonseed also has market value and sold as feed to organic dairies. A portion of the crop may also be saved for replanting (USDA, 2014b, p.1). A shortage of organic cotton seed for cultivation remains a challenge for the organic industry (Textile Exchange, 2013, p.14).

Secondary co-products of ginning include cottonseed used for oil, animal feed, cosmetics, and fertilizer and linters, which are very short fibers used in the production of rayon, acetate, cellophane, fingernail polish, and methylcellulose (Kadolph, 2007, p. 43). Yarn spinning creates a secondary co-product, noils, that also have economic value (Cotton Inc., 2012, p. 20).



Solid Waste

At every stage, from harvest to fiber to fabric, there is a loss of material that does not have any economic value. Major cotton wastes include cotton stalks, gin waste, and fabric selva associated with textile weaving or knitting (Cotton Inc., 2012, p.20). Stalks are often composted in organic systems or reused as part of conservation tillage, and gin waste and fabric scraps can be recycled into other cotton products. Abraded fiber from spinning and weaving/knitting processes also ends up as waste (Kadolph, 2007, p. 221). Other solid wastes are associated with packaging of cotton as it moves through the life cycle via transportation.



Hazardous Waste/Toxicity

Inherent in organic farming is the avoidance of synthetic pesticides and fertilizers that may result in the generation of hazardous waste from farm operations. Moreover, the use of toxic and persistent chemicals is avoided as well. Little, if any, hazardous waste or toxic materials are used in post-harvest cotton processing and greige manufacture.



Wastewater

Organic cotton is predominantly rain fed but when irrigation is used, large volumes of wastewater runoff may result (as much as 50% of applied water, Montgomery and Wigginton, n.d.). Runoff typically contains fertilizers and pesticides (Chapagain, et al., 2006, p. 192), although a recent study showed that organic farming practices have a much smaller grey (polluted) water footprint, and therefore a lower impact on water resources, than conventional farming, while having similar land productivities (Water Footprint Network, 2013, p. 23).



GHG Emissions

On average, organic cotton cultivation causes 978 kg CO₂- equivalent for every 1000 kilograms of cotton fiber produced (Textile Exchange, 2014, p.55). This compares to 1,808 kg CO₂- equivalent/ 1000 kg of fiber for conventional cotton (Cotton Inc., 2012, p. 11; Textile Exchange, 2014a, p. 52). Key sources of GHG emissions in organic cotton production are fuel use for farm equipment, electricity use primarily for pumping water, and nitrous oxide emissions associated with nitrogen-based fertilizers. Manure contributes to GHG emissions due to ruminant emissions of methane, manure emissions and soil development of nitrous oxide (Chadwick, 2011, p.1). An estimated 44 kg of nitrogen is applied as the active ingredient of organic fertilizer per hectare of cultivation (Textile Exchange, 2014, p.74). All other steps of processing require the same equipment and thus likely have similar emissions (Blackburn, 2009, p. 264).

Table 1. Inputs And Outputs Per KG Of Cotton: Cradle to Gin Gate

	Organic	Conventional
Energy (MJ)	5.76 ⁱ	15 ⁱⁱ
Water (L) ⁱⁱ	182 ⁱ	2,120 ⁱⁱ
Waste (kg) ⁱⁱⁱ	0.3 ⁱ	0.3 ⁱ
GHG emissions (kg CO ₂ eq) ⁱⁱⁱ	0.978 ⁱ	1.808 ⁱⁱ

Note: The values shown here derive from two independent peer-reviewed studies with aligned modeling approaches and system boundaries definition, allowing indicative comparison, but the comparability has not been verified as part of the critical review process.

References

ⁱ Textile Exchange, 2014, p. 42, p. 22, p. 40, p. 36

ⁱⁱ Cotton Inc., 2012, p. 61 (calculated with data from p. 66)

ⁱⁱⁱ Note that both the TE and Cotton Inc GHG emission values do not account for the CO₂ that is stored in the fiber (1,540 kg CO₂) and subsequent products, then released later at end of life.

