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# The water footprints of global textiles trade

## Why the 'virtual water' use hidden in supply chains is critical to sustainability

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## Summary


- As the global textile trade causes goods to cross the world in highly complex supply chains, countries effectively trade the 'virtual water' used in the production of those goods, so that water moves indirectly through products rather than crossing borders physically. Every textile carries a hidden 'water footprint' – an indicator of the amount of water embedded in its production, trade, consumption and end-of-life disposal. Each stage of the product life cycle thus contributes to water use that builds pressures on rivers, lakes and aquifers; unsustainable water use can degrade ecosystems, disrupt supply chains and threaten local communities' equitable access to water. The impacts are highly visible where they occur, but are often unseen – or disregarded – as products travel towards markets further along the value chain.

- Global fibre production has nearly quadrupled over the last 50 years, and is expected to reach some 169 million tonnes by 2030. As demand for textiles continues to grow, there is a correspondingly urgent need for governments, producers, investors, businesses and consumers to understand the true water footprint of textiles throughout the product life cycle, and what implications this carries for efforts to promote equity, good governance and resilience in established and shifting supply chains.

- This research paper aims to help build this understanding, and inform work to ensure robust water governance, supply-chain transparency and best-practice innovation in global textile trade. The paper studies the water use of the entire textile life cycle, from the sourcing of raw materials – with a focus on polyester, cotton and man-made cellulosic fibres – to the disposal of textile waste. Using trade data, water-stress indicators and case studies, it examines the growing role of the industry in driving water insecurity across globally dispersed value chains. It outlines industry standards and best practices across the sector, and identifies opportunities for advancement towards more sustainable, equitable and efficient value chains.

- In many regions, textiles are a critical source of jobs and economic opportunity. The industry employs around 90 million people worldwide, more than half of whom are women. It has driven manufacturing growth in countries such as Bangladesh, where the apparel sector contributed 81.5 per cent of export earnings in 2024/25. But such successes can lock the industry into harmful practices such as intensive water abstraction and pollution of water bodies through improperly managed wastewater.

- As water stress intensifies, vulnerabilities are becoming ever more acute in major producing regions, as well as in countries that bear the growing burden of disposal of used textiles. The impacts are felt unequally, with already marginalized groups often most exposed to the harms arising from unsustainable and unsafe practices.

- Companies and investors are increasingly aware that failure to manage water dependencies in textile supply chains presents operational, reputational and financial risks. Governments, too, are seeking to protect supply chains and reduce vulnerabilities in trading relationships. Doing so while avoiding further

outsourcing of water stress requires existing and new suppliers to strengthen water governance, adopt sustainable practices and ensure more equitable benefit-sharing.

— Addressing the water footprint of textiles demands a whole-of-value-chain approach, and collective commitment to more sustainable and circular practices. Consumers play a pivotal role in developing demand for sustainable and circular textile products – provided they are supported with clear information, including accurate product labelling, and access to lower-impact alternatives. Interventions must therefore target both supply- and demand-side drivers, with a focus on strengthening governance frameworks, making effective use of trade levers, and accelerating uptake of best-practice innovations. This will involve:

  — Governments prioritizing diplomatic engagement on water as a shared and traded resource, in order to strengthen cooperation along the value chain on reducing the risks of water scarcity and poor water quality.

  — Policymakers and trade bodies working to embed water stewardship and circularity criteria into trade policy frameworks, with the goal of preventing social and environmental burdens from being displaced across borders and into vulnerable regions.

  — National governments and regional trade blocs building standardized water footprint metrics and incentives into trade agreements, to promote transparency along value chains.

  — At national level, ministries cooperating across sectors to ensure water is priced accurately to reflect baseline water stress and the true economic, environmental and social costs of water use.

  — International standards bodies, along with regional and national regulators, coordinating to fill gaps in existing regulatory and voluntary mechanisms, strengthen interoperability, and incentivize moves to more sustainable, efficient and equitable production.

