A Screening LCA Study of Two Supply Chains

March 2022

LOOP HOME

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Project Team

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Goal of the Study

The goal of the study is to conduct a screening LCA study for Loop Home's **towel, bedding, and bag** products based on a cradle-to-gate approach. The products include fitted sheet, flat sheet, pillow cases, quilt cover, fabric bags, tote bags, hand towel, bath mat, bath towel and laundry bags. Loop Home's products within this study are referred to as textile products throughout the report. Packaging and notions such as buttons, zippers etc. are excluded.

The intended audience includes Loop Home and its internal stakeholders. The findings of this study are intended to be used as a basis for internal communication; understanding the overall impacts of Loop Home's supply chains by baselining it with the impacts from alternative fibers.

The LCA framework used in the study is in accordance with the ISO 14040:2006 and ISO 14044:2006 standards.

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Scope of the Study

Product System: The product system to be studied are finished products from cradle to factory gates for two organic cotton Loop Home supply chains. The overview of each supply chain is presented in the table below:

Table 1: Overview of supply chains examined in this study.

Supply Chain	Fiber	Country of Origin	Garments Produced
Supply Chain 1: Printed Products	Organic Cotton (100%)	Turkey	Flat Sheet, Quilt Cover, Pillow Cases (Quilt Set), Fabric Bags
Supply Chain 1: Unprinted Products	Organic Cotton (100%)	Turkey	Fitted Sheet, Pillow Cases (Sheet Set), Tote Bags
Supply Chain 2: Yarn Dyed Products	Organic Cotton (100%)	Turkey	Hand Towel, Bath Towel, Bath Mat, Laundry Bags

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Scope of the Study

Product Function: The function of the product system is to produce textile products that are used by consumers.

Functional Unit: 1 kg of Loop Home's textile products made out of 100% organic cotton produced from Loop Home's supply chains in Turkey, with the warehouse in Australia. All the environmental impact results calculated in this study are relative to the functional unit.

Life Cycle Analysis (LCA): In this study, Loop Home's organic cotton supply chains are baselined against conventional cotton supply chains of identical textile processes and supply chain locations and are referred to as identical supply chains.

Selection of Life Cycle Impact Assessment (LCIA) methodologies: The life cycle inventories are analysed based on the following three impact categories chosen after discussion with Loop Home:

- Global warming potential (kgCO_2eq/kg of textile products)
- Primary energy demand (MJ/kg of textile products)
- Blue water consumption (Litre/kg of textile products)

System Boundary

Fiber Production: This stage covers the cultivation of cotton. This process includes all sub-processes such as the cultivation and harvesting of crops, ginning and other processes.

Yarn Production: This stage includes the spinning of yarn into fibers. For organic cotton, this includes different subprocesses such as opening, carding, drawing, combing, roving, and spinning

Yarn Dyeing: This stage happens at the yarn level and only occurs in towel products within supply chain 2, as indicated by Loop Home. All other products within supply chain 2 are assumed to be batched dyed.

