

Supplementary Materials

Table S1. Wastewater treatment process data (during bagasse washi production).

Item		Amount of activity per kg of Bagasse washi	
Input	Wastewater	6.94×10^2	kg
	Sodium hydroxide	3.94×10^{-4}	kg
	Sodium hypochlorite (process cleaning)	3.15×10^{-4}	kg
	Poly aluminum chloride	1.99×10^{-3}	kg
	Organic polymer flocculant	6.94×10^{-4}	kg
	Public power	8.04×10^{-2}	kWh
Output	Purified water	6.94×10^2	kg
	Sludge	6.31×10^{-2}	kg

Table S2. Slitting bagasse washi process data.

Item		Amount of activity per kg of Slit bagasse washi	
Input	Bagasse washi	1.09	kg
	Public electricity	2.42×10^{-1}	kg
Output	Slit bagasse washi	1.00	kg
	Waste	8.62×10^{-2}	kg

Table S3. Bagasse washi yarn production process data.

Item		Amount of activity per kg of Bagasse washi yarn	
Input	Slit bagasse washi	1.00	kg
	Public electricity	9.09×10^{-1}	kWh
Output	Bagasse washi yarn	1.00	kg

Note:

Ministry of Economy, Trade and Industry. LCA Study Report on Textile Products (Clothing)- Updated Version Due to Correction of Data on Dyeing Process, etc. 2009.

Table S4. Cotton yarn spinning process data.

Item		Amount of activity per kg of Cotton yarn	
Input	Cotton fiber	1.12	kg
	Lubricant	1.60×10^{-3}	kg
	Electricity	2.00	kWh
Output	Cotton yarn	1.00	kg
	Waste	1.24×10^{-1}	kg

Note: The data from Mistra future fashion. Environmental Assessment of Swedish Clothing Consumption—Six Garments, Sustainable Futures. 2019. Available online: <http://mistrafuturefashion.com/wp-content/uploads/2019/08/G.Sandin-Environmentalassessment-of-Swedish-clothing-consumption.MistraFutureFashionReport-2019.05.pdf> (accessed on 1 May 2024).

Table S5. Cotton yarn bleaching process data.

Item		Amount of activity per kg of Bleached cotton yarn	
Input	Cotton yarn	1.00	kg
	Industrial water	2.40×10^{-2}	m ³
	Detergent/wetting agent	6.00×10^{-3}	kg
	Hydrogen peroxide	2.30×10^{-2}	kg
	Peroxide stabilizer	3.00×10^{-3}	kg
	Phosphoric acid	6.00×10^{-3}	kg
	Sodium hydroxide	1.50×10^{-3}	kg
	Sulfuric acid	6.00×10^{-3}	kg
	Wetting/penetrating agent, cellulosic	3.00×10^{-3}	kg
	Electricity	7.00×10^{-1}	kWh
	Light fuel oil	3.00×10^1	MJ
Output	Bleached cotton yarn	1.00	kg
	Wastewater	2.40×10^{-2}	m ³

Note: The data from Mistra future fashion. Environmental Assessment of Swedish Clothing Consumption—Six Garments, Sustainable Futures, 2019. Available online: <http://mistrafuturefashion.com/wp-content/uploads/2019/08/G.Sandin-Environmentalassessment-of-Swedish-clothing-consumption.MistraFutureFashionReport-2019.05.pdf> (accessed on 1 May 2024).

Table S6. Bagasse washi denim fabric weaving process data.

Item		Amount of activity per kg of Bagasse washi denim fabric	
Input	Dyed cotton yarn	5.67×10^{-1}	kg
	Bagasse washi yarn	4.46×10^{-1}	kg
	Public electricity	1.21	kWh
Output	Bagasse washi denim fabric	1.00	kg
	Waste	1.30×10^{-2}	kg

Table S7. Cutting process data.

Item		Amount of activity per kg of Bagasse washi jeans parts	
Input	Denim washi fabric	1.25	kg
Output	Bagasse washi jeans parts (56% Cotton, 44% Washi)	1.00	kg
	Waste	2.50×10^{-1}	kg

Note: The data from Mistra future fashion. Environmental Assessment of Swedish Clothing Consumption—Six Garments, Sustainable Futures. 2019. Available online: <http://mistrafuturefashion.com/wp-content/uploads/2019/08/G.Sandin-Environmentalassessment-of-Swedish-clothing-consumption.MistraFutureFashionReport-2019.05.pdf> (accessed on 1 May 2024).

Table S8. Bagasse washi jeans production process data.

Item		Amount of activity per kg of Bagasse washi jeans	
Input	Bagasse washi jeans parts (56% Cotton, 44% Washi)	9.50×10^{-1}	kg
	Pocket fabric (100% Cotton)	1.50×10^{-2}	kg
	Buttons	2.00×10^{-2}	kg
	Rivets	1.00×10^{-2}	kg
	Sewing yarn	1.00×10^{-4}	kg
	Care label	4.00×10^{-4}	kg
	Leather patches	4.50×10^{-3}	kg
	Public electricity	3.60	kWh
Output	Bagasse washi jeans	1.00	kg
	Waste	0.00	kg

Table S9. Comparison of the life cycle of bagasse washi jeans and conventional 100% cotton jeans.

Process		GHG emissions	
		[kg-CO _{2e} /pair of jeans]	
		Bagasse washi jeans	100% cotton jeans
Fabric production	Bagasse washi yarn production	1.93	-
	Cotton yarn production	1.30	3.53
	Dyeing	3.24	6.02
	Weaving	7.63×10 ⁻¹	7.63×10 ⁻¹
	Fabric finishing	1.56	1.56
Jeans production	Cut/Sewing	2.07	2.07
	Transportation	1.43	1.30
	Sales	7.16×10 ⁻¹	7.16×10 ⁻¹
	Laundry	3.18	3.18
	Disposal	-9.01×10 ⁻¹	0.00
Total		1.53×10 ¹	1.91×10 ¹

Table S10. List of companies providing data on the production of bagasse washi jeans.

Company	Area	Business	Obtained process data
Company A	Okinawa Prefecture	Sugar production from sugarcane	Bagasse production
Company B	Okinawa Prefecture	Vegetable powder processing	Bagasse powdering
Company C	Gifu Prefecture	Development and production of specialty paper	Bagasse washi production
Company D	Hiroshima Prefecture	Washi yarn production	Slitting and twisting of bagasse washi
Company E	Hiroshima Prefecture	Yarn vat dyeing	Indigo dyeing of cotton yarn
Company F	Hiroshima Prefecture	Weaving and finishing of denim fabrics	Bagasse washi weaving and finishing
Company G	Hiroshima Prefecture	Production of jeans and denim jackets	Cutting bagasse washi denim fabric and sewing bagasse washi jeans

Table S11. Utilities of fossil resources.

Fossil resources	Calorific value	
Light fuel oil	3.80×10^1	MJ/L
Heavy oil A	3.89×10^1	MJ/L
LPG	5.01×10^1	MJ/kg
LNG	5.47×10^1	MJ/kg

Note: The data from Agency for Natural Resources and Energy. List of Standard Calorific Value and Carbon Emission Factor by Energy Source, 2022. Available online: https://www.enecho.meti.go.jp/statistics/total_energy/carbon.html (accessed on 1 May 2024).