Table 2. Fiber Properties Of (Conventional U.S.) Cotton

Fiber Properties	U.S. Cotton
Staple length ⁱ	2.22 - 3.81 mm
Tenacity (g/d) ⁱ	3.5 - 4.0
Tensile Strain (%) ⁱⁱ	3 - 7
Water retention (%) ⁱ	7 - 11
Breaking Stress - Dry (cN/tex) ⁱⁱⁱ	26 - 43
Breaking Stress - Wet (cN/tex) ⁱⁱⁱ	26 - 47
Fineness (dtex) ⁱⁱ	1.2 - 2.8
Ignition temperature (°C) ⁱⁱⁱ	390

References

ⁱ Kadolph, 2007, p. 43, 47

ⁱⁱ Ziva and Krste 2010, p. 28

ⁱⁱⁱ Brandrup et al., 2009, pp.142, 147

Performance And Processing

Functional Attributes And Performance

- Absorbent
- Machine washable
- Resistant to high heat
- No static buildup
- Stronger when wet
- Soft hand feel

Mechanical Attributes

Cotton staple length determines the fineness of the final product. Higher amount of glucose monomers within a long liner chain that make up each fiber improves fiber strength (Kadolph, 2007, p. 46). Cotton is relatively strong, with a dry breaking tenacity of 3.5-4.0 grams/denier, and is 30% stronger when wet. Resiliency in cotton is very low due to weak hydrogen bonds, causing degradation and frequent wrinkling (Kadolph, 2007, p. 47). Cotton may be mercerized to improve absorbency and improve dyability. Fabrics made from entirely cotton yarn will shrink, especially when treated in hot water. They have an elastic recovery of about 75% from a 2-5 percent stretch (Kadolph, 2007, p. 47). Color of the fiber ranges between white and yellow, and is also graded on reflectivity. Color of the fiber ranges between white and yellow, and is also graded on reflectivity.

Processing Characteristics

Cotton that contains remnants of leaves, dirt, and other agricultural byproducts will result in lower quality fabric (Kadolph, 2007, p. 46). Immature and coarse fibers also degrade the character of cotton, reducing fineness and can cause defects in fabrics.

Aesthetics

Cotton can be sorted by staple length, character, and grade. Staple length determines the quality, and longer staples produce softer, smoother, stronger fabrics with higher luster (Kadolph, 2007, p. 47). Cotton has relatively short length for a fiber, but contains convolutions that improve the tensile adhesion between fibers (Kadolph, 2007, p. 47).

Potential Social And Ethical Concerns

Organic cotton cultivation aims to reduce or eliminate environmental, ethical, and social concerns caused by conventional cotton production (IFOAM, n.d.). Organic cotton aims to promote protection of ecosystems as well as improve economic fairness, transparency, and ethical production and sourcing (Textile Exchange, 2013, p. 9). Fairtrade or formal decent work policies have been adopted by 65% of organic cotton producer groups (Textile Exchange, 2015b, p. 9).

Handpicking remains the dominant harvesting method globally, which could cause concerns over worker treatment (Blackburn, 2009, p. 261). A potential exists for human exposure to fertilizer contaminated water; similarly, there may be some potential for ecosystem exposures to flora and fauna occur on and off the farm and has contributed to hypoxia of surface waters and marine environments (USEPA, n.d.). Where intensive tillage is used with organic fertilizers there may be an increase in topsoil erosion; this may be offset by other practices that enhance agricultural productivity (Guerena and Sullivan, 2003, p. 3). The intensity of water use may compete with food crops in water scarce areas (Strom, 2014).

Social and ethical concerns for cotton include exposure to cotton fibers in subsequent processing. Uncontrolled exposures to cotton lint may cause byssinosis, a debilitating lung disease (USDOL, n.d.). Although workplace health and safety laws, particularly in agricultural settings, can be uneven (Wall et al, 2008, pp. iv-vi). The Global Organic Textile Standard requires a minimum social criteria for organic certification (GOTS, 2014, p.27).