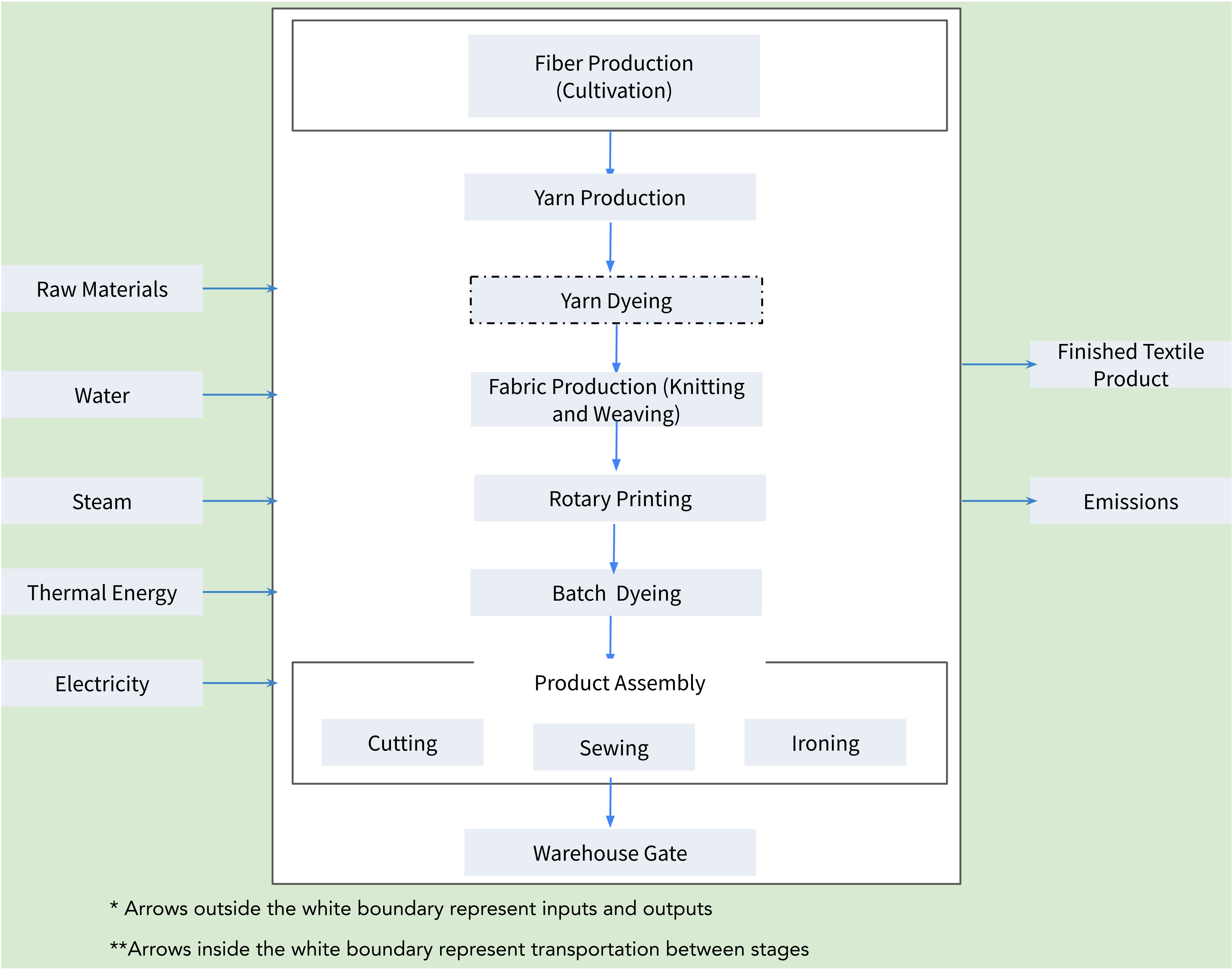

Fig. 1: General System Boundary for the Scope of the Study

System Boundary

Fabric Production: This stage includes the weaving of yarn into fabric and considers all subprocesses like winding, warping and sizing.

Rotary Printing: This stage includes the printing of textile products on the fabric level. Based on inputs from Loop Home, it is assumed that 5% of the product is printed.

Batch Dyeing: This stage includes processes such as scouring, dyeing and other related finishing processes.

Product Assembly: This stage includes processes such as the cutting, sewing and ironing of textile products. Product assembly numbers are deemed as negligible due to the low amounts of steam and electricity that are required to produce the products covered under the study. *

Transport: This process covers all the transportation between the above-mentioned stages of production starting from raw material acquisition to the delivery of the finished product to the warehouse.

Excluded stages: use phase and end of life.

*European Commission JRC. (2014) "Environmental Improvement Potential of Textiles (IMPRO Textiles). JRC Scientific and Policy Reports.

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Allocation

This study does not include any co-products therefore, no allocation was required.

Data Validation

No internal or external audit of resource utilization data provided by Loop Home was performed by Green Story for this study. It is assumed that data provided by Loop Home and its suppliers are factual and accurate.

Critical Review

No external critical review has been performed for this study.

