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Pathways to Progress

Increasing Cotton's Water Productivity

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Today's Speakers

Dr. Jesse Daystar
Vice President &
Chief Sustainability Officer

Cotton Incorporated

Dr. Ed Barnes
Senior Director, Agricultural &
Environmental Research

Cotton Incorporated

Webinar Support

Type your questions using the Q&A feature at any time during the webinar.

A recording of this webinar will be available on **cottonworks.com**.

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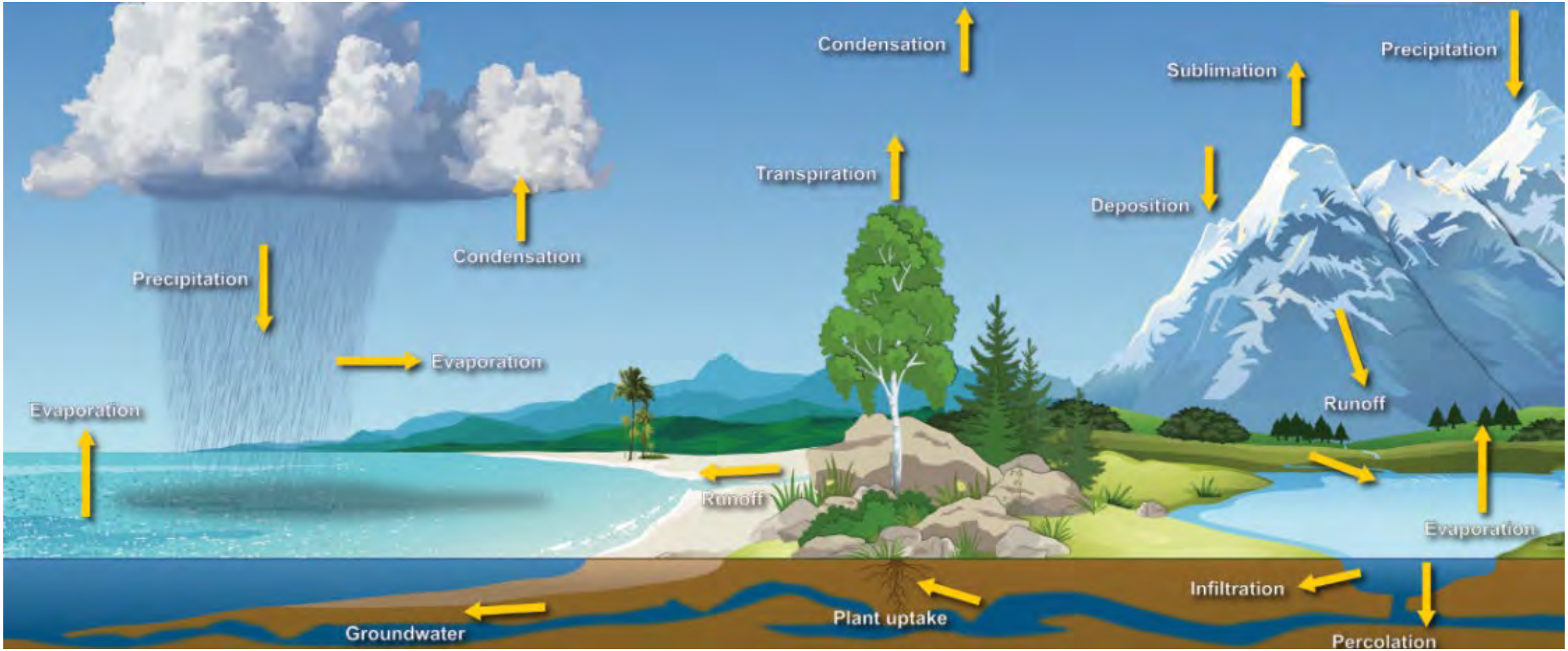
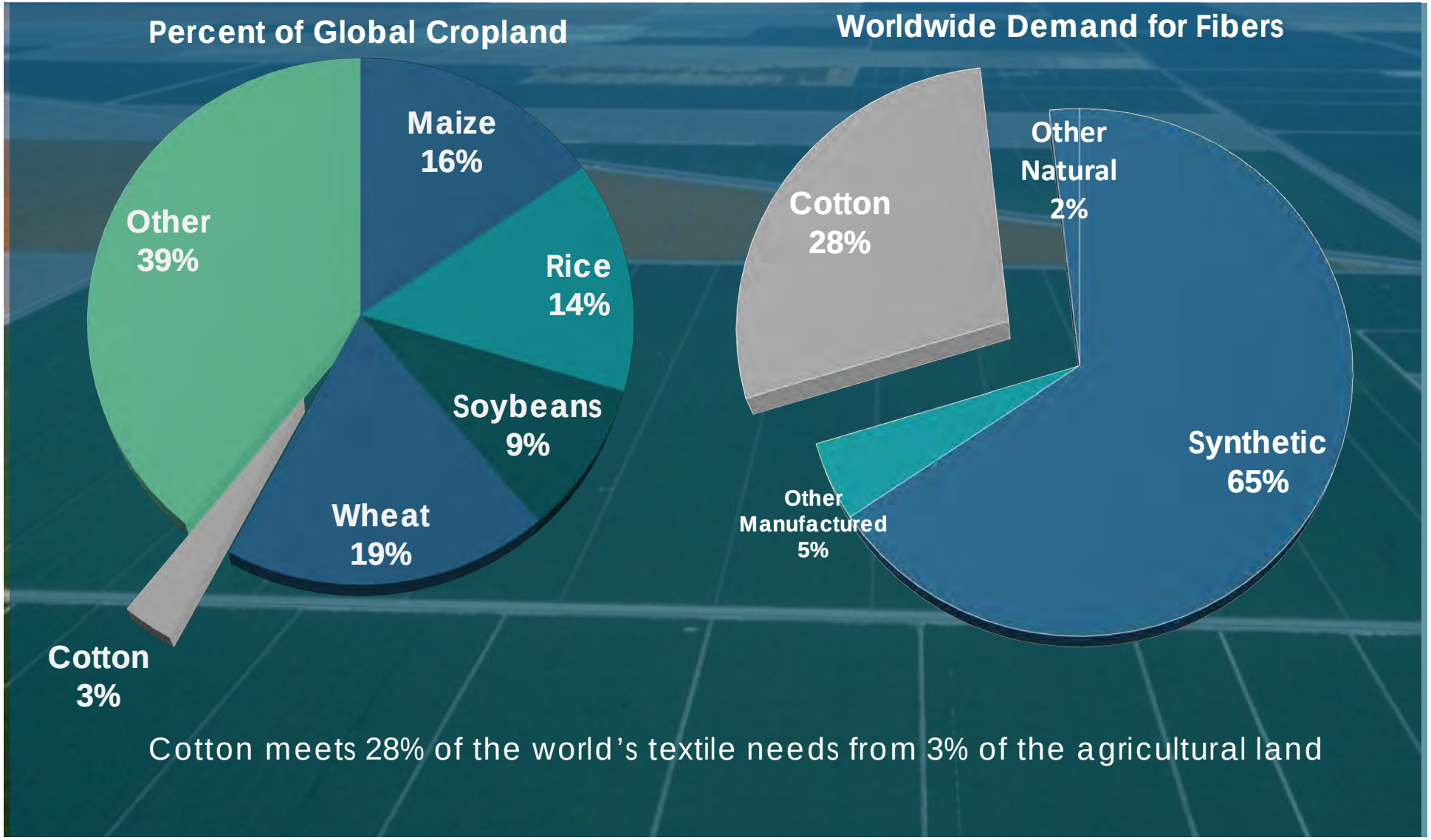
Water Cycle



Source: https://www.noaa.gov/education/resource-collections/freshwater/water-cycle

The water cycle. (Dennis Cain/NWS)

