

Cotton and the Environment

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ICAC Research Associates Program – 2010
Improving Productivity of Cotton

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Outline

- What is sustainability?
- Cotton and the environment

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Sustainability

- Not going away: over 600 labels worldwide denote some definition of 'eco-friendly'
- Consumers are starting to care/want it
- Questions from customers for fiber sourcing / textile/ garment manufacturers
- Could be factors used in determining suppliers
- Some retailers are mandating certain practices, without economic compensation, as a cost of doing business

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Sustainability

- Farms are only 'sustainable' if they can make a profit
- A potential economic benefit for farms -- maximizing production efficiency
- Reductions in cost from saving water, reduced input use, soil retention and energy savings are a few of the real metrics that farmers can understand and embrace
- Can it actually boost profitability?

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What is sustainability?

- > '**Sustainability**' can not be determined exactly nor defined objectively.
- > The term 'sustainable' is not approved for use by ISO 14021/14020 and US FTC as a marketing claim.
- > When using the term 'sustainable' as a marketing claim, it should be referenced to a set of criteria/metrics that can be verified by an independent third party.
- > The UN and the US EPA definitions can be used as appropriate guides for 'sustainability' but every industry and society have to weigh the priorities between different values, which can conflict with one another.
- > '**Sustainability**' should be considered as the achievement of a successful balance between three concerns: environmental protection/health, economic profitability, and social needs.

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United Nations: Our Common Future

1987 : The Brundtland Report



"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."



US Environmental Protection Agency

*"Sustainability has many definitions but the basic principles and concepts remain constant: **balancing a growing economy, protection for the environment, and social responsibility**, so they together lead to an improved quality of life for ourselves and future generations."*

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Defining Sustainability

US Dept Agriculture

"a way of practicing agriculture which seeks to optimize skills and technology to achieve long-term stability of the agricultural enterprise, environmental protection, and consumer safety....."

The Field to Market Alliance for Sustainable Agriculture

Sustainable agriculture meets the needs of the present while enhancing the ability of future generations to meet their needs."

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USDA Sustainable Agriculture

- Does not refer to a prescribed set of practices
- It challenges producers to consider long-term impacts on the environment
- Preserves biodiversity, meets the challenges of climate change and prevents potential degradation of major waterways

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'More Sustainable' Cotton Production

- It must supply the world's demand for natural fiber and food **today** and **tomorrow**.
- It must **maintain environmental quality and the natural resource base** upon which the agricultural economy depends.
- It must **sustain the economic viability** of farm operations.

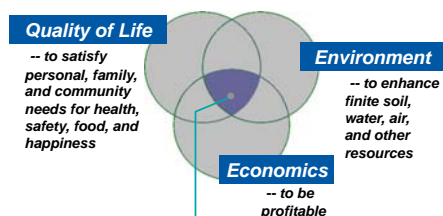
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Sustainability

- **Sustainability** should be considered as the achievement of a successful balance between three concerns: **environmental protection/health**, **economic profitability**, and **social needs**

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Sustainable Agriculture seeks to balance three long-term goals



In any given situation, the most sustainable choice is the one where the net effects come closest to meeting all three goals.

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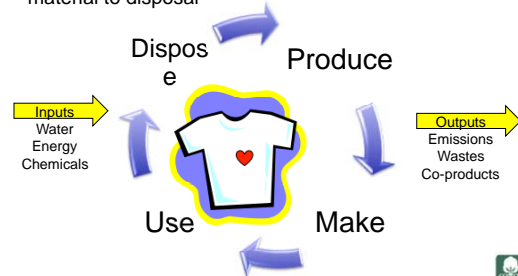
'More Sustainable' Cotton

- **Environmental** [will mainly be discussed]
- **Economics** [a company has to determine this for themselves and their suppliers]
- **Social accountability** [a farm/company should have a program for workers (human rights; forced labor & child labor) and outreach to the community & requirements for their suppliers (e.g., SA 8000)]

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What is Life Cycle Assessment (LCA)?

- Environmental footprint of a product from raw material to disposal



Assessment of 'More Sustainable' Textiles

- Fiber sourcing [The fiber used is a major consideration for a 'more sustainable' textile]
- Safety of materials / chemicals
- Energy and water use
- Emissions to the environment [air, water, solid waste]
- Social accountability [to workers, community]

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Organic Cotton

- What organic cotton fiber is and is not

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Organic Cotton

Cotton grown without the use of any synthetically compounded chemicals (i.e., pesticides, defoliants, etc.) and fertilizers is considered '**organic' cotton**. It is an agriculture production system that require certification.