Peer Review: This study has been peer reviewed by Green Story's LCA review team.

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Life Cycle Inventory (LCI) Analysis

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Supply Chain Overview: Organic Cotton Products

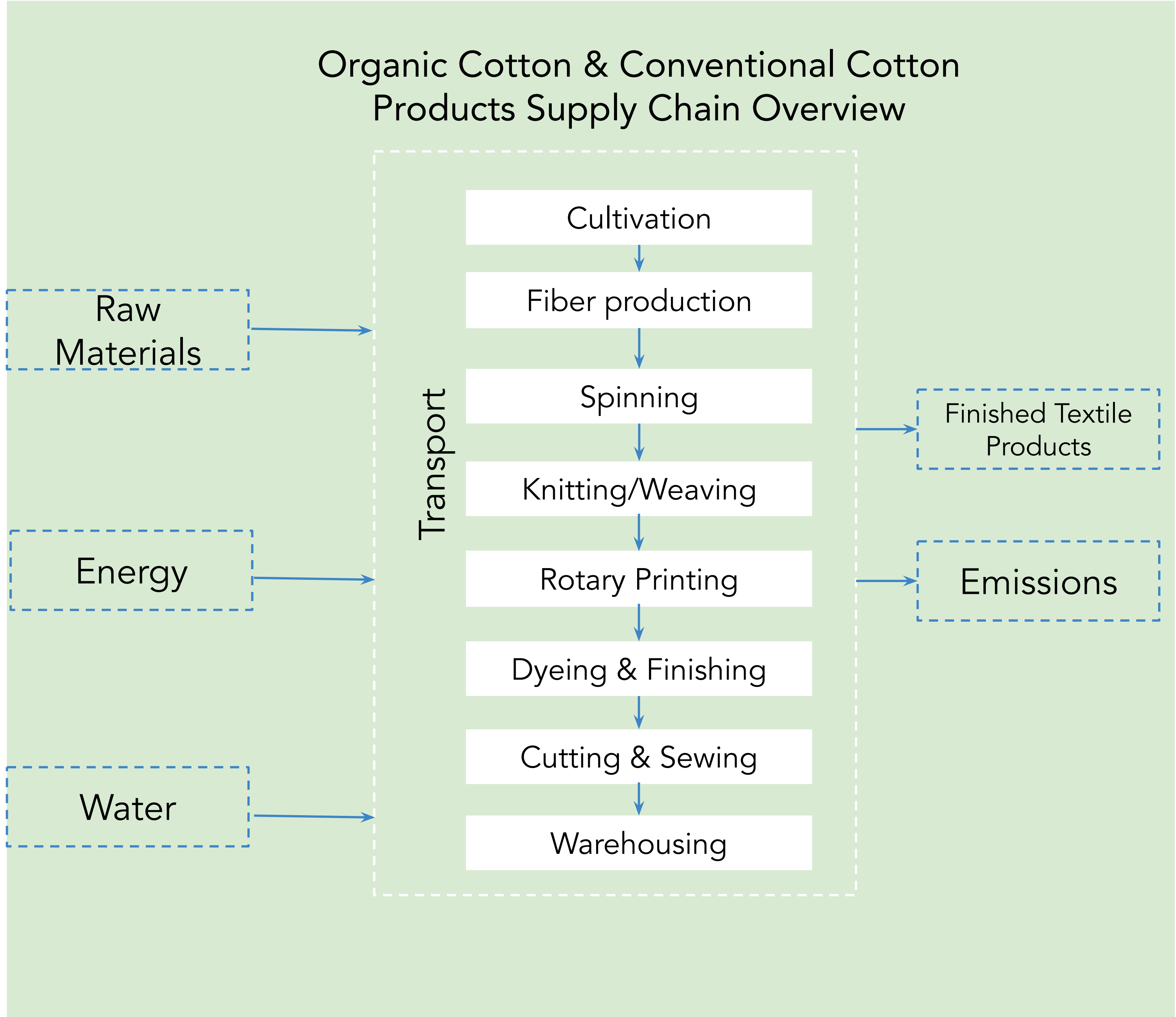

Fig. 2: Organic and Conventional Cotton Textile Products System Boundary

Organic Cotton Textile Products Supply Chain:

Organic cotton supply chain has been baselined against conventional cotton supply chain. Identical supply chains have been modelled for organic cotton and conventional cotton. The change in impact is due to the cultivation processes involved in producing these two different fibers.