World Agriculture Land

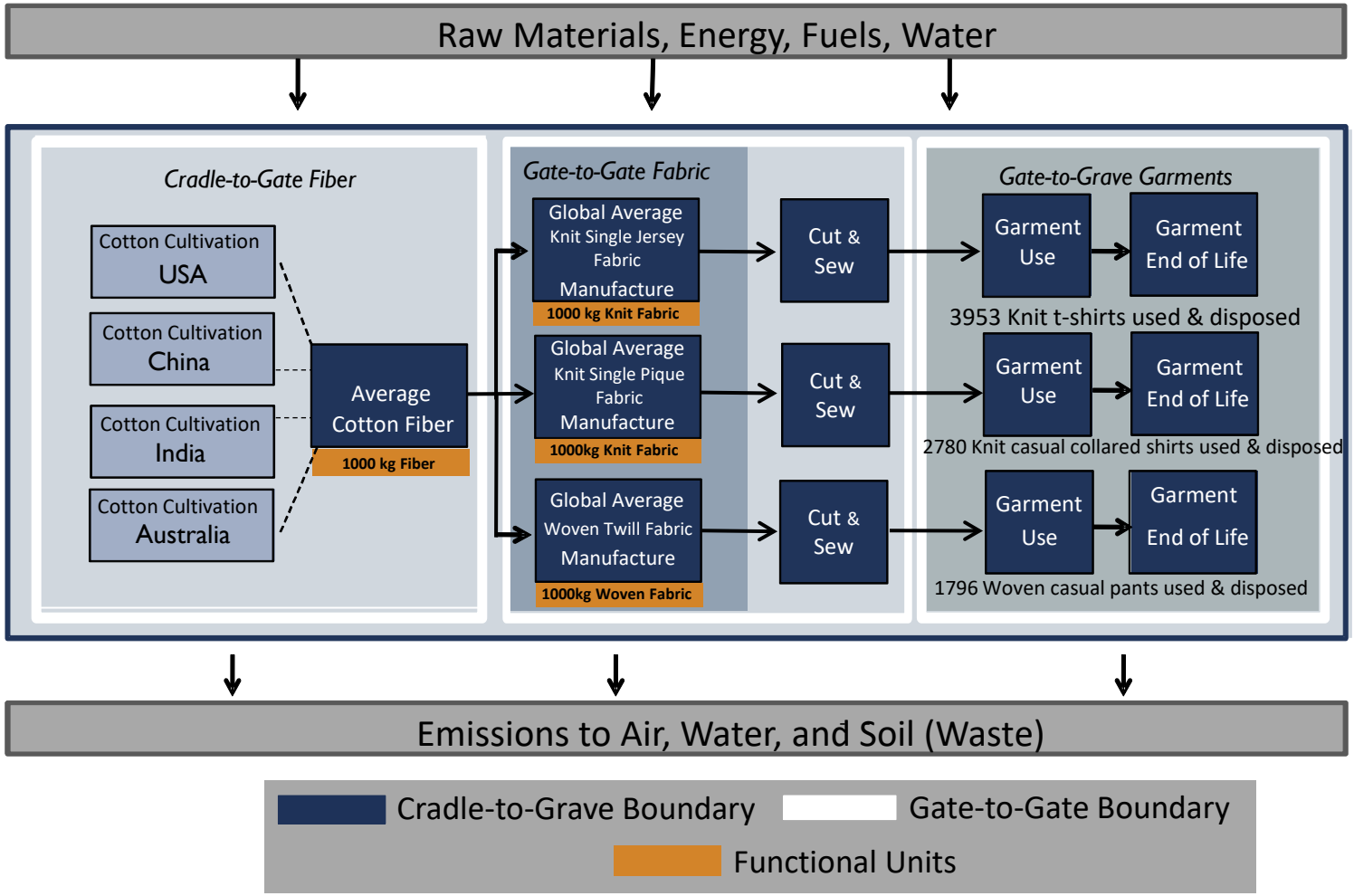


Sources: Land use: FAO, 2013; Fiber Use: Horn and Snowman, 2013

Life Cycle Assessment Overview

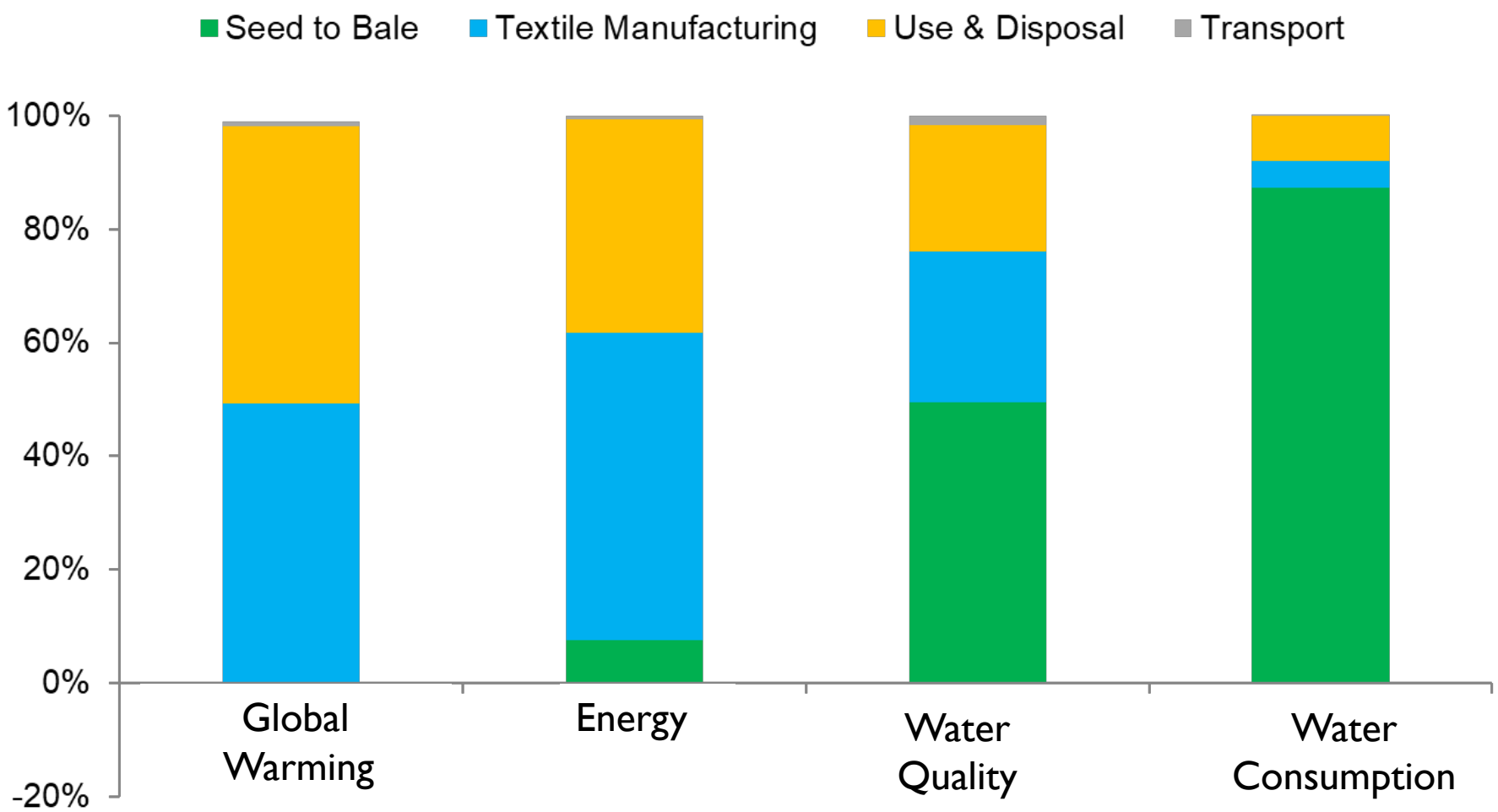
Source: Cotton Incorporated (2017). LCA Update of cotton fiber and fabric life cycle. https://cottontoday.cottoninc.com/wp-content/uploads/2019/11/2016-LCA-Full-Report-Update.pdf

LCA Goal, Scope Functional Units



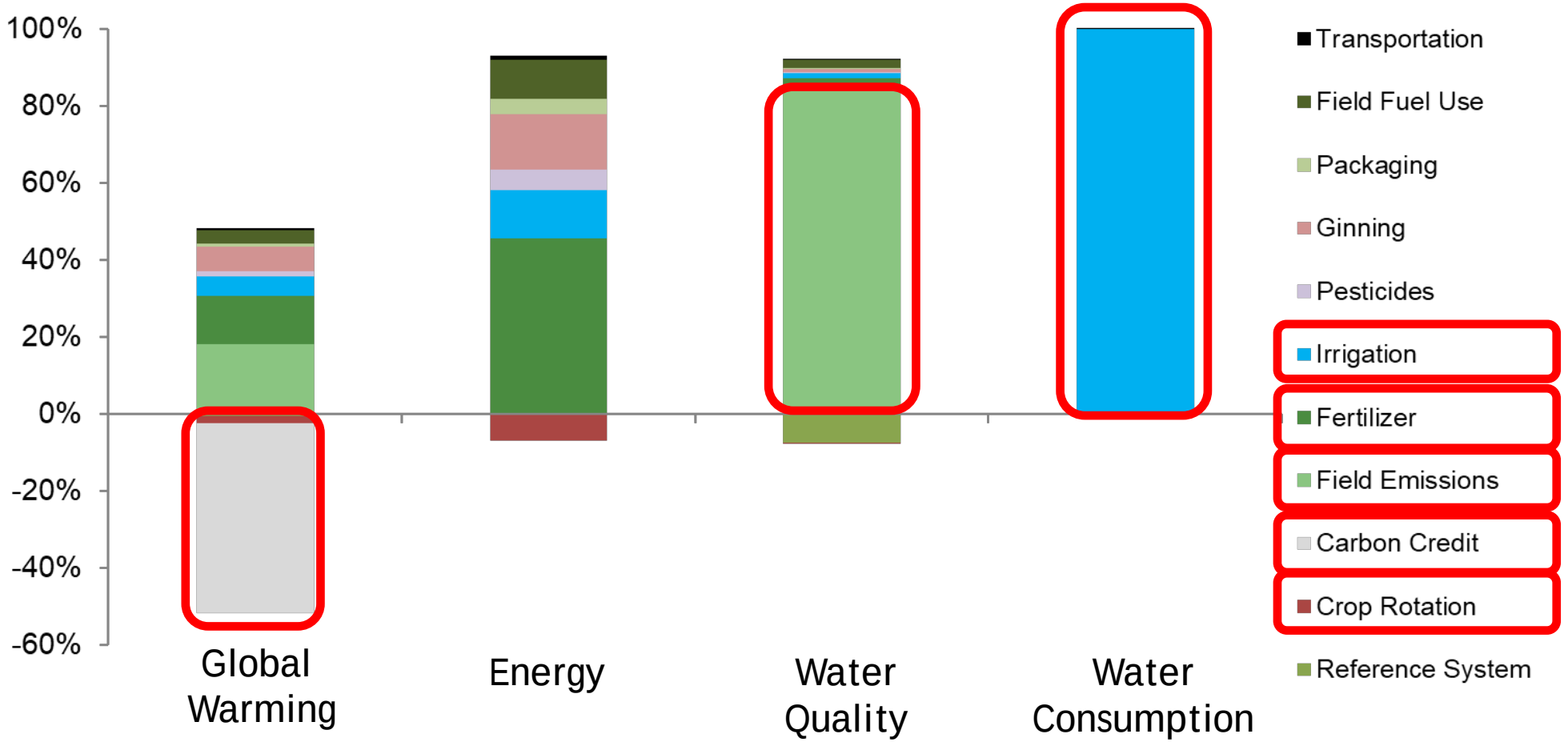
Source: Cotton Incorporated (2017). LCA Update of cotton fiber and fabric life cycle. https://cottontoday.cottoninc.com/wp-content/uploads/2019/11/2016-LCA-Full-Report-Update.pdf

Overall Results for a Knit Collared Shirt



Source: Cotton Incorporated (2017). LCA Update of cotton fiber and fabric life cycle. https://cottontoday.cottoninc.com/wp-content/uploads/2019/11/2016-LCA-Full-Report-Update.pdf

Agricultural Phase Details



Source: Cotton Incorporated (2017). LCA Update of cotton fiber and fabric life cycle. https://cottontoday.cottoninc.com/wp-content/uploads/2019/11/2016-LCA-Full-Report-Update.pdf

How do we interact with water?

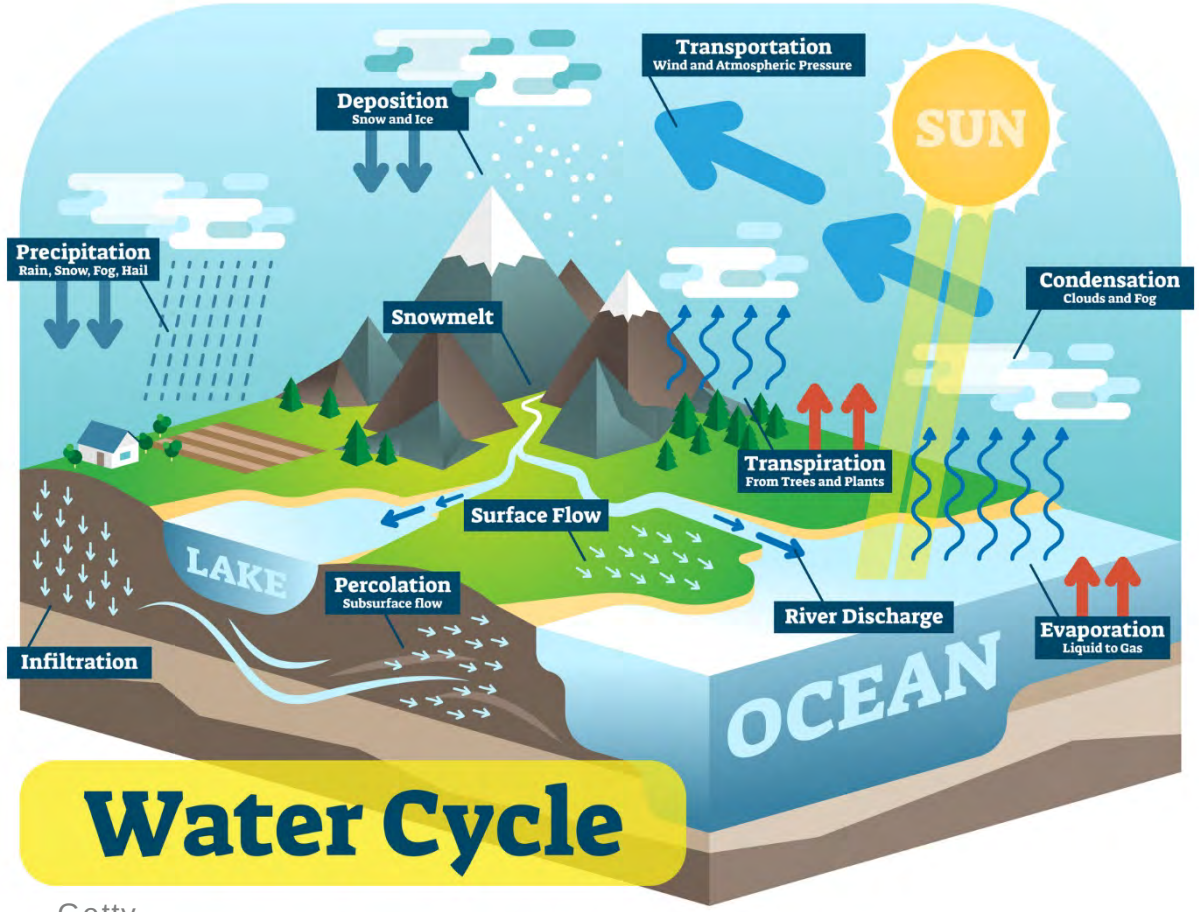
Interactions with Water

Water Use/Water Withdraw

Water that has been withdrawn or required for a process/product regardless of whether it is returned or removed from the watershed

Water Consumption

Withdrawn and removed from a water basin through evaporation, imbedded in a product or through other means



Getty

Water **“Consumption”** vs. **“Use”**

Power Plant Example

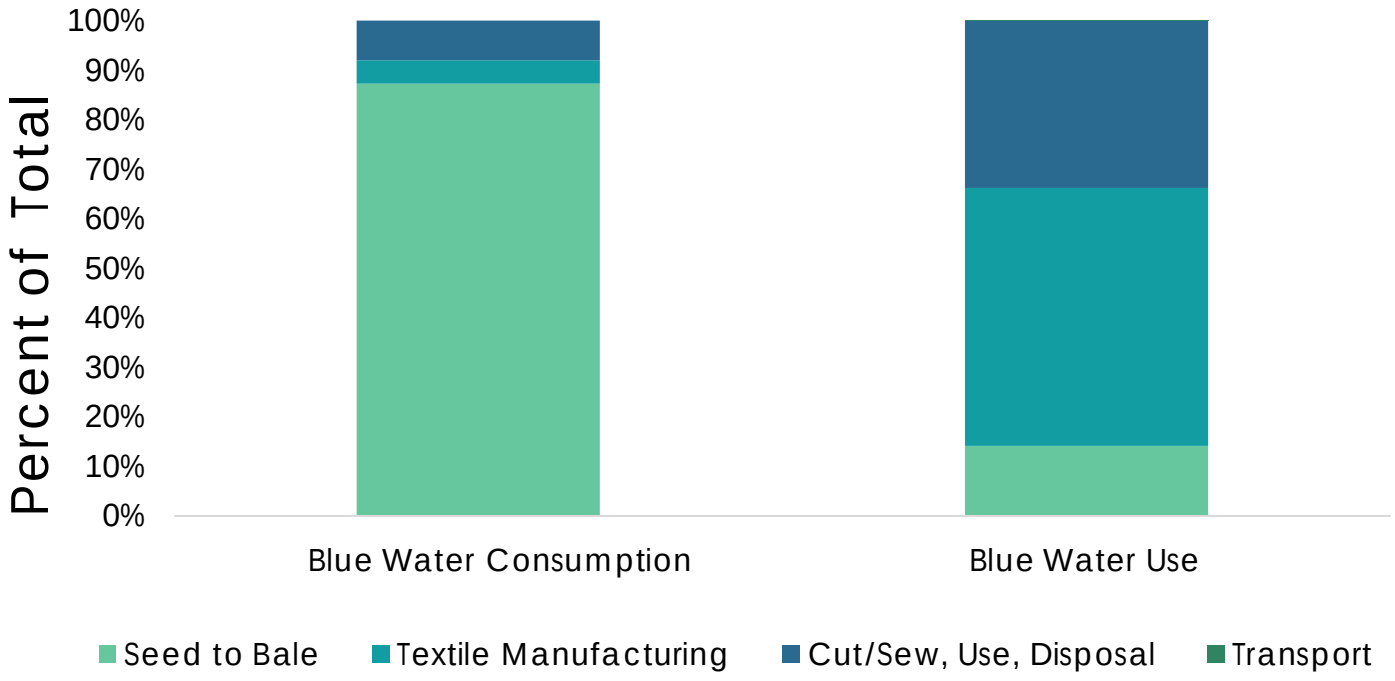
Consumption = water that evaporates and is not returned to the river.