  — Investors and private sector actors at all stages of the textile value chain supporting accelerated uptake of sustainable practices in regenerative agriculture, forest conservation, closed-loop technologies and circularity, through knowledge exchange and investment in innovation, implementation and monitoring; and de-risking the transitional period to ensure that value-chain transformation is both sustainable and just.

# Preface

At the 2021 United Nations Climate Change Conference, COP26, a coalition of 23 governments (including the host nation, the UK), businesses and civil society organizations signed the **Glasgow Declaration for Fair Water Footprints for Climate-Resilient, Inclusive, and Sustainable Development**. Signatories resolved to 'take transformative action for fair water footprints which will have durable benefits for our communities, ecosystems, and economies, and help to achieve Sustainable Development Goal 6 (SDG 6): Ensure availability and sustainable management of access to water and sanitation for all by 2030'.[1] This minilateral, multi-stakeholder initiative aims to demonstrate commitment to good water stewardship, promote best practice, and have its principles considered and taken up in a broader set of forums, including existing multilateral processes.

The Glasgow Declaration is based on shared recognition that the 'water footprints' (i.e. the direct and indirect water use – see Box 2) of consumer society, economic activity and international trade are tightly connected, including through global supply chains. Signatories identify the shared obligation of consumers, producers, trading partners, industry, investors, financiers and retailers to ensure sustainable and equitable water use.

**Water governance is not only a matter for those concerned with local river basin management or in-country economic development. It is a cross-border and global issue affecting multiple aspects of international relations.**

Underpinning this commitment is the principle that water governance is not only a matter for those concerned with local river basin management or in-country economic development, as is often perceived to be the case. It is also a cross-border and global issue affecting multiple aspects of international relations. The consequent need for a global approach to water governance is exemplified by the fact that the water footprints of many high-income nations are 40–80 per cent external, meaning that such countries are highly reliant on water use elsewhere in the world for the production and delivery of imported goods.[2]

Trade potentially allows for a more balanced use of the world's water resources by enabling water-scarce countries to access water-intensive products from water-plentiful countries and regions – and for both parties to profit from the exchange. However, in reality, a combination of overextraction of resources, underpricing and low regulation in many countries often results in water-intensive

1 Fair Water Footprints (2021), 'The Glasgow Declaration for Fair Water Footprints for Climate-Resilient, Inclusive, and Sustainable Development', p. 3, https://fairwaterfootprints.org/resource/declaration-in-full/fwf_glasgow_declaration_rebrand_proof_01.
2 Chapagain, A. K. and Mekonnen, M. M. (2023), 'Understanding the water footprints of the Global North and dependency on water use within the Global South', Water Witness International, https://fairwaterfootprints.org/resource/towards-fair-water-footprints-understanding-the-water-footprints-of-the-global-north-and-dependency-on-water-use-in-the-global-south.

products coming from water-scarce and/or climate-vulnerable regions. In such cases, the production of commodities for export can have significant negative consequences for water resources in the exporting country, including by causing water pollution, diversion and depletion, and by reducing society's resilience to climate and biodiversity crises. Globally, the safe limits for fresh water use have been transgressed, increasing the risk of unmanageable instability in the hydrological system.[3]

In this context, the Glasgow Declaration defines 'fair water footprints' as those that meet five social and environmental sustainability criteria: zero water pollution; sustainable water withdrawals and equitable allocation of water; protection of nature; access to safe water, sanitation and hygiene; and resilience to droughts, floods, climate variability and water conflict (see Box 1).[4]

This research paper is one of a series of three that explore the water-related impacts of global trade in different sectors. The sectors are: food and agriculture; textiles; and mining of critical metals and minerals for the technology industry. These sectors were chosen because all have significant international water footprints, are often particularly thirsty and polluting, and are increasingly affected by (and themselves affect) climate change and other environmental challenges. Each paper provides a concise overview of what is known about that sector's water footprint, highlighting the global trade dependencies between producer and consumer countries. The papers provide an overview of how global trade is contributing to, or undermining, prospects for realizing the Glasgow Declaration's ambition for 'fair water footprints' in each sector. At the same time, they examine how trade partnerships can serve countries' strategic security interests and – at both national and multilateral levels – strengthen water-related policy and practice.