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Loop Home's Supply Chain Locations

The below table 2 illustrates the geographical coverage of Loop Home's supply chains for organic cotton.

Table 2: Locations of all textile processes for all Loop Home supply chains within the scope of the study

Material	Cultivation/ Sorting	Fiber/ Granulate /Recycling	Yarn	Fabric	Dyeing	Printing	Cut & Sew	Warehouse
Organic Cotton (Supply Chain 1)	Aegean Region, Turkey	Izmir, Turkey	Istanbul, Turkey	Kirklareli, Turkey	Kirklareli, Turkey	Kirklareli, Turkey	Kirklareli, Turkey	Melbourne, Australia
Organic Cotton (Supply Chain 2)	Aegean Region, Turkey	Izmir, Turkey	Istanbul, Turkey	Denizli, Turkey	Denizli, Turkey	N/A (Products were specified to be unprinted)	Denizli, Turkey	Melbourne, Australia

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Life Cycle Impact Assessment (LCIA) Results

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Environmental Impacts: Supply Chain 1 Printed Products - Organic Cotton vs Conventional Cotton

Table 3: LCIA for Supply Chain 1 (per kg of printed products)

Net impact difference	Organic Cotton	Conventional Cotton	Percentage Difference
GHG emissions (kgCO2e)	11.87	13.78	-14%
Energy (MJ)	185.11	260.91	-29%
Blue water consumption (litres)	228.44	2822.74	-92%

* + sign indicates higher impact, - sign indicates lower impact

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Environmental Impacts By Stage: Supply Chain 1 Printed Products - Organic Cotton Products vs Conventional Cotton Products

Table 4: LCIA by stage for Supply Chain 1 (per kg of printed products)

	Unit	Total	*Fiber Production	Yarn production	Fabric Production	Dyeing	**Cut & Sew	Printing	Inner Transport	Distribution
Organic Cotton GHG	kgCO2eq	11.86	0.26	2.34	2.24	6.05	0	0.55	0.13	0.29
Conventional Cotton GHG	kgCO2eq	13.77	2.17	2.34	2.24	6.05	0	0.55	0.13	0.29
Organic Cotton PED	MJ	185.11	2.80	38.30	35.70	93.50	0	8.33	2.04	4.44
Conventional Cotton PED	MJ	260.91	78.60	38.30	35.70	93.50	0	8.33	2.04	4.44
Organic Cotton BWC	L	228.44	45.70	21.70	21.30	136.00	0	2.93	0.22	0.59
Conventional Cotton BWC	L	2822.74	2640.00	21.70	21.30	136.00	0	2.93	0.22	0.59

*quantity includes both cultivation and fiber production

**Cut and Sew numbers are deemed as negligible due to the low amounts of steam and electricity that are required to produce Loop Home's products

European Commission JRC. (2014) "Environmental Improvement Potential of Textiles (IMPRO Textiles). JRC Scientific and Policy Reports.

Environmental Impacts: Supply Chain 1 Unprinted Products - Organic Cotton vs Conventional Cotton

Table 5: LCIA for Supply Chain 1 (per kg of unprinted products)

Net impact difference	Organic Cotton	Conventional Cotton	Percentage Difference
GHG emissions (kgCO2e)	11.32	13.23	-14%
Energy (MJ)	176.78	252.58	-30%
Blue water consumption (litres)	225.51	2819.81	-92%

* + sign indicates higher impact, - sign indicates lower impact

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Environmental Impacts By Stage: Supply Chain 1 Unprinted Products - Organic Cotton Products vs Conventional Cotton Products

Table 6: LCIA by stage for Supply Chain 1 (per kg of unprinted products)