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Organic Cotton

- '**Organic**' is a labeling term [for the agricultural product].

•For cotton to be sold as '**organic cotton**', it must be certified by an independent organization that verifies that it meets or exceeds defined **organic agricultural production standards**. In the USA it is the USDA –NOP. [On National Organic Program website (<http://www.ams.usda.gov/nop/CertifyingAgents/Accredited.html>) is a comprehensive list of the USDA Accredited Certifying Agents (ACAs) by state for domestic ACAs and by country for foreign ACAs-- ~40-55 of each]

•To produce '**organic cotton textiles**', certified organic cotton should be manufactured according to **organic fiber processing guidelines** [e.g., GOTS, etc.].

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World Organic Cotton Production

2008/09: world production of organic cotton was **~175,113 metric tons** (802,599 US 480 lb bale equivalents) [20% increase from 2007/08]

~ 0.6% of world cotton production, which was ~ 25 million MT (120 million US 480 lb bales)

2009/10: *Less but actual figures not available yet*

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Organic Cotton Production 2008/09

- **India 107,510 MT [493,000 bales] [~61%]**
 - **Turkey 24,440 MT [112,000 bales]**
 - **Syria 22,000 MT [100,000 bales]**
- [~90% of world organic cotton production]**

- **Tanzania 4181 MT [19,000 bales]**
 - **China 3849 MT [17,660 bales]**
 - **USA 2729 MT [12,500 bales]**
- [~5% of world organic cotton production]**

[~5% ROW – other 16 countries]

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Summary

•Organic cotton production is *not* more sustainable than current conventional cotton production.

- It requires more land to produce the same amount of cotton;
- It requires more water and more labor to produce;
- Organic cotton yields are less than conventional yields.** [according to data from the OTA and USDA statistics there is a yield penalty of ~30% for growing organic cotton]
- It can have **lower grades**, which affects economics; and
- It **costs more to produce.** [results from a six-year study in the USA showed organic cotton production costs at about 50% higher than those of conventional cotton];
- From a consumer residue standpoint, there is **no** difference between conventionally grown cotton and organically grown cotton.

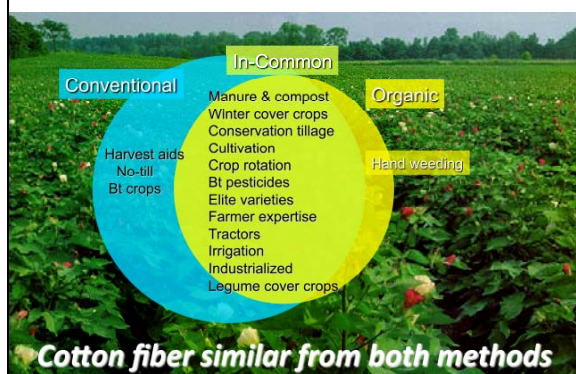
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Summary

- Conventional and organic production can co-exist. Profitability will drive decisions in the supply chain.
- **Both organic or conventional cotton production practices *may* be considered 'more sustainable' products**
- We must correctly define *sustainability*
 - Organic is NOT equivalent to sustainable.
 - 'Sustainability' is equivalent to **SURVIVAL!**

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Cotton Production Practices



Crop Production

Many of the environmentally friendly procedures that are used in some organic cotton production also are used in producing conventional cotton –

cover crops, trap crops, strip cropping, wind breaks, beneficial insects, biological control of insects, including pheromone trapping and mating disruption, etc.

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Organic Cotton Production –chemical use

Organic cotton production does not use synthetically compounded chemicals but can use 'natural' chemicals like sulfur dust and Bt and other biological control agents in pest management and organic acid-based foliar sprays (eg, citric acid) and nitrogen and zinc sulphate in harvest preparation.

[USA - USDA NOP; 7 CFR Sec. 205.601; list allowed]

Beneficial insects, natural cattle manure, chilli, garlic, and alfalfa are some of the ingredients used in organic farming.