Chatham House is a member of the Fair Water Footprints partnership[5] alongside CDP, the International Institute for Environment and Development, Water Witness International, and the UK government's Foreign, Commonwealth and Development Office (FCDO). Together we are working with signatories to the Glasgow Declaration to drive progress towards the ambitions of the declaration.

### **Box 1.** Fair water footprints

The Glasgow Declaration defines fair water footprints[6] as direct and indirect water use that demonstrates:

— **Zero water pollution.** No adverse impacts on the aquatic environment or other water users or functions arising from wastewater discharges. Diffuse pollution is controlled to improve the aquatic environment.

**3** Richardson, K. et al. (2023), 'Earth beyond six of nine planetary boundaries', *Science Advances*, 9(37), https://doi.org/10.1126/sciadv.adh2458.
**4** Fair Water Footprints (2021), 'The Glasgow Declaration for Fair Water Footprints for Climate-Resilient, Inclusive, and Sustainable Development'.
**5** Fair Water Footprints (undated), 'Frequently asked questions', https://fairwaterfootprints.org/faqs-glasgow-declaration-for-fair-water-footprints.
**6** Fair Water Footprints (2021), 'The Glasgow Declaration for Fair Water Footprints for Climate-Resilient, Inclusive, and Sustainable Development'.

- **Sustainable withdrawal and equitable allocation of water.** Water abstractions and use are within sustainable limits and do not compromise the human right to water, adversely affect downstream needs, or imperil the water security of future generations. This criterion is focused on 'blue water' impacts – that is, those affecting streams, rivers, lakes, aquifers, etc. (See Box 2 for definitions of terminology.)
- **Protection of nature.** Ecosystems and their services are valued and protected; nature-based and regenerative solutions are prioritized. This criterion encompasses 'green water' (essentially, soil moisture – see Box 2) and blue water uses.
- **Access to safe water, sanitation and hygiene.** Within the workplace, all workers have access to reliable and safe drinking water, toilets and washing facilities; collective action reaches communities in need.
- **Resilience to droughts, floods, climate variability and water conflict.** Effective planning, policy and investment support resilience to climate change, water-related disasters and conflict.

# Introduction

The story of the global textiles trade is, at its core, a story of water. From the cotton fields of South Asia to the polyester mills of China, and from dye houses and textile factories in Bangladesh to the second-hand clothing markets of cities like Accra or Bucharest, every stage of the textile life cycle carries a water footprint – an indicator of the amount of water embedded in the production, trade, consumption and end of life of textiles.[7]

It is also a story of a system that externalizes and obscures responsibility for the environmental and societal costs of textile production and waste. The impacts of water use, scarcity and pollution are highly visible where they occur, but are largely unseen – or disregarded – as products travel towards markets further along the value chain. This leaves consumers largely unaware of the hidden social, environmental and economic costs of the water needed to produce their clothing.

Among the textile industry's many environmental challenges, water stands out as the most pressing. The water footprint of textiles is unusually complex and globally dispersed, with each stage of the product life cycle contributing to water use that exerts pressures on rivers, lakes and aquifers. Vast volumes of water are consumed at every stage: 'green' water from rainfall and soil moisture through natural fibre cultivation; 'blue' water from surface and groundwater used in irrigation, manufacturing, consumer use and recycling; and 'grey' water arising from pollution caused by fertilizers and pesticides used in agriculture and forestry, as well as untreated or inadequately treated wastewater generated during all life cycle stages. (See Box 2 for a fuller note on the terminology used in this paper.)

**7** This paper focuses on textiles used for personal or household use (consumer textiles), including but not limited to apparel, home furnishings and other lifestyle-related goods. An exception is made in the analysis of used textiles, which focuses specifically on clothing. The scope excludes industrial, technical and medical textile applications.