	Unit	Total	*Fiber Production	Yarn production	Fabric Production	Dyeing	**Cut & Sew	Inner Transport	Distribution
Organic Cotton GHG	kgCO2eq	11.31	0.26	2.34	2.24	6.05	0	0.13	0.29
Conventional Cotton GHG	kgCO2eq	13.22	2.17	2.34	2.24	6.05	0	0.13	0.29
Organic Cotton PED	MJ	176.78	2.80	38.30	35.70	93.50	0	2.04	4.44
Conventional Cotton PED	MJ	252.58	78.60	38.30	35.70	93.50	0	2.04	4.44
Organic Cotton BWC	L	225.51	45.70	21.70	21.30	136.00	0	0.22	0.59
Conventional Cotton BWC	L	2819.81	2640.00	21.70	21.30	136.00	0	0.22	0.59

*quantity includes both cultivation and fiber production
**Cut and Sew numbers are deemed as negligible due to the low amounts of steam and electricity that are required to produce Loop Home's products
European Commission JRC. (2014) "Environmental Improvement Potential of Textiles (IMPRO Textiles). JRC Scientific and Policy Reports.

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Environmental Impacts: Supply Chain 2 Yarn Dyed Products - Organic Cotton vs Conventional Cotton

Table 7: LCIA for Supply Chain 2 (per kg of yarn dyed products)

Net impact difference	Organic Cotton	Conventional Cotton	Percentage Difference
GHG emissions (kgCO2e)	7.54	9.44	-20%
Energy (MJ)	119.95	195.08	-39%
Blue water consumption (litres)	240.68	2805.48	-91%

* + sign indicates higher impact, - sign indicates lower impact

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Environmental Impacts by Stage: Supply Chain 2 Yarn Dyed Products - Organic Cotton Products vs Conventional Cotton

Table 8: LCIA by stage for Supply Chain 2 (per kg of yarn dyed products)

	Unit	Total	*Fiber Production	Yarn production	Fabric Production	Dyeing	**Cut&Sew	Inner Transport	Distribution
Organic Cotton GHG	kgCO2eq	7.54	0.26	2.32	2.22	2.27	0	0.18	0.29
Conventional Cotton GHG	kgCO2eq	9.43	2.15	2.32	2.22	2.27	0	0.18	0.29
Organic Cotton PED	MJ	119.95	2.77	37.90	35.40	36.70	0	2.83	4.35
Conventional Cotton PED	MJ	195.08	77.90	37.90	35.40	36.70	0	2.83	4.35
Organic Cotton BWC	L	240.68	45.20	21.50	21.10	152.00	0	0.30	0.58
Conventional Cotton BWC	L	2805.48	2610.00	21.50	21.10	152.00	0	0.30	0.58

*quantity includes both cultivation and fiber production

**Cut and Sew numbers are deemed as negligible due to the low amounts of steam and electricity that are required to produce Loop Home's products

European Commission JRC. (2014) "Environmental Improvement Potential of Textiles (IMPRO Textiles). JRC Scientific and Policy Reports.

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Hotspot Analysis

Important Note: This LCA study has been carried out with predominantly secondary data from LCA databases & literature. The results might vary (significantly for some impact categories) if primary data (process level) for supply chains is used, instead. Also, a LCA study with primary data is a robust option to make any performance improvement decisions by Loop Home management as compared to one based on secondary data. The analysis from this section should be read accordingly.

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Impact Details for Organic Cotton Supply Chain 1- Printed Products

The below table 9 indicates the hotspot stages for supply chain 1 - printed products

Table 9: Impact details for organic cotton supply chain 1 - unprinted products

Impact Category	Most Impactful Stages
GHG Emissions	**The dyeing stage** causes an approximate of 51% of the overall GHG emissions.
Primary Energy Demand	The **dyeing stage** causes an approximate 50% of the overall PED contribution.
Blue Water Consumption	The **dyeing stage** causes an approximate 59% of the overall BWC contribution.