Use = withdraw = All water that goes into the power plant.

Getty

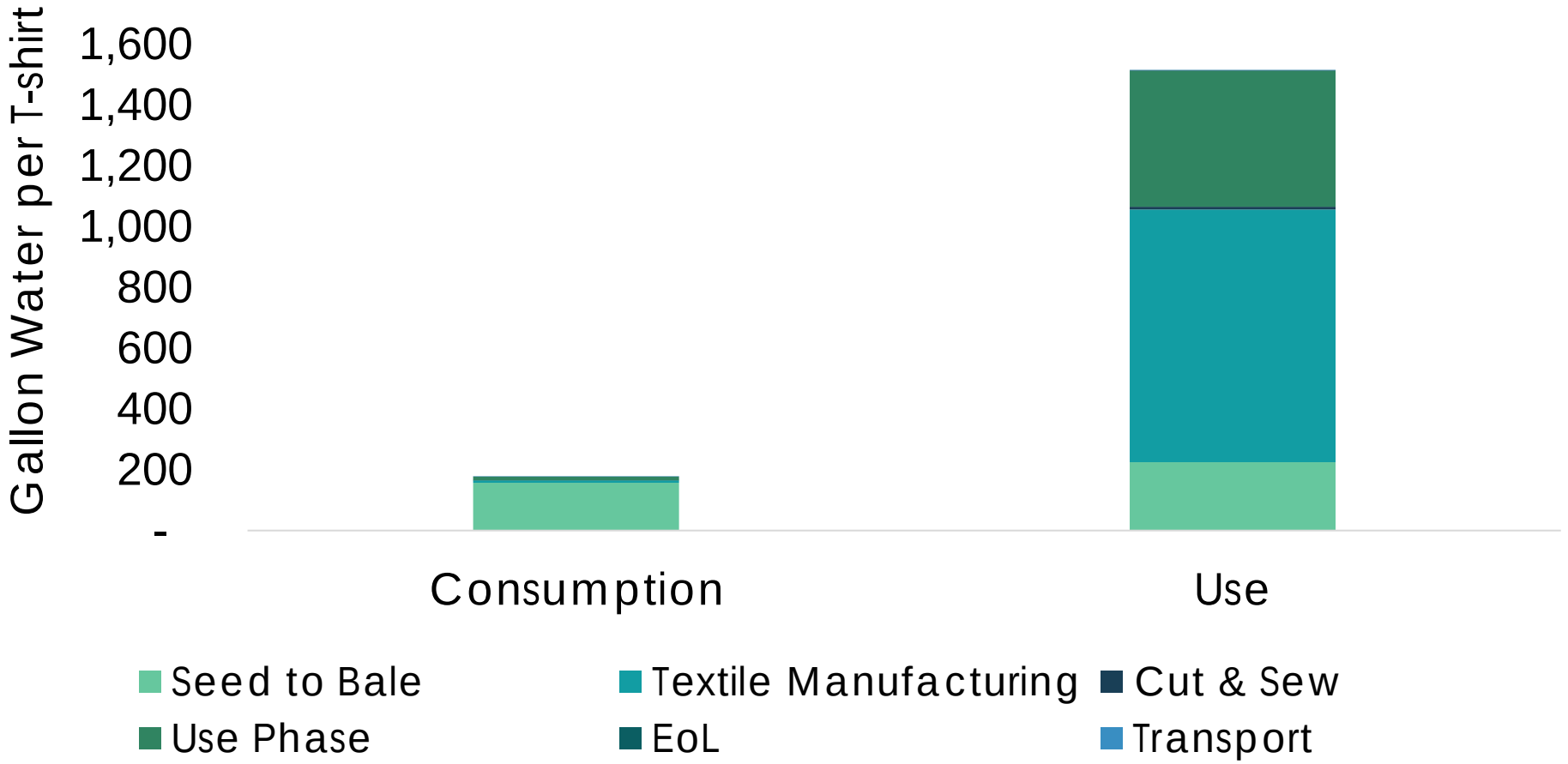
Water Consumption & Use Hotspots Cradle to Grave

- Collared shirt
  - ~87% water consumption in seed to bale
  - ~14% water use in seed to bale



Source: The Life Cycle Inventory & Life Cycle Assessment of Cotton Fiber & Fabric. (2016). Cotton Incorporated. https://cottontoday.cottoninc.com/wp-content/uploads/2019/11/2016-LCA-Full-Report-Update.pdf

Water Consumption vs. Use



Source: The Life Cycle Inventory & Life Cycle Assessment of Cotton Fiber & Fabric. (2016). Cotton Incorporated. https://cottontoday.cottoninc.com/wp-content/uploads/2019/11/2016-LCA-Full-Report-Update.pdf

Water Consumption to Make Cotton for a T-shirt

T-shirt water **consumption** across life cycle: 177 gallons (2.2 bathtubs)

T-shirt agriculture water **consumption**: 157 gallons (irrigation)

Assume 225 gram cotton

Cotton Incorporated (2016). LCA Update of Cotton Fiber and Fabric Life Cycle Inventory. https://cottontoday.cottoninc.com/lca-2016/

Water Use to Make Cotton for a T-shirt

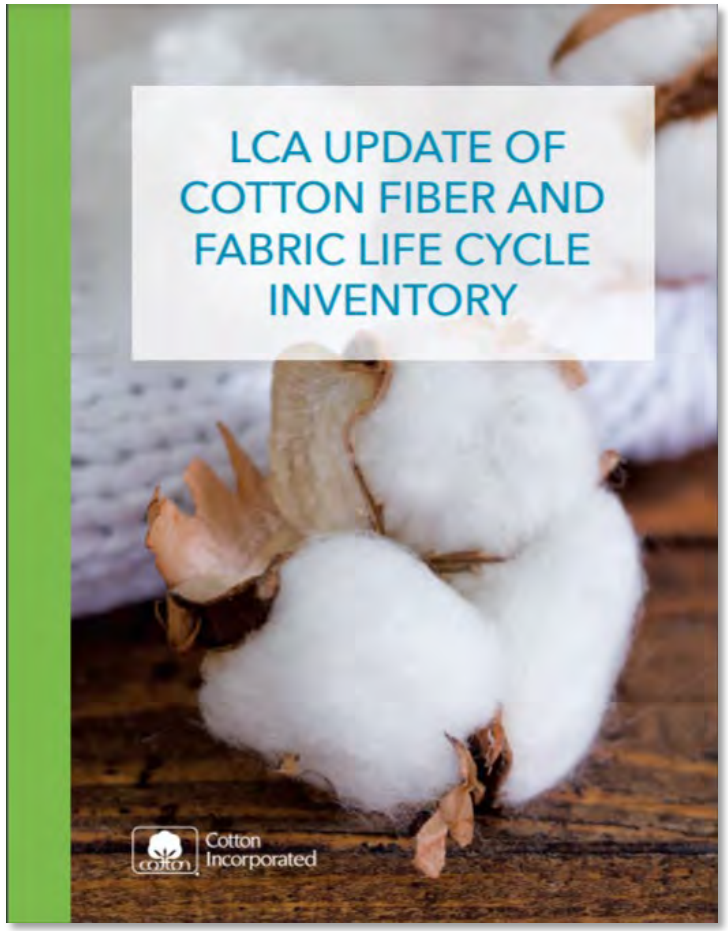
T-shirt water **use** across life cycle:
1,500 gallons

85% of water **use** is not in cotton growth

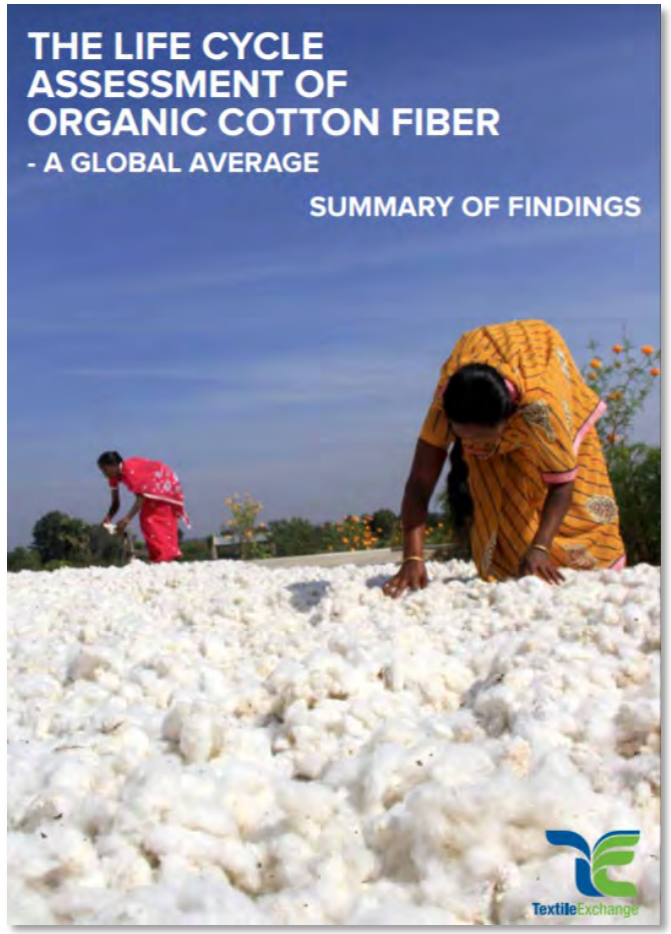
Assume 225 gram cotton

Cotton Incorporated (2016). LCA Update of Cotton Fiber and Fabric Life Cycle Inventory. https://cottontoday.cottoninc.com/lca-2016/

Not a Comparative LCA



VS.



Cotton Incorporated (2016). LCA Update of Cotton Fiber and Fabric Life Cycle Inventory. https://cottontoday.cottoninc.com/lca-2016/

https://textileexchange.org/wp-content/uploads/2017/06/TE-LCA_of_Organic_Cotton-Fiber-Summary_of-Findings.pdf

How do we measure the impacts of our interactions?

Methods for Measuring Impacts

1. Water footprint (WFP)

   waterfootprint.org/en

2. Available water remaining (AWARE)

   wulca-waterlca.org/aware.html

Water Footprint

The water footprint of a product is an empirical indicator of how much water is consumed, when and where, measured over the whole supply chain of the product.