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Conventional cotton -- Pesticides

(Includes: Herbicides, Insecticides, Fungicides)

FACTS:

•In the USA, approximately 1lb (0.45kg) insecticide and 2.3 lbs (1.05kg) of herbicide are used per acre.

•**MYTH:** Some claim it takes 5* oz (~142g) of pesticides & fertilizer to grow cotton for one T-shirt.

FACT: It takes ~ 1.4 oz (~39.7g) [only about 0.038oz (~1.08g) of that is pesticide]

•The use of Bt cotton has significantly reduced insecticide use and improved biodiversity in cotton fields

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Pesticide Residue on Raw Fiber **ABSENT**

The Bremen Cotton Exchange (Bremen, Germany) routinely conducts laboratory tests for pesticides (228 substances) on raw cotton from many growing regions of the world. The results showed that all cottons, including U.S. cottons, satisfy the Eco-Label standards and easily pass the regulations for foodstuffs. 'Thus, cotton under German law theoretically can be used as a foodstuff.'

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Crop Production –

All methods of cotton production have some practices that are not necessarily environmentally friendly but are necessary to produce the crop (if the full cradle-to-grave lifecycle is assessed.)

e.g., for fertilization:

- conventional cotton uses 80-150lbs/acre (90-168kg/ha) nitrogen fertilizer using conservation tillage
- Organic cotton uses ~ 3-5 t/acre (7-11MT/ha) poultry manure, 9-15 t/a (20-30 MT/ha) cattle/dairy manure with conventional tillage [only enough animal manure in USA to grow a small part of the crop]

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Soil, Air, and Water

•Cotton is a very drought- and heat-tolerant crop that does not require excessive amounts of water. Organic cotton production requires more water.

•Conservation tillage is difficult or impossible to implement in organic cotton production systems because of the heavy reliance on mechanical cultivation or use of extensive hand labor for weed control. This increases risk of soil erosion and use of fossil fuels for mechanical cultivation.

•Conservation tillage, used significantly in convention production, has a significant impact on greenhouse gas (CO₂) emissions; saves approximately 1 billion tons of soil per year in US; saves 306 million gallons of tractor fuel

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Today's Cotton and Natural Resources

Resource	Impact
Land	<ul style="list-style-type: none"> • <3% of world's agricultural land • Yield doubled in last 30 years
Energy	<ul style="list-style-type: none"> • Energy neutral to energy positive
Green House Gas	<ul style="list-style-type: none"> • Neutral or captures carbon • More carbon stored in fiber than emitted into the air
Water	<ul style="list-style-type: none"> • Drought tolerant. • 64% U.S. cotton grown without irrigation • Water use proportional to land use
Ecosystem Services	<ul style="list-style-type: none"> • Cotton producers active in environmental programs • 2007 – 34% of US cotton not treated with insecticide

Critical Integration of Modern Technologies into Integrated Pest Management (IPM)

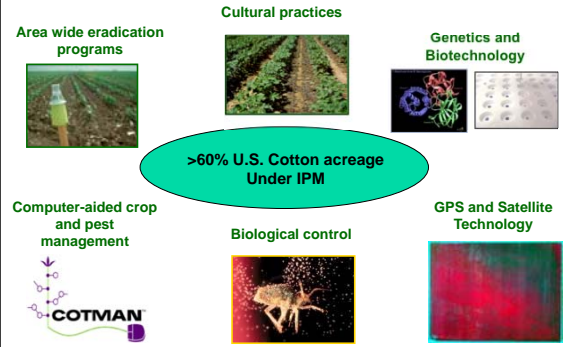
•USA Cotton producers are in the forefront of adopting modern technology for IPM – cultural practices, computer-aided management systems, biological control, precision agriculture, biotechnology, and genetics.

•Most of these are integrated and used before any synthetic pesticides are applied to cotton fields.

•IPM is practiced in ~ 60% of USA cotton acreage.

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Integrated Pest Management (IPM) and Modern Technologies



Environmental Footprint [EIQ]

The Environmental Impact Quotient (EIQ) equation was published in 1992 to enable farmers and agricultural professionals to compare pesticides on the basis of environmental risk. It is based on the three principal components of agricultural production systems: a farm worker component, a consumer component, and an ecological component.

It has been widely used to analyze and compare pesticide use patterns over time.