Availability Of Material

Organic cotton production increased by 10% in the 2013/14 production year after having fallen in the three previous years due to drought in the United States and South America, and social unrest in Syria, formerly the world's second largest organic producer (Textile Exchange, 2015a, p. 25, Textile Exchange, 2013, p.16). Cotton fabrics are manufactured globally, with China producing the majority of finished textiles (USDA 2014a, p. 4). Consistent and stable organic cotton production has been a challenge globally (Textile Exchange, 2013, p. 24), mostly due to farmer price margins and market uncertainty. A 2015 market survey indicated that there is rising demand from brands and retailers', leading to growth in the market share held by organic cotton (Textile Exchange, 2015a, p.5).

Availability Of Certified Materials

Organic farming standards are typically established by national bodies. Organic cotton fiber is certified through a variety of organizations, which must ensure compliance to applicable country or regional standards. Certifying bodies must be accredited by a recognized authority (e.g., IFOAM, USDA) that they meet standards and norms for certification. In the United States, the Department of Agriculture sets standards for organic material in the U.S., accredits certification organizations (approximately 80 as of May 2015, USDA, 2015, p. 1), and has agreements with certain countries to accept products certified to their organic standards. (USDA, 2013).

To ensure the chain of custody through the supply chain two standards are available.

The Organic Content Standard (OCS) relies on third-party certification to verify that a final product contains the accurate amount of a given organically grown material. It does not address the use of chemicals or any social or environmental aspects of production beyond the integrity of the organic material, and references national and IFOAM organic farm standards. The OCS uses the chain of custody requirements of the Content Claim Standard (CCS).

The number of OCS certified facilities increased by 26%, from 2516 facilities in 2013 to 3170 in 2014. OCS certified facilities are located in 45 countries around the world. The top ten countries in terms of total number of OCS certified facilities are: India, Bangladesh, China, Turkey, South Korea, Japan, Pakistan, Hong Kong and Sri Lanka.

GOTS covers the processing, manufacturing, packaging, labelling, trading and distribution of all textiles made from at least 70 percent certified organic natural fibers. The final products may include, but are not limited to fiber products, yarns, fabrics, clothes and home textiles. GOTS is developed and maintained by the Global Organic Textile Standard International Working Group (GOTS, 2014, p. 4). The International Working Group also approves certification organizations that assess and audit compliance with GOTS (GOTS, n.d.).

The number of GOTS certified facilities grew by more than 18%, from 3085 facilities in 2013 to 3663 facilities in 2014. GOTS certified facilities are now located in 64 countries around the world. The top ten countries in terms of the total number of GOTS-certified facilities are: India, Turkey, Germany, China, Bangladesh, Pakistan, Italy, South Korea, Portugal and Japan.