Source: https://waterfootprint.org/media/downloads/Report-48-WaterFootprint-AnimalProducts-Vol1.pdf

Water Footprint Network

Green Water Footprint

Volume of rainwater evaporated or incorporated into a product

Blue Water Footprint

Volume of surface or ground water evaporated or incorporated into a product

Gray Water Footprint

Volume of water needed to assimilate pollution

Getty Images

Methods for Measuring Impacts

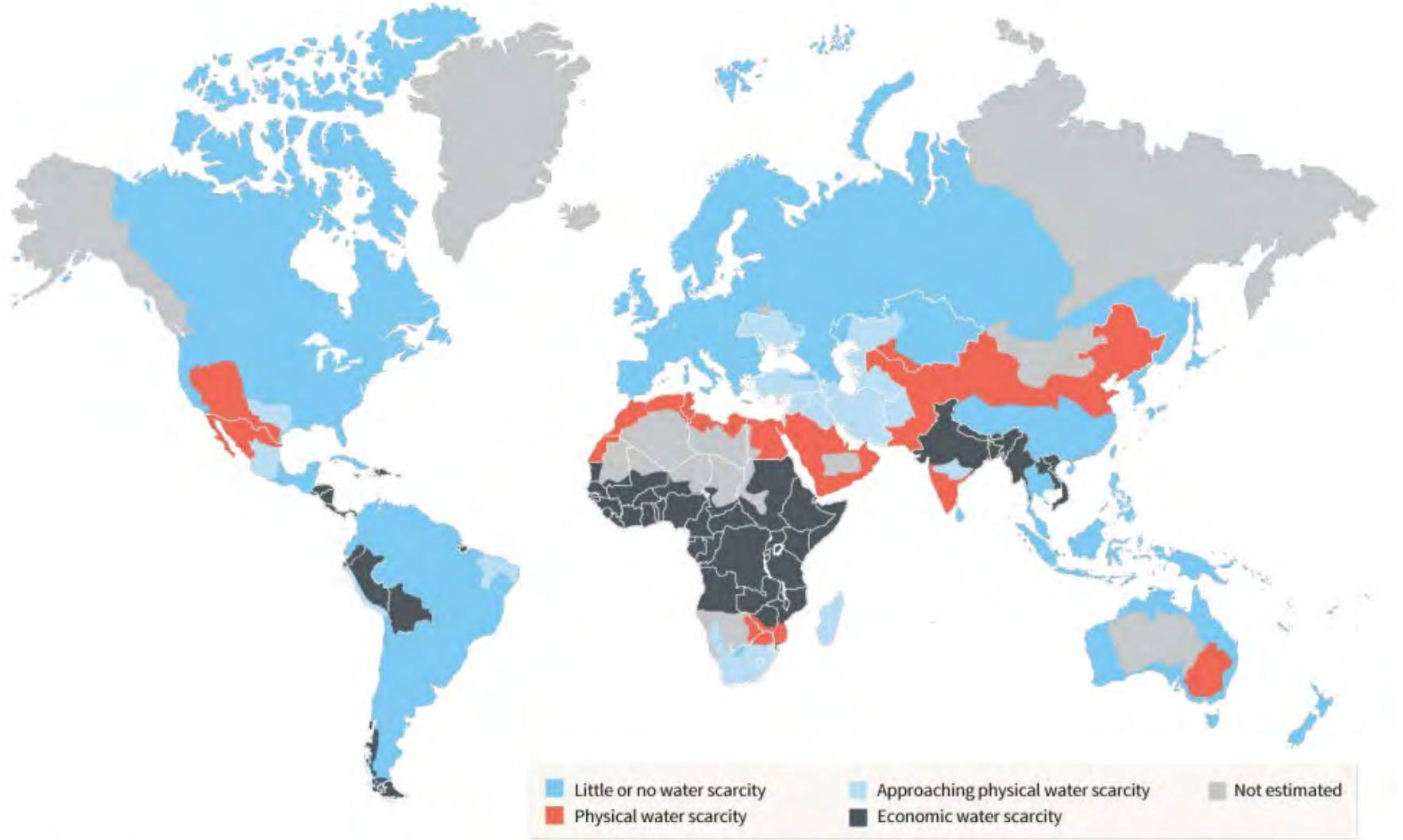
1. Water footprint (WFP)

   waterfootprint.org/en

2. Available water remaining (AWARE)

   wulca-waterlca.org/aware.html

Global Water Scarcity



© 2019 GRACE Communications Foundation. All Rights Reserved. | Lessons for Understanding Our Water Footprint | Lesson 1: Water Resources and Water Footprints

Available WAter REmaining (AWARE)

Asking the Right Question…

What is the potential of depriving another user of water (human or ecosystems) when consuming water in this area?

Developed by a multi-stakeholder initiative

Water Use in Life Cycle Assessment (WULCA)

wulca-waterlca.org/aware.html

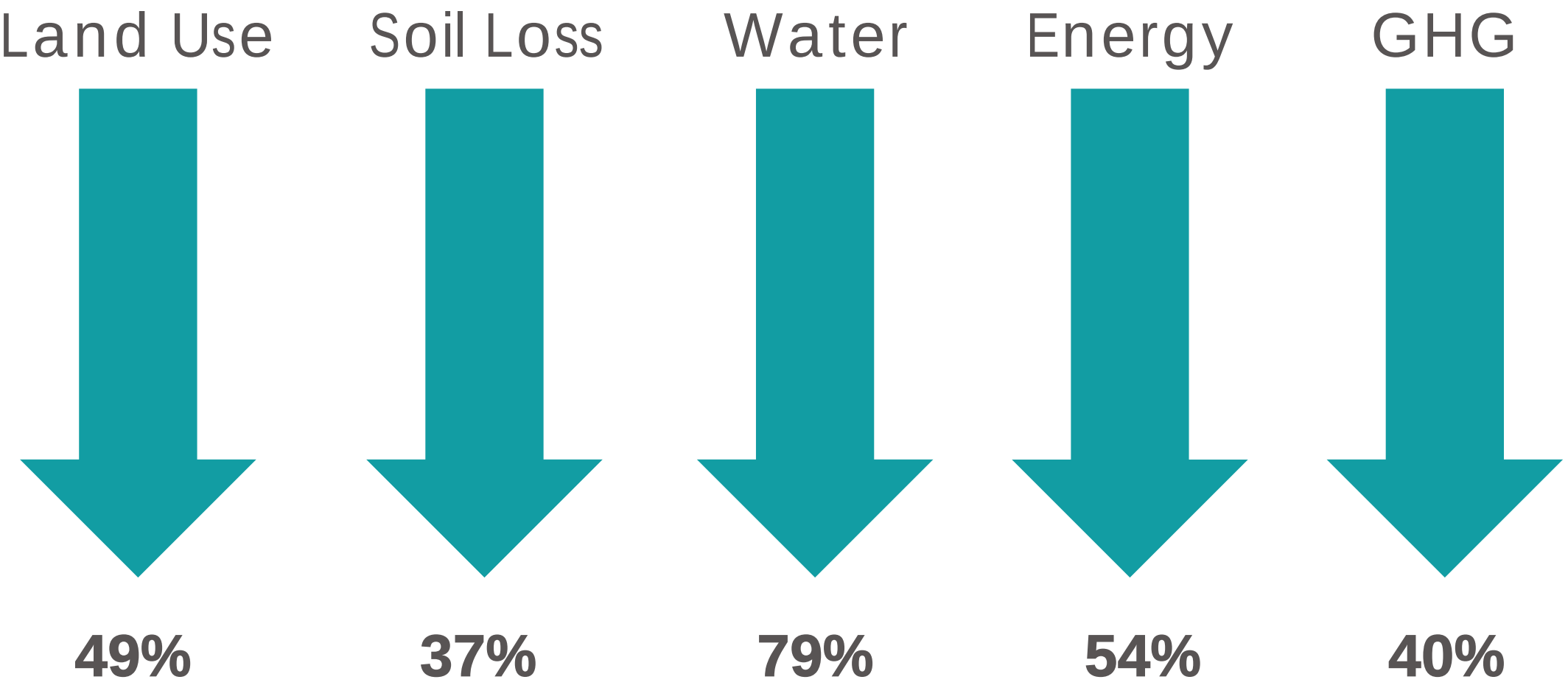
Water Use Efficiency

- Water Use Efficiency (WUE) is also referred to as “Water Productivity”
- WUE is the mass of economically valuable product per volume of all water consumed (irrigation and rainfall)
- Sometimes it is defined based only on the mass of fiber produced when applied to cotton.
- Approximate value for cotton: 0.23 kg fiber per cubic meter of water (50 pounds of fiber per inch of rainfall on an acre of land)

$$WUE = \frac{Mass\ of\ cotton\ fiber\ [and\ seed]}{Volume\ of\ Water\ Consumed}$$

Zwart, S.J. and W.G.M. Bastiaanssen. 2004. Review of measured crop water productivity values for irrigated wheat, rice, cotton and maize. Ag. Water Man. 69:115-133

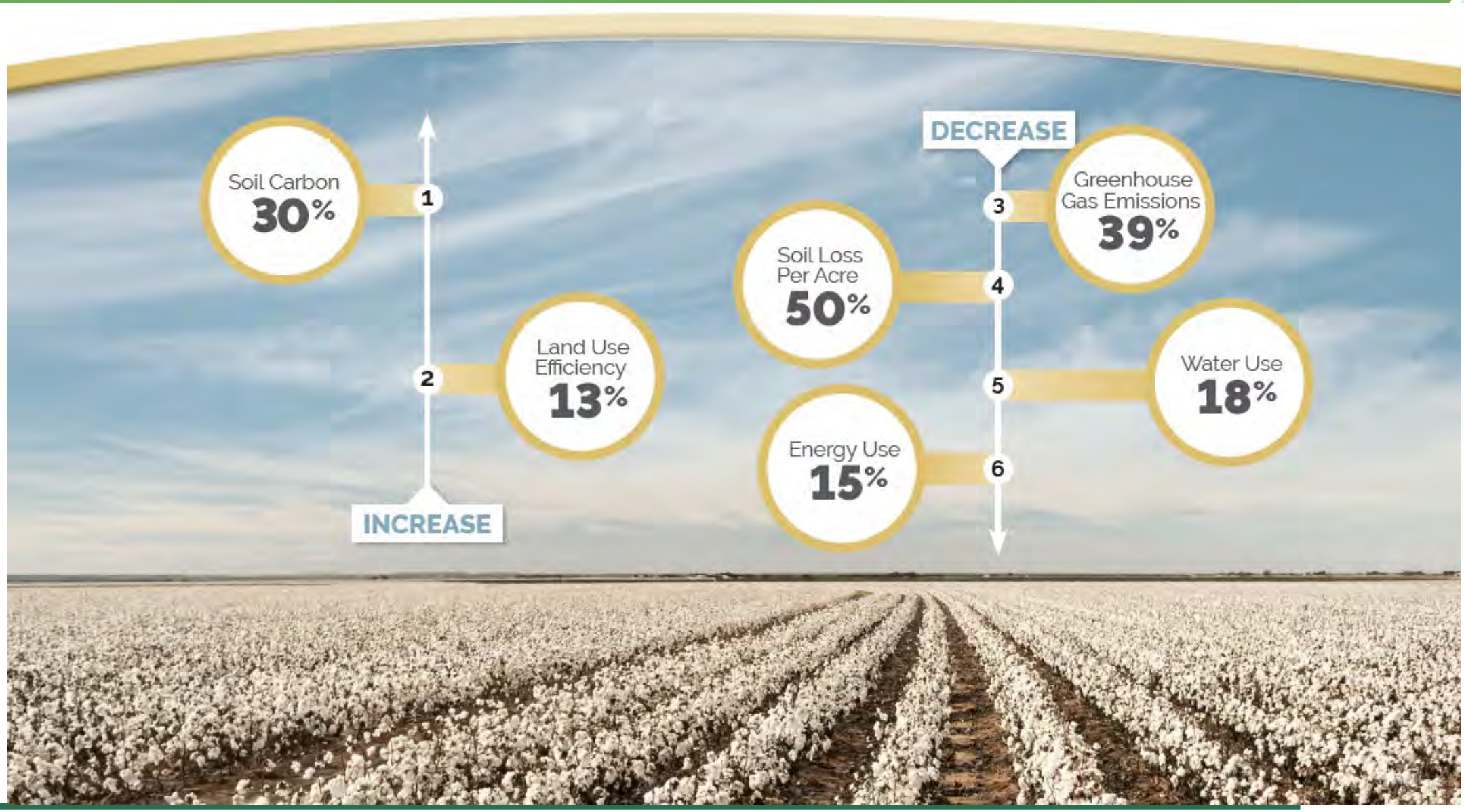
35 Years of Reduced Environmental Impact



Field to Market

Source: Field to Market: The Alliance for Sustainable Agriculture National Indicators Report (2016). https://fieldtomarket.org/national-indicators-report-2016/