Impact Details for Organic Cotton Supply Chain 1- Unprinted Products

The below table 10 indicates the hotspot stages for supply chain 1 - printed products

Table 10: Impact details for organic cotton supply chain 1 - unprinted products

Impact Category	Most Impactful Stages
GHG Emissions	**The dyeing stage** causes an approximate of 53% of the overall GHG emissions.
Primary Energy Demand	The **dyeing stage** causes an approximate 52% of the overall PED contribution.
Blue Water Consumption	The **dyeing stage** causes an approximate 60% of the overall BWC contribution.

Impact Details for Organic Cotton Supply Chain 2- Batch Dyed Products

The below table 11 indicates the hotspot stages for supply chain 1 - printed products

Table 11: Impact details for organic cotton supply chain 2 - batch dyed products

Impact Category	Most Impactful Stages
GHG Emissions	**The dyeing stage** causes an approximate of 53% of the overall GHG emissions.
Primary Energy Demand	The **dyeing stage** causes an approximate 52% of the overall PED contribution.
Blue Water Consumption	The **dyeing stage** causes an approximate 60% of the overall BWC contribution.

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Impact Details for Organic Cotton Supply Chain 2- Yarn Dyed Products

The below table 12 indicates the hotspot stages for supply chain 1 - printed products

Table 12: Impact details for organic cotton supply chain 2 - yarn dyed products

Impact Category	Most Impactful Stages
GHG Emissions	The yarn production stage causes an approximate of 38% of the overall GHG emissions.
Primary Energy Demand	The **yarn production stage** causes an approximate 31% of the overall PED contribution.
Blue Water Consumption	The **dyeing stage** causes an approximate 60% of the overall BWC contribution.

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Recommendations

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Enhance Representativeness of the Study:

To better understand the impacts associated with Loophome's processes, GS recommends conducting a process level primary data based LCA study. This can help management to identify the inefficiencies that are more representative of their existing processes.

E.g.: The inventory for the dyeing (both batch dyed and yarn dyed, including sub processes) is taken from secondary data sources, which have been found to be a major contributor to all three impact categories in this study.

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Glossary

Term	Definition
Greenhouse Gas Emissions (GHG)	Greenhouse gas is any gas that has the property of absorbing infrared radiation (net heat energy) emitted from Earth's surface and reradiating it back to Earth's surface, thus contributing to the greenhouse effect. Carbon dioxide, methane, and water vapour are the most important greenhouse gases. [1]
Blue Water Consumption (BWC)	Blue water refers to the water withdrawn from groundwater or surface water bodies. The blue water inventory of a process includes all freshwater inputs but excludes rainwater. [2]
Inner Transport	This Includes transportation between various textile product supply chain stages (i.e., from cultivation until cut and sew).
Distribution	This includes transportation to the warehouse (i.e., from textile product cut & sew location to the warehouse location).
Primary Energy Demand (PED)	The quantity of primary energy (energy form found in nature that has not been subjected to any human engineered conversion process) directly withdrawn from the hydrosphere, atmosphere or geosphere or energy source. [3]

[1] https://www.britannica.com/science/greenhouse-gas [2] https://gabi.sphera.com/fileadmin/Documents/Introduction_to_Water_Assessment_V2.2_03.pdf [3] https://gabi.sphera.com/fileadmin/gabi/Modelling_Principles/Modeling_Principles_-_GaBi_Databases_2020_2.pdf

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General and Key Assumptions

Electricity, Thermal Energy and Steam Usage

Cultivation and Fiber

- Turkish organic cotton impacts have been taken from Textile Exchange, Life Cycle Assessment of Organic Cotton: A Global Average, PE International 2014.
- Electricity upstream data used in all Turkish organic cotton fiber production is ‘market for electricity, medium’ in Turkey.

Yarn Production

- Yarn production from natural fibers includes the spinning of fibers into yarn and includes all subprocesses such as opening, carding, drawing, combing, roving, and spinning. The yarn production inputs are taken from Hasanbeigi (2014) and Koç & Kaplan (2007).
- Electricity upstream data used in Turkish organic cotton yarn production is ‘market for electricity, medium’ in Turkey.