Global production of textile fibres has nearly quadrupled since 1975, and production per person has increased from 8.3 kilograms (kg) to 16.2 kg in 2024.[8] Approximately 16 per cent of unsustainable water use and 11 per cent of groundwater depletion globally are embedded in global imports and exports.[9] Impacts ripple across the value chain, and are increasing as markets – including for textiles – continue to expand.

The consequences of these pressures are profound. Intensive water use and pollution deplete aquifers, contaminate rivers, lakes and coastal waters, and undermine access to safe drinking water and economic opportunities for communities living alongside textile processing and manufacturing clusters. Often, the resulting degradation disproportionately affects regions and people who are least able to respond and recover. The economic dividends arising from these water uses may also be inequitably distributed, with those who are most directly impacted by water consumption and pollution receiving relatively few direct benefits from the production and use of textiles.

This research paper makes the case that, across the textile industry, shifting towards sustainable, efficient and equitable production is vital for producing regions, and that this transition is inseparable from efforts to promote equity, good governance and resilience in both established and shifting supply chains. Using trade data and case studies, the research sets out to identify where water impacts are most acute across production, use, re-use and disposal of textiles, with a focus on three principal fibre types used in the textile industry: synthetics, cotton and man-made cellulosic fibres.

The textile industry employs around 90 million people worldwide, more than half of whom (some 55 per cent) are women.[10] Textiles-related activities play a notable role in poverty alleviation and employment generation in many developing economies. In the case of cotton, for instance, UN studies have estimated that, on average, every tonne of cotton produced provides year-round employment for five people.[11]

The industry has become emblematic of both immense opportunity and significant controversy. Persistent labour rights abuses, underscored by tragedies such as the Rana Plaza disaster in Bangladesh,[12] have spurred efforts to improve workers’ safety. Simultaneously, environmental concerns have intensified with the rapid expansion of fast fashion and online retail, as accelerated production cycles and flexible return policies have introduced new complexities to global value chains in which fibres, finished goods and waste are traded across borders. The paper explores existing mandatory and voluntary measures developed to reduce the social and environmental costs of textile production, and presents examples of initiatives

**8** Textile Exchange (2025), *Materials Market Report 2025*, https://textileexchange.org/knowledge-center/reports/materials-market-report-2025.
**9** Mekonnen, M. M. et al. (2024), ‘Trends and environmental impacts of virtual water trade’, *Nat Rev Earth Environ*, 5, pp. 890–905, https://doi.org/10.1038/s43017-024-00605-2.
**10** International Labour Organization (2020), *COVID-19 and global supply chains: How the jobs crisis propagates across borders*, Policy Brief, Geneva: ILO, p. 7, https://researchrepository.ilo.org/esploro/outputs/995219439502676.
**11** UNCTAD (2022), ‘Tapping the full potential of cotton in developing countries’, 7 October 2022, https://unctad.org/news/tapping-full-potential-cotton-developing-countries.
**12** Trebilcock, A. (2020), ‘The Rana Plaza disaster seven years on: transnational experiments and perhaps a new treaty?’, *International Labour Review*, 159, pp. 545–68, https://doi.org/10.1111/ilr.12183.

and best practices that can be replicated and expanded on. Recommendations are provided to address the governance gaps that leave the people and natural environment of producer countries and regions, together with onward supply chains and consumers, exposed to mounting water risks.

While trade can be an important tool for improving the overall efficiency of production, ensuring the sector's water use is put on a more sustainable and equitable footing requires more than simple geographic shifts in production. It necessitates a fundamental reinvention – transforming the textile sector from an extraction-based model to one built on principles of fair water footprints and circularity. This requires engaging actors across the textile value chain to strengthen governance frameworks, bolster water security through effective use of trade levers and accelerate the implementation of technological innovations. Our research shows that the tools and precedents exist – what is urgently needed is the political and commercial will to apply them at scale.