U.S. Cotton's Sustainability Goals for 2025

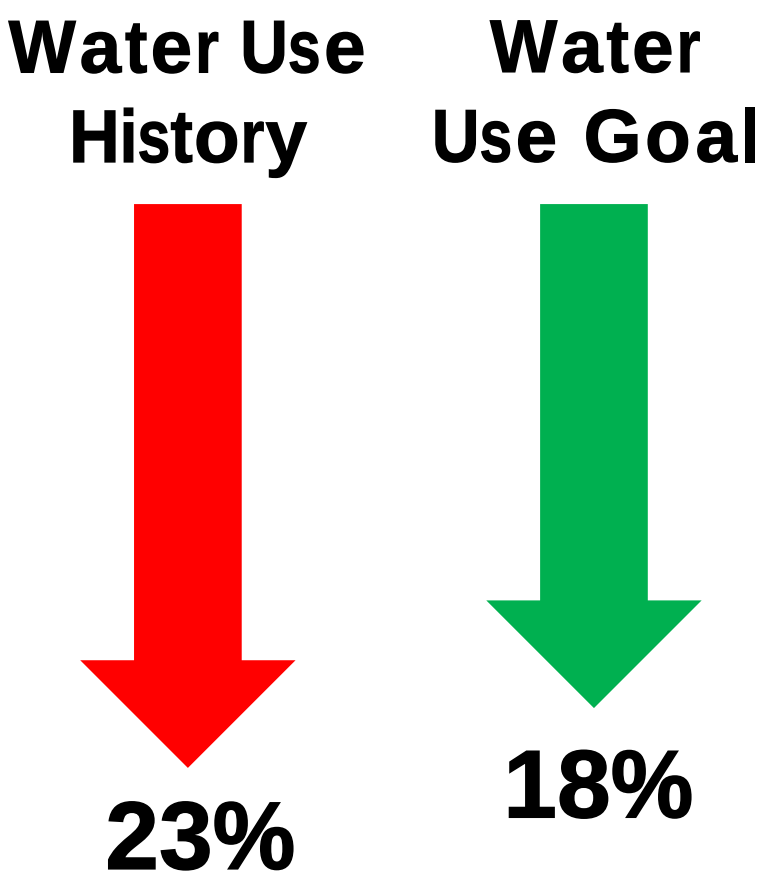


10-Year Goal Demonstrates Cotton's Leadership in Water Use Efficiency

Water Use History

23%

10-Year Goal Demonstrates Cotton's Leadership in Water Use Efficiency



10-Year Goal Demonstrates Cotton's Leadership in Water Use Efficiency

Water Use History

23%

Water Use Goal

18%

Water Use is the gallons of irrigated water used to produce a pound of cotton

Currently using 540 gallons to produce 1 pound of fiber and 1.3 pounds of cottonseed

10-year goal is 460 gallons

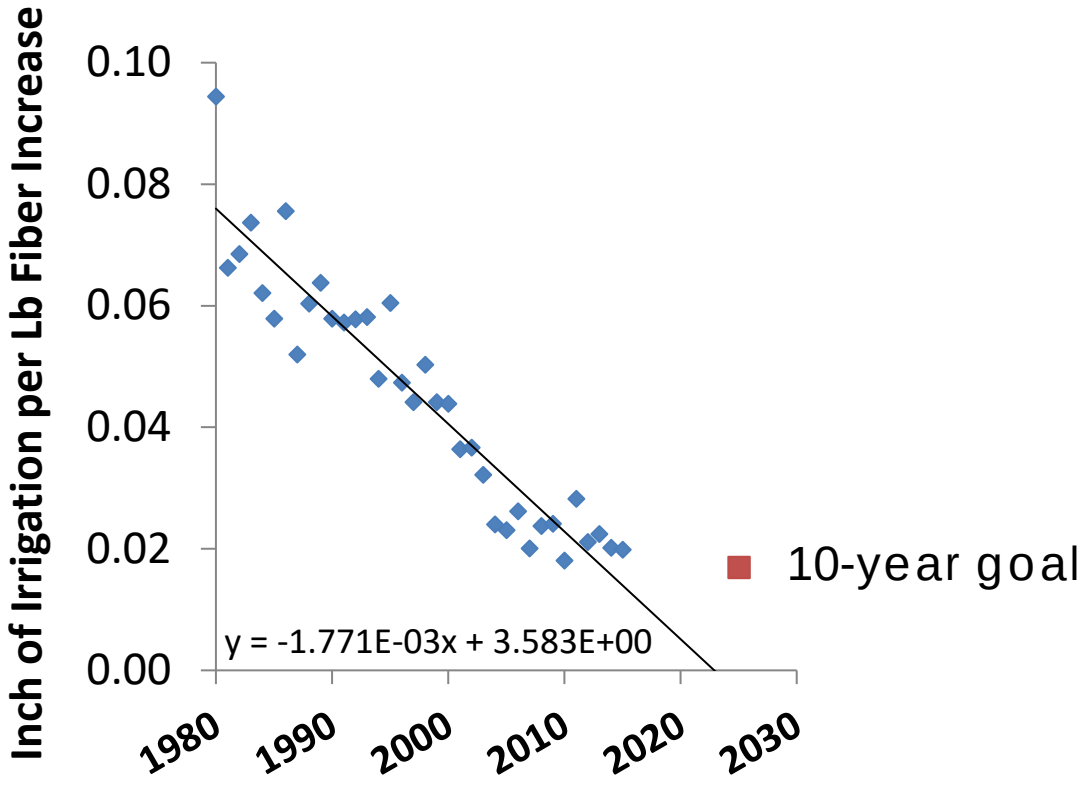
10-Year Goal Demonstrates Cotton's Leadership in Water Use Efficiency

Water Use History

23%

Water Use Goal

18%



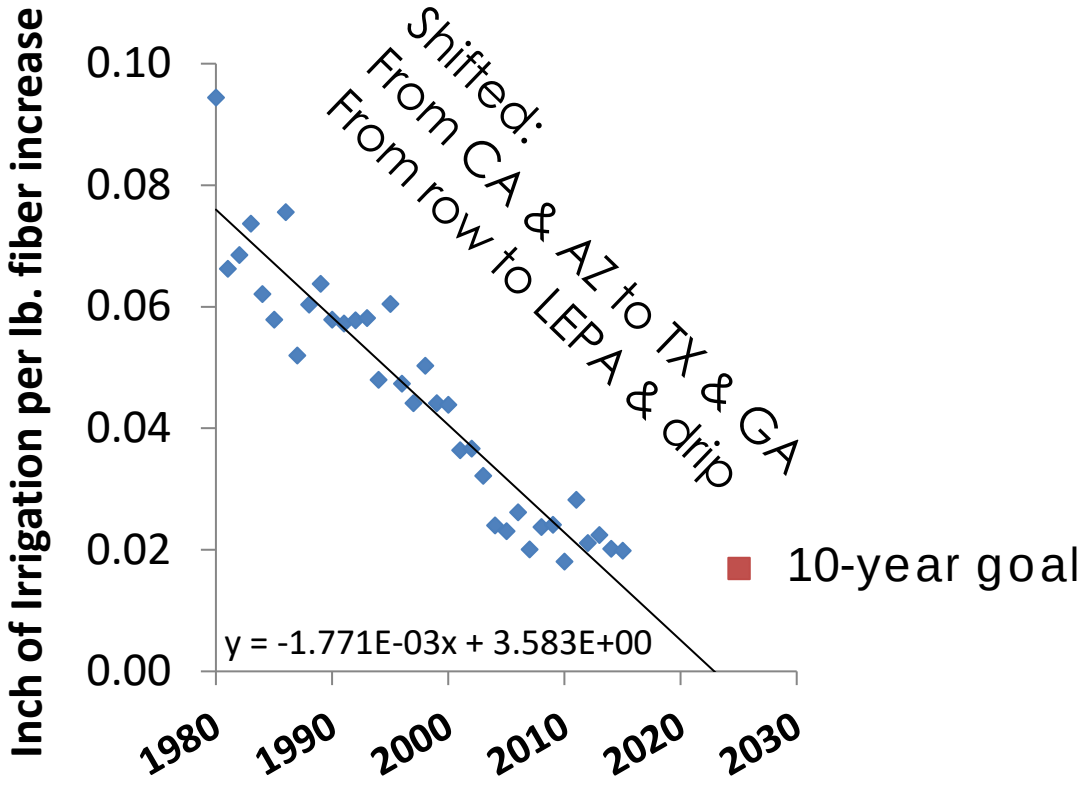
10-Year Goal Demonstrates Cotton's Leadership in Water Use Efficiency

Water Use History

23%

Water Use Goal

18%



Reaching Our Water Goal

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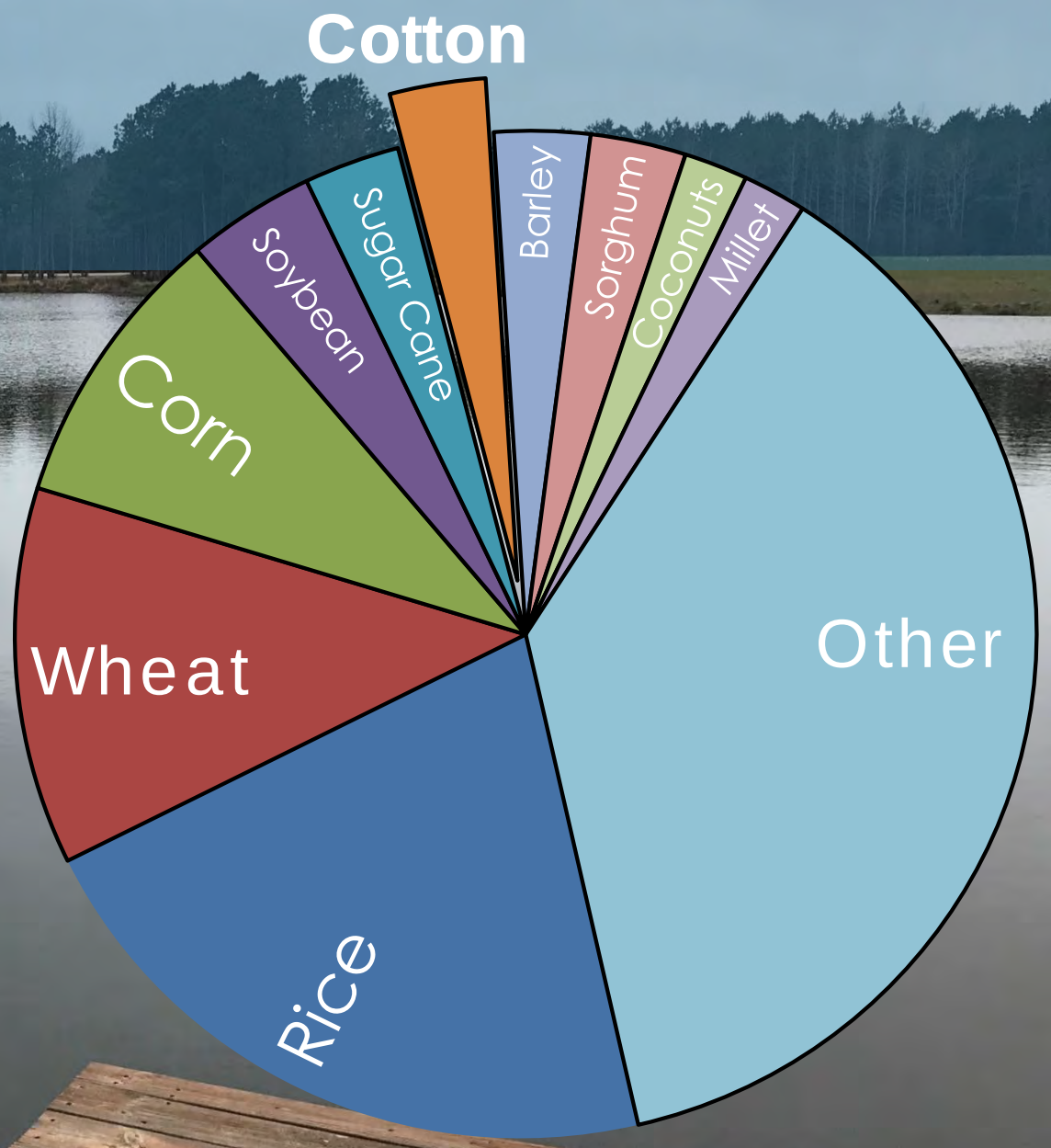
Cotton's Global Water Use