Dyeing (naturals)

- The impacts of compacting were assumed to be part of the finishing process, taken from Cotton Inc, (2012). “The Life Cycle Inventory and Life Cycle Assessment of Cotton Fiber and Fabric: Executive Summary.” (pp.1-30)
- Electricity upstream data used in Turkish organic cotton yarn production is ‘market for electricity, medium’ in Turkey.
- Thermal Energy data is used as ‘Thermal energy from light fuel oil (Turkey) (Batch Dyeing).

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General and Key Assumptions

Electricity, Thermal Energy and Steam Usage

Fabric Production (weaving)

- The weaving process was taken from Van der Velden at al., 2014, "LCA benchmarking study on textiles made of cotton, polyester, nylon, acryl, or elastane." The International Journal of Life Cycle Assessment 19(2) (pp.331-356.)
- Electricity upstream data used in Turkish weaving is ‘market for electricity, medium’ in Turkey.

Cut & Sew

- Energy metrics for textile product assembly were taken from Gherzi et al. (2013). “Benchmarking energy efficiency in apparel production.” Sustainable Energy Saving for the European Clothing Industry. (pp.1-19)
- Electricity and steam consumptions for Loop Home’s towel, bedding, and bag products - included in this study- are taken from European Commission JRC. (2014) “Environmental Improvement Potential of Textiles (IMPRO Textiles). JRC Scientific and Policy Reports.

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General and Key Assumptions

Transport (Identical Supply Chain)

All Supply Chains

- All distances between process stages were calculated using SeaRates LP. "Current Market Rate." SeaRates, 2018.
- All distance assumptions containing unknown locations were used in accordance with Quantis, 2018. Measuring fashion: Insights from the environmental impact of the global apparel, textile product and footwear industries.
- Distances from the Cut and Sew facility to the international airport were calculated using www.google.com\maps

Supply Chain 1

- A distance of 30 km was assumed as the distance between the cultivation stage located in Aegean Region, Turkey and the fiber production located in Izmir, Turkey.
- Assumed Marmara Ereglisi to be the closest port city to Kirklareli, Turkey.
- During the distribution process from product assembly to the warehouse location air travel is taken into account, for this case it was assumed that Istanbul Airport was the closest international airport.

Supply Chain 2

- A distance of 30 km was assumed as the distance between the cultivation stage located in Aegean Region, Turkey and the fiber production located in Izmir, Turkey.
- From Yarn Production to Fabric Production assumed Kocaeli, Turkey to be a passing city in the transportation route.
- Assumed Gocek, Turkey as the closest port city to Denizli, Turkey.
- During the distribution process from product assembly to the warehouse location air travel is taken into account, for this case it was assumed that Istanbul Airport was the closest international airport.

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General and Key Assumptions

Global Comparison (Appendix)

Fiber (Organic Cotton- Gabi)

- Global dataset taken for organic cotton Textile Exchange, Life Cycle Assessment of Organic Cotton: A Global Average, PE International 2014.

Global Distribution (with Cotton)

- Conventional cotton fiber and yarn distribution is assumed based on ICAC (2020) by largest cotton producing countries.
- Conventional global distributions for fabric and cut and sew production is taken from Quantis (2018) and energy sources (electricity, steam, light fuel oil, thermal energy and diesel) considered as a weighted average of these distributions.

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General and Key Assumptions

Global Comparison (Appendix)

Transport

- All transportation between raw material production until warehouse storage is taken into consideration for both Loop Home and conventional production.
- Transport for conventional materials from Cut & Sew facility to warehouse was calculated as a weighted average from global distribution of Quantis (2018) to Loop Home's warehouse.
- Global distributions for cotton fiber and yarn are taken based on ICAC (2020) by largest cotton producing countries, and fabric and assembly global distributions from Quantis (2018).
- Conventional transport from Cut & Sew facility to warehouse was taken as 92% via ship and 8% via air as standard practice specified by Quantis (2018).
- Transportation by ship and air for the conventional supply chain was taken as the distance from harbor/airport to harbor/airport plus 500 km in each country as done by Quantis (2018).
- Conventional dyeing is assumed to be done in the same city as fabric production, hence 30 km transportation is included between these stages.
- All distances were calculated with SeaRates LP (2018) and www.distance.to (only for air distances).