### **Box 2.** A note on terminology

**'Blue', 'green' and 'grey' water**
Discussion of the hydrological cycle and freshwater use typically categorizes fresh water according to source or pollution, with each category assigned a colour:

**Blue water** refers to surface and groundwater stores and flows (springs, rivers, lakes, reservoirs, aquifers). Groundwater includes both renewable and fossil resources, the latter of which are not replenished by the hydrological cycle; this means that fossil water extraction results in a permanent depletion of that resource.

- **Withdrawal of blue water** includes both 'consumptive' and 'non-consumptive' uses:
  - Consumptive water use is defined as use that results in the water not returning to its source. This includes evaporation, the incorporation of water into products, and the return of water to another catchment or sea. Only consumptive use is measured in water footprints.
  - Non-consumptive water use results in water being removed but later returned to its source. This is also known as 'return flow' and is not measured in water footprints.
- **The sustainability of blue water footprints** is measured with reference to water depletion. The measurement reflects the ratio between the blue water footprint (see definition of 'footprints' below) in an area/period and the total available volume of blue water in the same area/period.

**Green water** refers to soil moisture, which forms the evaporative flow for crop growth or for maintaining natural ecosystems.

**Grey water** refers to the volume of freshwater required to dilute pollutants or to meet water quality standards for a specific pollutant load. If that volume of water is not available (and in the in the absence of other treatment), then water quality standards are violated.

**Water footprints**

Water footprints are an indicator of freshwater use. They consider both direct and indirect water use by consumers and producers of goods or services. The water footprint of a consumer of specific goods or services is defined as the total volume of fresh water used to provide the goods or services consumed;[13] the water footprint of a producer of goods and services is defined as the total volume of fresh water used to provide those goods or services. Water use is measured in terms of water volumes consumed (i.e. evaporated or incorporated into a product) and/or polluted per unit of time.

A water footprint can be calculated for a particular product (e.g. for a type of food, textile or critical material, etc.) in relation to any well-defined category of consumer of that product (e.g. an individual, family, village, business, city, province, state or nation), as well as in relation to any producer of that product (e.g. a public organization, private enterprise or economic sector).[14]

Where direct and indirect water footprints are distinguished from one another, the direct water footprint is the water consumed or polluted by the specific actor or in the specific activity in question, whereas the indirect water footprint is the water consumed or polluted in the inputs or supply-chain activities prior to the relevant actor or activity.

A water footprint is a geographically explicit indicator and can be used to understand the water interdependencies that arise between countries through the export and import of goods. However, because it is a purely volumetric measurement, it does not directly convey the sustainability or impacts on water scarcity of water consumption. But the water footprint can be used alongside other measures to ascertain whether water use in a specific location – whether affecting an aquifer, river basin or entire nation – is sustainable. In this way, the impacts of water use on environmental water requirements and water quality can be assessed.

**Virtual water**

'Virtual water' is the amount of water (blue and/or green) required to produce a good or service, including all the production steps. This is also referred to as the water 'embedded' within a product. For a given product, its blue/green virtual water content is the same as its blue/green water footprint, but the concept of virtual water applies only at the *product* level whereas a water *footprint* can also measure water consumption by a company, region or country, etc. A water footprint can also quantify water pollution impacts. This is known as the 'grey water' footprint. The concept of virtual water is often used in trade contexts, with 'virtual water trade' referring to the exchange of goods and services based on their virtual water content.[15]

**13** Service-related water footprints have historically reflected small amounts of water consumption, but may become a more meaningful category given that data processing (e.g. for artificial intelligence) entails very high levels of water consumption.
**14** Fair Water Footprints (2021), 'The Glasgow Declaration for Fair Water Footprints for Climate-Resilient, Inclusive, and Sustainable Development'.
**15** Global Commission on the Economics of Water (2024), *The Economics of Water: Valuing the Hydrological Cycle as a Global Common Good*, Paris: OECD/Global Commission on the Economics of Water, https://watercommission.org/#report.