Cotton production uses

3%

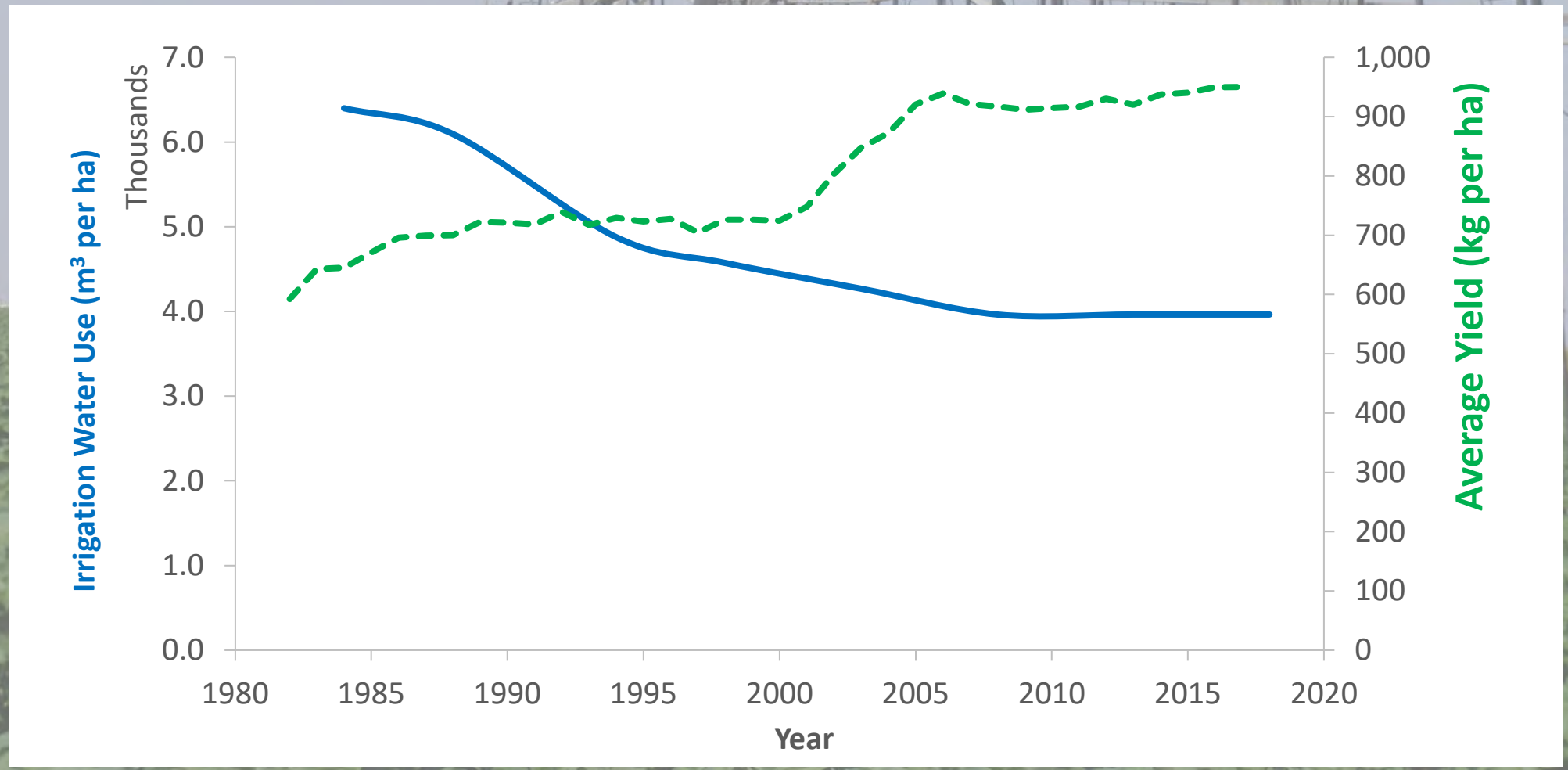
of the world's

agricultural water



Source: Hoekstra, A. Y. & Chapagain, A. K. (2007). Water footprints of nations: water use by people as a function of their consumption pattern. *Water Resource Management*, (21)1, 35–48.

U.S. Water & Yield Trends



Source: USDA Farm and Ranch Irrigation Surveys

Water Strategy

Maximize Rainfall Capture

Optimize Irrigation Water Use

Increase Plant Water Productivity

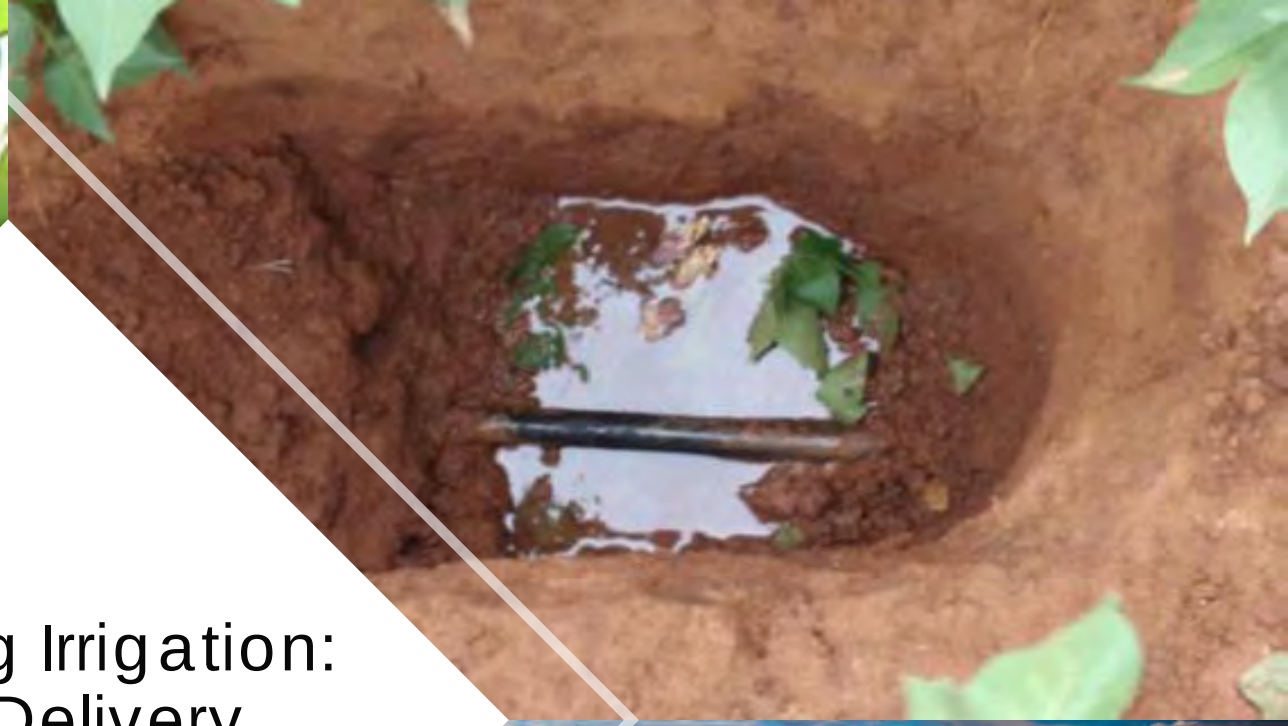
Evaluate with Credible Metrics

Top left, top right, bottom left photos courtesy of Dr. Ed Barnes
Bottom right .photo from Getty

Maximizing Rainfall: Soil Health & Farm Ponds

Photos courtesy of Dr. Ed Barnes

Optimizing Irrigation: Water Delivery Systems

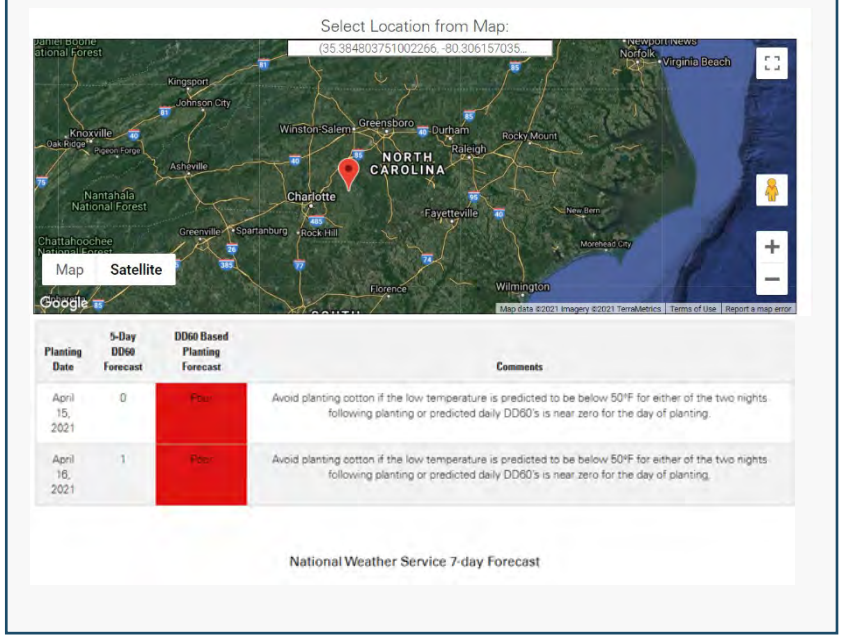


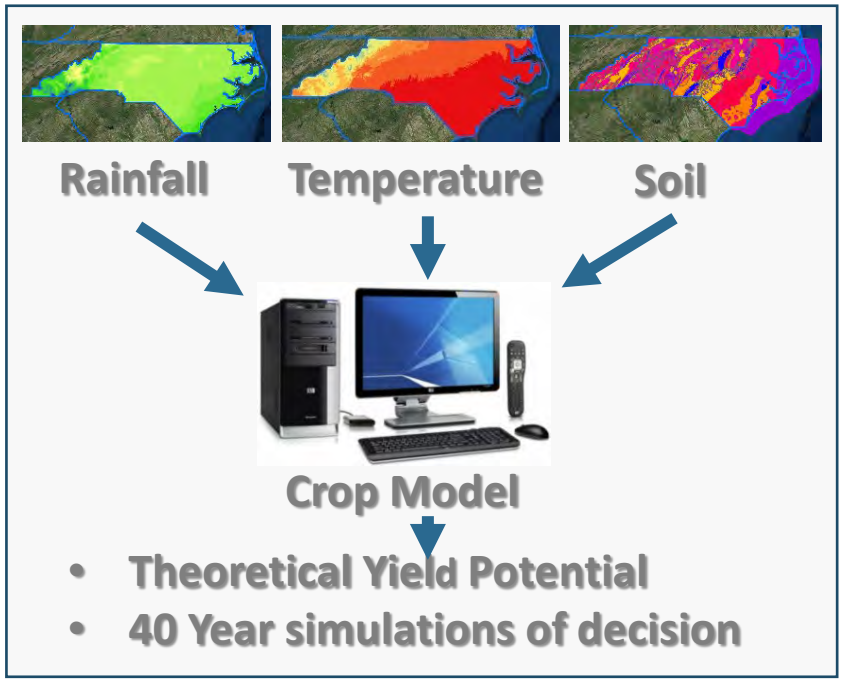
Top left, top right, bottom left photos courtesy of Dr. Ed Barnes
Bottom right photo courtesy of Valley Irrigation