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Environmental Footprint of Cotton Production

The *Environmental Impact Quotient (EIQ)* is used as a robust measure of environmental impact of technologies, as it incorporates key toxicity and environmental exposure data related to individual products.

- Global reduction in EIQ (environmental footprint) for 1996-2004 associated with cotton production!



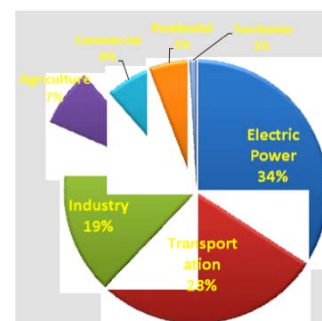
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Cotton and Greenhouse Gases

[carbon footprint of cotton fiber]

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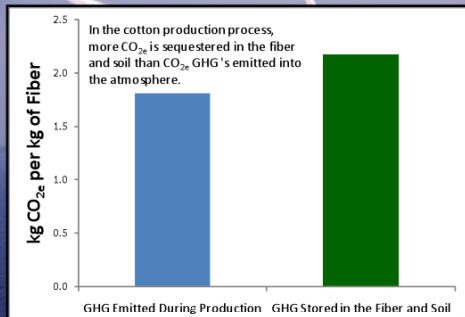
GHG's - Where do they come from?



EPA, 2009 - <http://www.epa.gov/climatechange/emissions/>

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GHG Emissions



M. Matlock University of Arkansas 2009; R. Nelson in J. Environ. Qual. 2009

GHG Emissions Sinks

Cotton Sequesters CO₂

In no-till fields and in fiber for the life of the garment



Causarano, Franzluebbers, Reeves & Shaw (2006)

GHG Emissions Sinks

The amount of CO₂ removed by cotton plants worldwide is equivalent to taking over 7 million cars off the highways.....



Jordan, A. 2007. Cotton carbon footprint. Cotton Incorporated

GHGs and Cotton

- Growing cotton reduces GHGs and produces more energy than it uses
- Cotton sequesters carbon in the fiber for the life of the fiber
- Determining the C-footprint of fibers is difficult; requires looking at the entire lifecycle
 - > Available 'data' on the carbon footprint of fibers are scarce and inaccurate.
- Cotton Incorporated is doing their own LCI/LCA

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Better Cotton Initiative (BCI)

- Farmer training
- Not organic, allows GM
- Operational and logistical details evolving
- Source as for conventional
- No certification
- No price premium
- No label

[several major retailers and Cotton Inc. are members]

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BCI

BETTER COTTON TIMELINE

2009 – Better Cotton Production Principles and Minimum Production Criteria Agreed

2010 – First Better Cotton harvest (Oct 2010 onwards)

2012 – Full evaluation of the Better Cotton System and results

- BCI has an objective of accounting for 300,000 t of cotton production by 2012 and expand its membership to include firms representing 1,000,000 t of retail level cotton consumption by 2015.

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Cotton Connect Program

Organic Exchange

- Similar to BCI
- Not strictly organic; focus 'sustainability'
- Biotech cotton / GM ok
- New and details evolving

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Cotton Textile Processing

[Yarn manufacture, Fabric Manufacture, Textile wet processing (preparation, coloration, finishing)]

- *The goals for cotton textile processing for producing more sustainable products are to reduce water use, energy use, and chemical use, use safer/ "greener" chemicals, and minimize inputs to the environment (air, water, solid waste).*
- **You can have a significant impact on lightening your environmental footprint by the textile choices you make**

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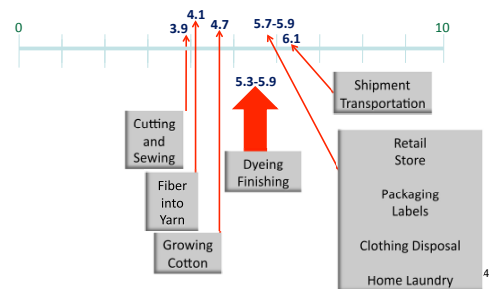
Cotton, throughout its product life cycle, has an impact on the environment.

- All fibers have an impact.
- All manufacturing operations have an impact.
- All retailing operations have an impact.
- All consumer use and product disposal practices have an impact.

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Cotton Clothing Production - The Environmental Impact

On a scale where 0 means "Not At All" and 10 means "Very Much," how much do the following areas of cotton clothing production impact the environment?