General and Key Assumptions

Waste Percentage for all Manufacturing Processes associated with Loop Home and conventional supply chains

Table 3: Waste percentages of all textile manufacturing processes in all supply chains

Waste scenario	Waste %*
Yarn Production (Natural)	12%
Weaving	5%
Dyeing (Cotton)	1%
Printing	0%
Cut & Sew (Organic Cotton Textile Products SC1)	3%
Cut & Sew (Organic Cotton Textile Products SC2)	3%
Cut & Sew (Organic Cotton Textile Products SC2 Yarn Dyed)	5%

*Numbers are rounded to the nearest whole number
*Yarn production waste amount are taken from Van der Velden et al. (2014) "LCA benchmarking study on textiles made of cotton, polyester, nylon, acryl, or elastane." The International Journal of Life Cycle Assessment 19(2) 331-356.
*The weaving process was taken from Van der Velden at al., 2014, "LCA benchmarking study on textiles made of cotton, polyester, nylon, acryl, or elastane." The International Journal of Life Cycle Assessment 19(2) (pp.331-356.)
*Organic Cotton dyeing waste amount is taken from Ecoinvent (2019) Database Ecoinvent version v3.6. The Swiss Centre for Life Cycle Inventories.
*Product production amounts are taken from Gherzi et al. (2013). “Benchmarking energy efficiency in undergarment production.” Sustainable Energy Saving for the European Clothing Industry. 1-19.

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About Green Story

PANGAIA

"Customers love seeing the positive impact they make and we're seeing a bump in conversion and loyalty."

Vitamin A

"Our B2B customers come back to us and tell us they love seeing the impact of their orders. We're adding metrics in all our presentations."

pact

"Green Story is by far the best vendor we have ever worked with. I highly recommend their work."

A globally trusted brand

Green Story was founded with the vision of getting every consumer in the world to ask "What's my impact?" before they make a purchase.

By using credible data, an advanced technology platform and easy to understand visuals, Green Story transforms the customer experience every step of the way by showing the positive impact a customer can make by choosing green products. We have a team of lifecycle analysis experts, third party datasets and academic research to ensure transparent, dependable and credible analysis of supply chains.

Green Story works with over 100 brands in 15 countries to calculate and show their impact to millions of consumers worldwide.

Partners and Supporting Organizations

/COLLIDER/

Ontario Ministry of the Environment and Climate Change

CLIMATE NEUTRAL NOW – MEASURE REDUCE OFFSET

TextileExchange – Creating Material Change

SOCIAL VENTURES ZONE

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Appendix: Life Cycle Impact Assessment (LCIA) Results
Global Conventional Numbers

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Environmental Impacts by Stage for a Conventional Cotton Global Average Supply Chain - Printed Products

	Unit	Total
Conventional Cotton GHG	kgCO2eq	17.63
Global Conventional Cotton PED	MJ	311.89
Global Conventional Cotton BWC	Liters	2808.98

**Cut and Sew numbers are deemed as negligible due to the low amounts of steam and electricity that are required to produce the products covered under the study

European Commission JRC. (2014) "Environmental Improvement Potential of Textiles (IMPRO Textiles). JRC Scientific and Policy Reports.

*quantity includes both cultivation and fiber production

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Environmental Impacts by Stage for a Conventional Cotton Global Average Supply Chain - Unprinted Products

	Unit	Total
Conventional Cotton GHG	kgCO2eq	16.96
Conventional Cotton PED	MJ	303.59
Conventional Cotton BWC	Liters	2806.21

**Cut and Sew numbers are deemed as negligible due to the low amounts of steam and electricity that are required to produce the products covered under the study

European Commission JRC. (2014) "Environmental Improvement Potential of Textiles (IMPRO Textiles). JRC Scientific and Policy Reports.

*quantity includes both cultivation and fiber production

MADE WITH 100% ORGANIC COTTON

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