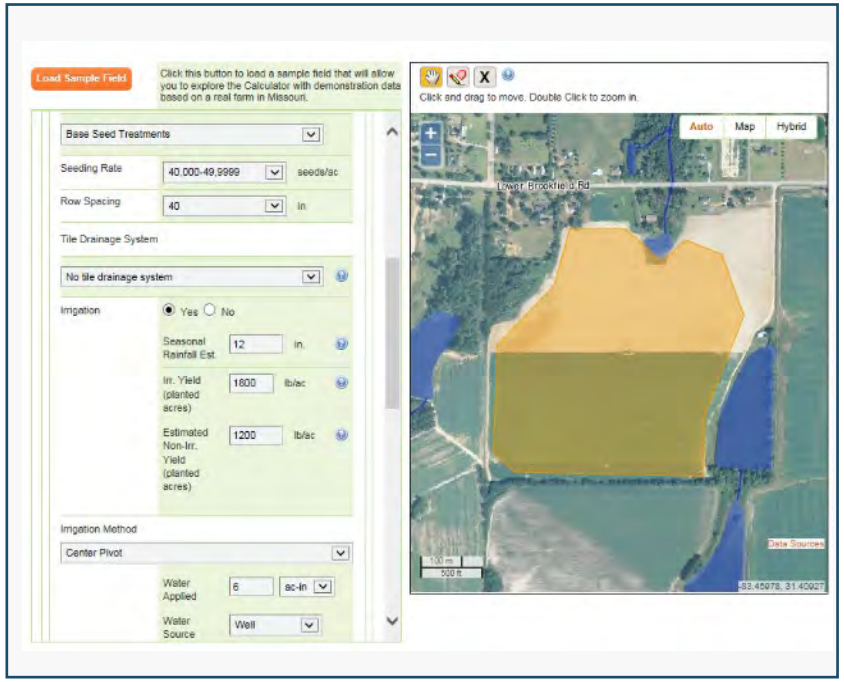
Photos courtesy of Dr. Ed Barnes

Optimizing Irrigation: Precision Timing

Optimizing Irrigation: Advanced Data Models







Grower Decision Aids

- Planting conditions
- Thrips
- Irrigation

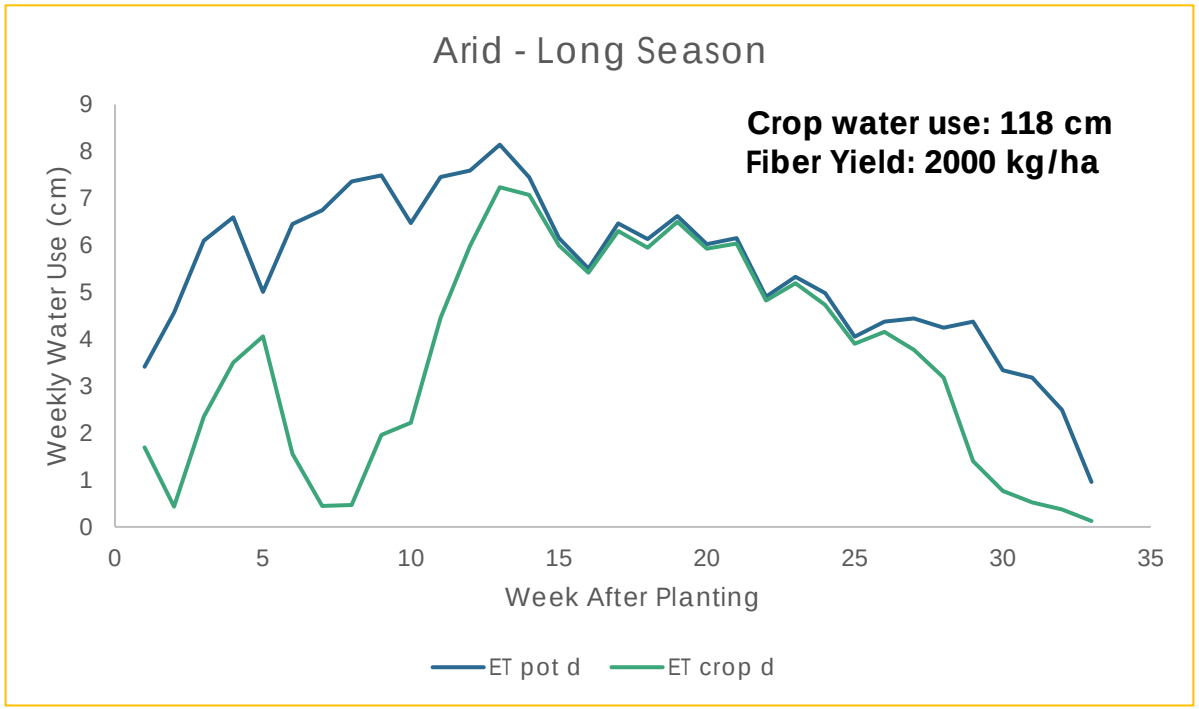
Crop Simulation

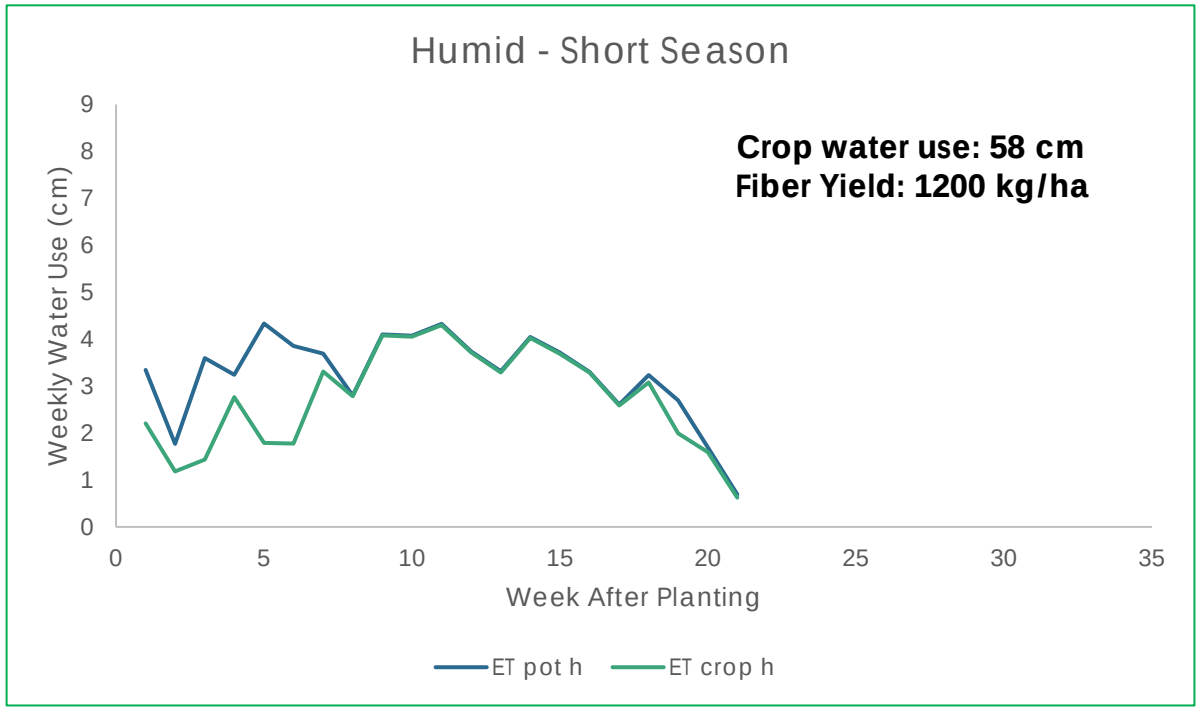
- Strategic decisions:
  - Irrigation profitable?
  - Rain for cover crop?
- Future: Real-time decisions

Ecosystem Services

- Carbon storage
- Water quality improvements
- Habitat enhancement

How much water does cotton need?



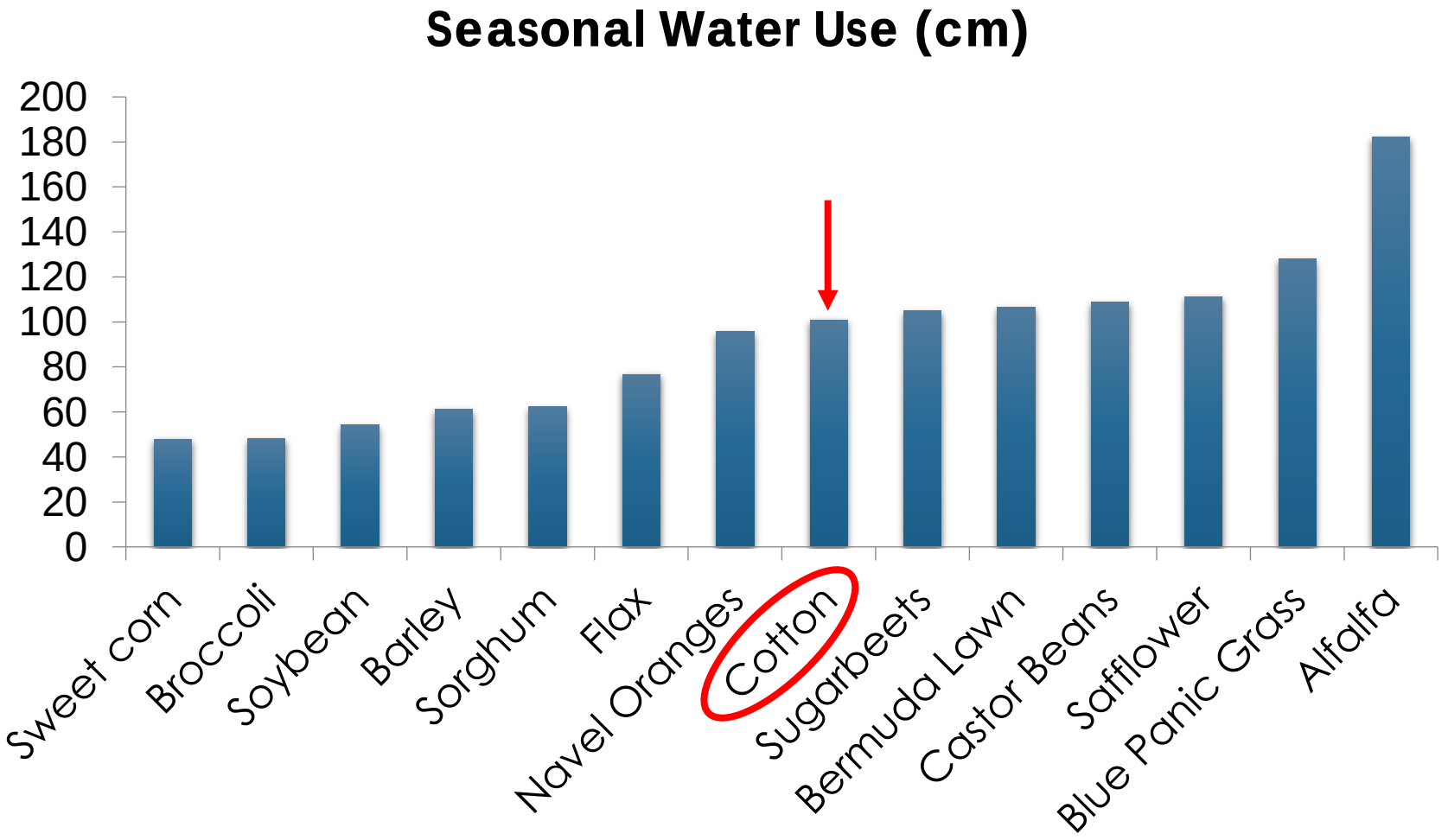


Based on calibrated crop simulation model outputs described in:

Thorp, K. R., Barnes, E. M., Hunsaker, D. J., Kimball, B. A., White, J. W., Nazareth, V. J., Hoogenboom, G., 2014. Evaluation of CSM-CROPGRO-Cotton for simulating effects of management and climate change on cotton growth and evapotranspiratin in an arid environment. Transactions of the ASABE, 57(6), 1627-1642. doi:10.13031/trans.57.10612, and

Spivey, T.A., G. G. Wilkerson, G. S. Buol, K. L. Edmisten, and E. M. Barnes. 2018. Use of the CSM-CROPGRO-Cotton model to determine the agronomic and economic value of irrigation to upland cotton production in North and South Carolina. Trans. ASABE 61(5): 1627-1638. https://doi.org/10.13031/trans.12801

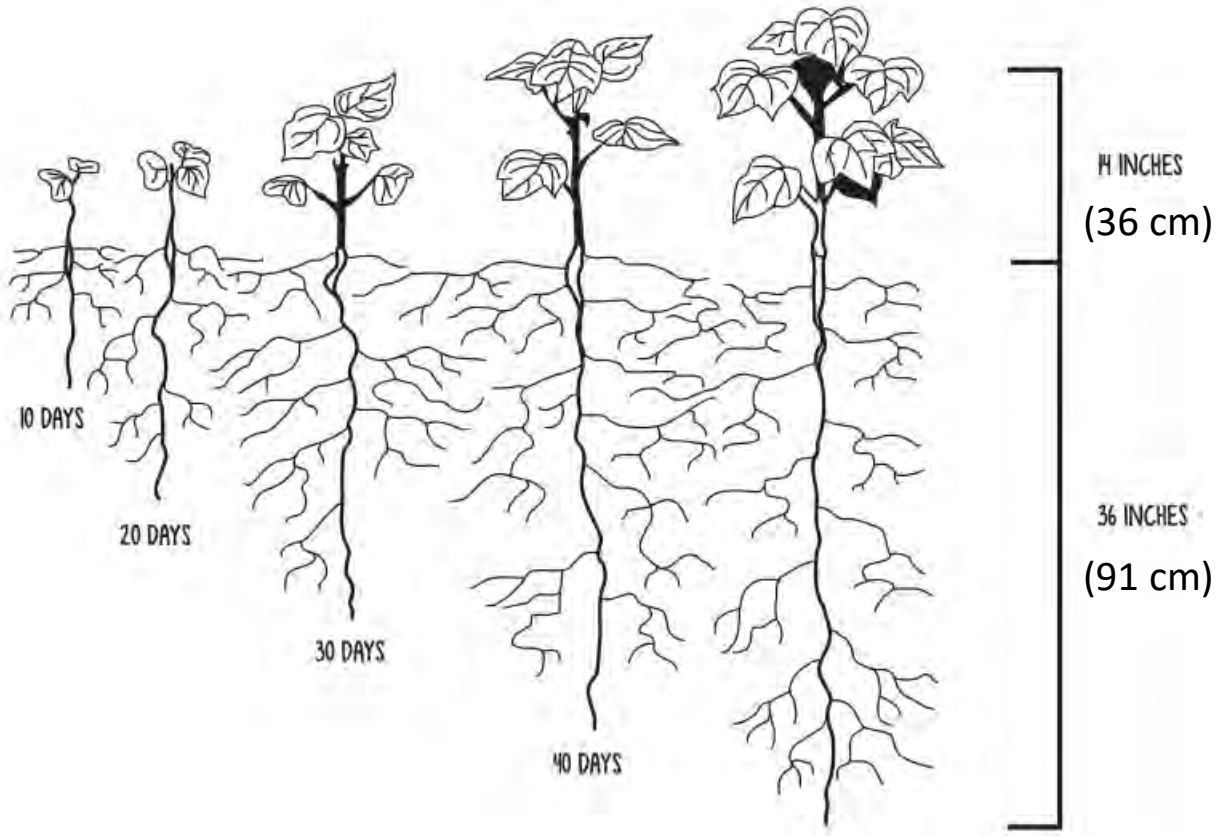
Seasonal Water Use – Arizona



USDA, ARS CR Report #29

Increasing Cotton's Plant Water Productivity

Tap Root Development



Root image source credit to Dr. Derrick Oosterhuis, U. of Arkansas

Finding Cotton with Even More Drought Tolerance

Photos courtesy of Dr. Ed Barnes

For More Details on Cotton Irrigation:

FORTY YEARS OF INCREASING COTTON'S WATER PRODUCTIVITY AND WHY THE TREND WILL CONTINUE

E. M. Barnes, B. T. Campbell, G. Vellidis, W. M. Porter, J. O. Payero, B. G. Leib, R. Sui, D. K. Fisher, S. Anapalli, P. D. Colaizzi, J. P. Bordovsky, D. O. Porter, S. Ale, J. Mahan, S. Taghvaeian, K. R. Thorp

Beyond 2020, VISION OF THE FUTURE Collection Review

Applied Engineering in Agriculture Vol. 36(4): 457-478

April 19, 2021

SmartIrrigation Cotton App

Designed for growers in Georgia and Florida, this interactive tool automatically downloads data from the closest weather station to help estimate irrigation water requirements.

Preview Tool View Tool

April 19, 2021

Placement and Interpretation of Soil Moisture Sensors for Irrigated Cotton Production in Humid Regions

This publication illustrates how to place soil water sensors and interpret the data in order to improve cotton irrigation management and achieve both higher water use efficiency and higher yields.

Preview PDF View PDF

https://cottoncultivated.cottoninc.com/resource-directory/?_sft_category=production+water-management

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Cotton's Agricultural Water Summary

- Cotton – **3%** agricultural water use
- Cotton is heat & drought tolerant
- Uses less water than a grass lawn
- About 4.4 cubic meters of rainfall and/or irrigation for 1 kg of fiber
- Water used for cotton represents less than 3% of a person's water consumption
- Actively researching how to further increase cotton's water productivity

ebarnes@cottoninc.com

Continue the Conversation

Reach out to us:

- Jdaystar@cottoninc.com
- Ebarnes@cottoninc.com

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Pathways to Progress

Increasing Cotton's Water Efficiency

Sustainability Goals for U.S. Cotton

Commitment & Innovation Define U.S. Cotton Production

U.S. cotton producers are leading the way in responsible cotton production practices.

Through the support of research and implementation of technology, U.S. cotton production is on the path to continual improvement, maximizing efficiencies while minimizing inputs.

Download *U.S. Cotton Ten-Year Sustainability Goals: Pathways to Progress.*

Sustainability Goals for U.S. Cotton

U.S. cotton producers are leading the way in responsible cotton production practices.

Learn how:

cottonworks.com/sustainability-goals-us-cotton

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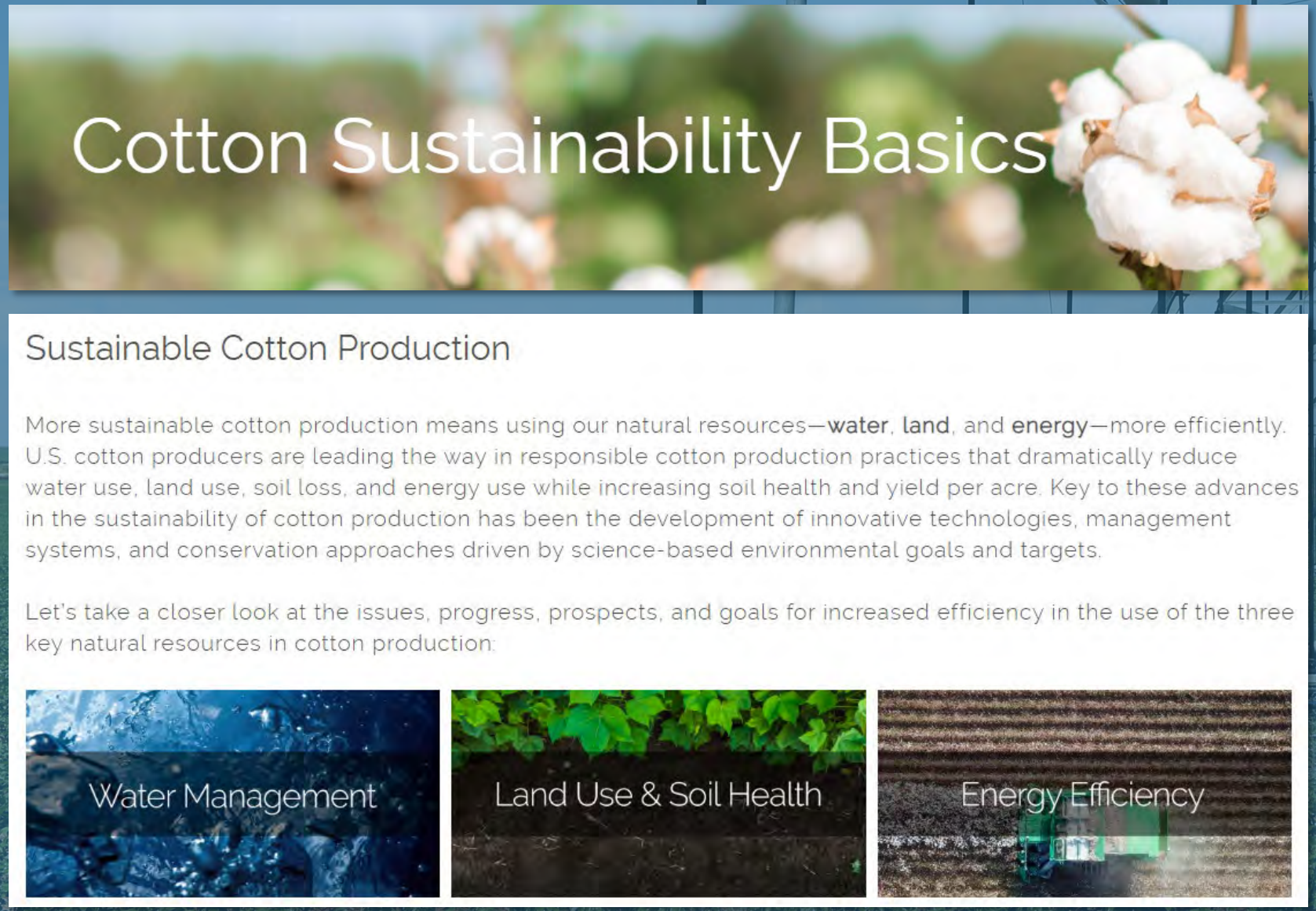

Cotton Sustainability Basics

Take a closer look at the issues, progress, prospects, and goals for increased efficiency in the use of the three key natural resources in cotton production: water, land, and energy.

Go to:

cottonworks.com/cotton-sustainability-basics

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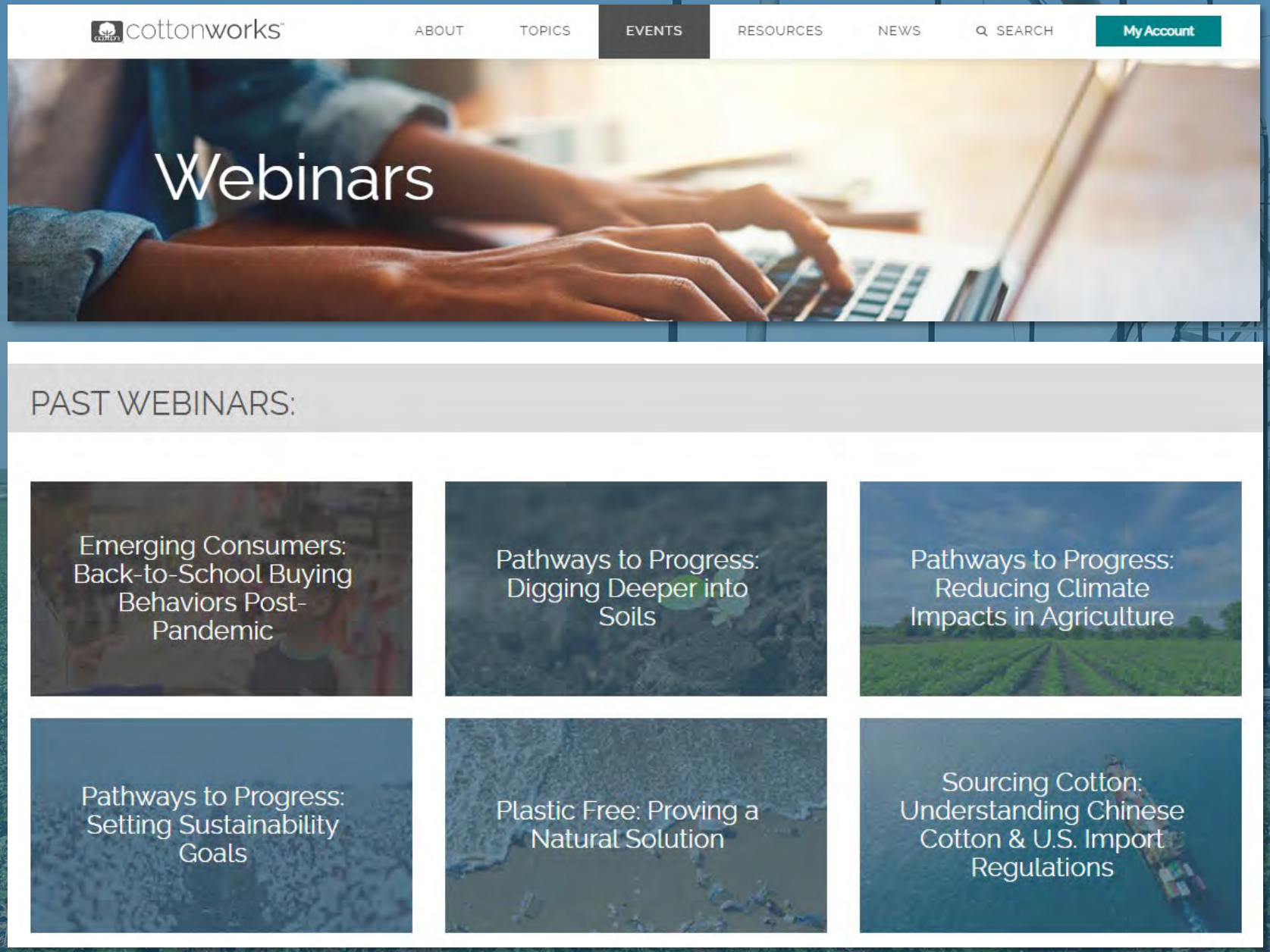

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Basic Information for Developing or Adjusting Sourcing Strategies

The United States imports textiles from more than 80 countries. Brands, retailers, and companies importing apparel and other textiles have many choices when it comes to the geography of sourcing cotton and cotton products. As companies develop or adjust their sourcing strategies, it is helpful to understand vital information about cotton, trade in cotton and production, and manufacturing practices that can affect sourcing and traceability.

Many companies are searching for information about cotton production in China and how this may be affected by current regulations by U.S. Customs and Border Protection.

Sourcing Cotton Webinars

Basic Information for Adjusting Sourcing Strategies

If business conditions, regulations, or compliance requirements have you rethinking your cotton sourcing strategy, this webinar takes you through basic information essential to evaluating your cotton sourcing plan.

Download PDF: Sourcing Cotton: Basic Information for Adjusting Sourcing Strategies

Webinar originally played 2/10/21

Understanding Chinese Cotton & U.S. Import Regulations

Learn how cotton flows through each stage of China's supply chain and how a leading trade association for U.S. importers is helping companies assess the situation.

Download PDF: Sourcing Cotton: Understanding Chinese Cotton & U.S. Import Regulations

Webinar originally played 3/9/21

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July 27 | Measurement

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