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Yarn manufacturing

All process similar for most fibers: spun yarn, open-end yarn, air jet etc.

If organic

- Segregation of product – all lines must be thoroughly cleaned or lines have to be dedicated to organic cotton yarn/fabric manufacturing – not different otherwise
- "Acts differently" – blending probably not enough to overcome all variability
- Potential problems in processing -- non-uniformity; higher trash/bark

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Fabric manufacturing

All processes similar for most fibers: woven, knit; recycle, reuse

if organic

- Should be no different if natural starches are used for sizing
- Polyvinyl alcohol size can not be used; all additives should be "natural"
- Potential problems in processing -- non-uniformity

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Preparation/Coloration/Finishing

Goals reduce water, energy, chemical use

- Use Safer, 'greener' chemicals
e.g., all dyes/pigments need to meet ETAD guides;
minimize use of chemical on RSL
- Control air emissions
- Waste water treatment
- Minimize and recycle solid waste

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Sustainability is about continuous improvement— there is no finish line

- Benchmarking and measurement are key.
- Changes in technology offer opportunities for continuous improvement.


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How can cotton's environmental footprint in manufacturing be reduced?

What technologies exist or need to be developed?

51 Copyright © 2010 Cotton Incorporated.



Many of the technologies needed to significantly reduce the environmental footprint in textile manufacturing already exist.

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Wal-Mart

- >Wal-mart maintains being an efficient and profitable business and being a good steward of the environment are goals that can work together.
- >Wal-mart environmental goals [simple and straightforward]:
 - To be supplied 100 percent by renewable energy;
 - To create zero waste;
 - To sell products that sustain people and the environment.
- >A new goal: is to cut 20 million mt of GHG emissions from its supply chain by the end of 2015

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Wal-mart Sustainable Product Index

The Need for an Index

- The world's population is increasing.
 - > It is estimated that the global population will reach 9 billion by 2050.
- The world's natural resources are decreasing.
 - > Natural resources for everything we grow, eat, drink, make, package, buy, transport and throw away is outpacing the earth's capacity to sustain it.
- Customers want more efficient, longer lasting, better performing products. They want to know:
 - > the materials in the product are safe
 - > that it is made well
 - > the product was produced in a responsible way

sustainable product index – Wal-mart says it is expected to lead to higher quality, lower costs and measure the sustainability of products, and help customers live better in the 21st century.

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Summary

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Cotton Fiber Production

- *The goal of USA cotton production is to produce the best quality product for textile mills with the lowest environmental impact, in an economically feasible and socially responsible manner.*
- *In efforts to help achieve sustainability, the US cotton industry and other countries are putting in practice new technologies, methods and new uses for the cotton plant that meet our current needs for productivity and profit without compromising the ability of future generations to meet their needs.*

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“Sustainability”

- The cotton industry envisions a future where environmentally sustainable production and manufacturing will thrive along with the businesses that depend on cotton as a source of income.
- **Fiber Sourcing** – The fiber used is a major consideration for a ‘more sustainable’ textile

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Cotton vs. Other Fibers

Cotton, has many environmental and performance advantages over other fibers. A few examples:

- Cotton uses sunlight and converts it directly to a fiber without intermediate processing steps. That’s increasingly important, since processing other fibers, even those from biological sources, require a large amount of energy to produce fiber.
- Cotton is a natural, rapidly-renewable [ANSI/NSF 336] fiber produced using IPM (reduced chemical inputs), conservation tillage, and other eco-friendly practices
- Fibers that are based on corn and bamboo require intermediate processing and additional chemicals to create a polyester or rayon-type fiber, which is still not a direct plant-based production of fiber.
- Wool requires four times more land than does cotton to produce fiber. Silk requires 20 times the land to produce the equivalent amount of silk fiber.
- Cotton has obvious environmental and sustainability advantages over petroleum-based synthetic fibers (e.g., polyester, nylon, polypropylene). Unlike petroleum-based fibers, cotton is energy self-sustaining, and does not contribute to net green house gas emissions.

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Cotton is more environmentally friendly

- Is a natural fiber
- Produces more energy than it uses
- Growing cotton reduces GHG
- Modern technologies safe and proven beneficial to the environment
- Nothing goes to waste...cotton byproducts are an added bonus

Best Overall Sustainability of all Major Fibers