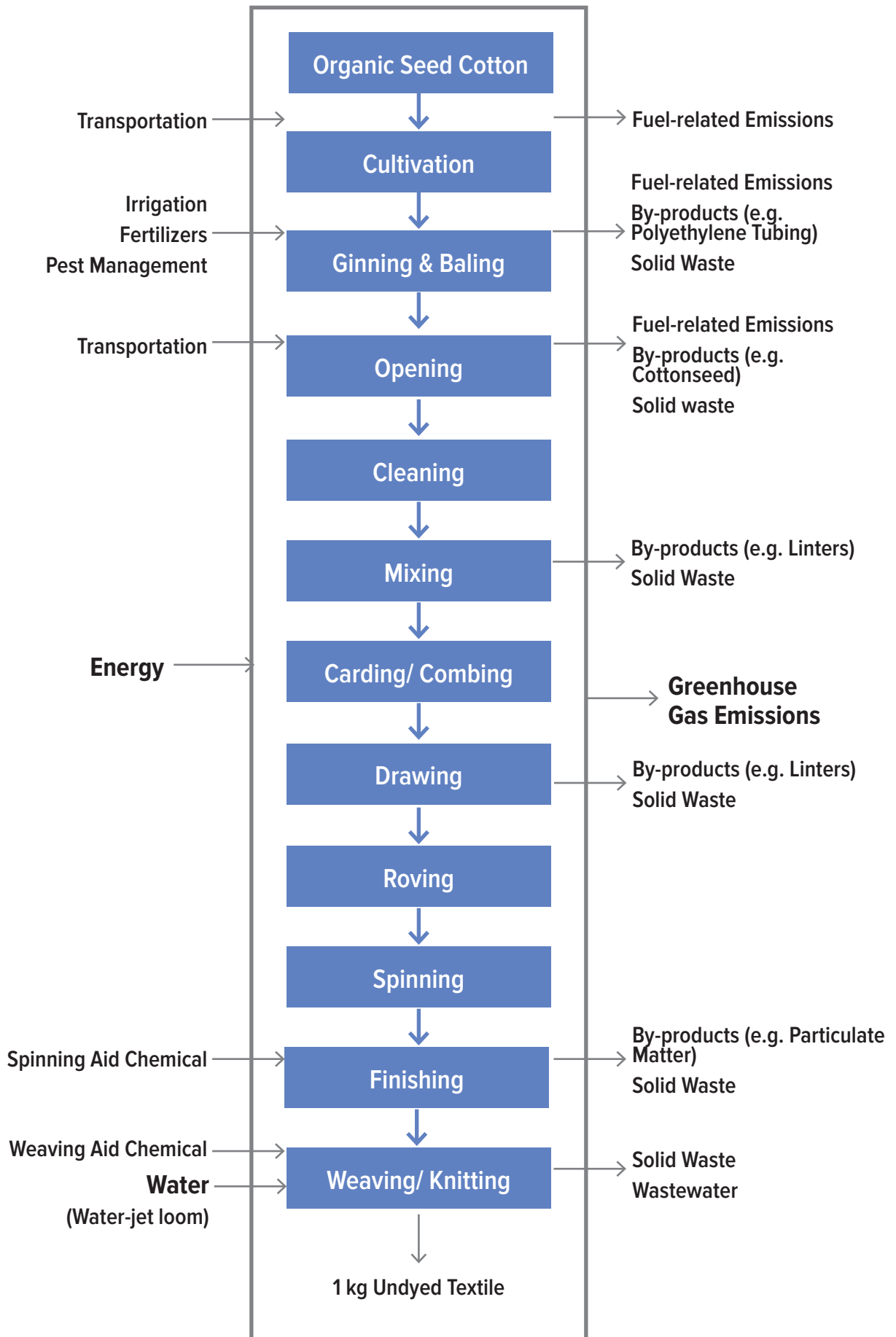
Cost Of Textile

Similar to other commodities, conventionally grown cotton prices can be volatile depending on supply and demand factors and on governmental subsidies and policies (Blackburn, p. 35). Organic cotton pricing varies, in some locations a price “premium” (organic price) is added to the equivalent conventional cotton price. In other case, organic cotton fiber is considered a specialty product and priced independently of the commodity cotton market, which usually results in less volatile prices. United States prices in 2014 were reported as \$1.38 per pound of organic cotton, reduced from prior years (Organic Trade Association, 2015, p. 4). The reduction was attributed to global pressure of increased production and lower prices; India produces over 70% of organic cotton globally and their stocks cost half of U.S. grown cotton, or about \$0.69 per pound. Organic cotton fiber prices in the 2013-2014 marketing year were \$2.08 to \$3.20/kg for Chinese organic fiber, \$1.60 to 2.15 /kg for Turkish organic fiber, and \$2.60 to \$3.40/kg for U.S. organic fiber; 2013-14 data for India are not available (Textile Exchange, 2015a, pp. 32, 42, 43).

Questions To Ask When Sourcing This Material

- Q:** Where is the cotton grown?
- Q:** Is there an organic certificate available for the cotton fiber?
- Q:** Who is the organic certifier?
- Q:** What organic standard is the cotton certified to?
- Q:** What entity accredited the certifier?
- Q:** Is the processing certified to GOTS?
- Q:** Who is the certifying entity?
- Q:** Is there chain of custody documentation available?
- Q:** Is the cotton Fairtrade and what entity certified it?

Figure 8. System Diagram Of Organic Cotton



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