## Impacts on fresh water along the textile value chain

The textile industry's water footprint (see Box 2) extends across multiple stages of a product's life cycle, from raw materials production to wet processing,[16] consumer use and end-of-life management, including recycling. Water-related impacts across the textile value chain impose substantial hidden social and environmental costs. Sustainable, efficient and equitable use of freshwater resources – in terms of both quantity and quality – needs to be an urgent priority for companies and their investors, in bilateral trading relationships, for workers and for communities that neighbour production sites. All of these may suffer – in different ways and to varying degrees – the consequences of the global textile industry's role in causing water insecurity through overuse and contamination of water bodies.

As much as one quarter of the world's population is exposed to extremely high water stress, with 74 per cent of the population of South Asia affected.[17] A large proportion of global textile production is concentrated in Asia, with China, Bangladesh, Vietnam and India being among the world's leading finished textiles exporters.[18]

**An analysis of apparel and textile industry clusters found that in 2020, 50 per cent of sites studied faced high water quality risk in 2020, and nearly 75 per cent of sites were projected to face high to extreme water quality risk by 2050, indicating that water quality is the most prominent water risk for the textile industry.**

An analysis of apparel and textile industry clusters found that in 2020, 15 per cent (14,699) of facility locations studied already faced above-medium water scarcity risk, with a projected increase to 23 per cent (21,993 sites) by 2050.[19] According to the same study, 50 per cent of sites faced high water quality risk in 2020, and nearly 75 per cent of sites were projected to face high to extreme water quality risk by 2050, indicating that water quality is the most prominent water risk for the textile industry.[20]

**16** The term wet processing includes textile washing, dyeing (bleaching or scouring, dye application and post-dye wash off) and finishing.
**17** World Resources Institute (2023), *Aqueduct 4.0: Updated Decision-Relevant Global Water Risk Indicators*, Technical Note, https://doi.org/10.46830/writn.23.00061; Kuzuma, S., Saccoccia, L. and Cherlock, M. (2023), '25 Countries, Home to One-Quarter of the Population, Face Extremely High Water Stress', World Resources Institute, 16 August 2023, https://www.wri.org/insights/highest-water-stressed-countries.
**18** World Trade Organization (2024), *Global Value Chains: Sectoral Profiles – Textiles and Clothing Industry*, https://www.wto.org/english/res_e/statis_e/miwi_e/gvc_sectoral_profiles_textiles_clothing24_e.pdf.
**19** Morgan, A. J. et al. (2022), *Avant-Garde: The water risks and opportunities facing apparel and textiles clusters – Part II Exploring water risks in the textile industry's value chain*, WWF Germany / WWF Sweden, p. 20, https://wwfint.awsassets.panda.org/downloads/avant_garde___the_water_risks_and_opportunities_facing_textile_and_apparel_clusters.pdf.
**20** Ibid., p. 22.

Climate change is projected to intensify such pressures through more frequent droughts, heatwaves and flooding tied to monsoon variability.[21] Recent floods in Bangladesh and record heatwaves in India illustrate the sector's vulnerability to these climate-driven shocks.[22] The impacts are not equitably distributed. The communities most exposed to water-related shocks are often the least structurally equipped to recover from them. Pollution and unsustainable water withdrawals can result in reduced access to clean water. The effects can be more severe for women and girls, who are often responsible for sourcing household water – and who depend on safe access to water, sanitation and hygiene. Indigenous groups and other people who depend on natural resources for their livelihoods are also impacted, as are those who already face structural barriers to access adequate and safe water, such as older or disabled people and other marginalized groups. At the same time, the economic benefits of local water resources are not shared equitably with those most affected by industrial water withdrawals and their polluting impacts.

**The interconnected nature of global trade in textiles compounds the lock-in of unsustainable water footprints. If the core problems of industry-led pollution and unsustainable water withdrawals are not addressed, shifting production from one region to another simply externalizes the same impacts in new locations.**

Many countries face severe implications from unsustainable freshwater withdrawals and water pollution. Those facing scarcity or pollution of freshwater resources – now or in the future – risk losing their competitive advantage over other producing countries. However, it is not a simple matter to shift production to new locations, which may require, among other things, restructuring of transport networks, investment in new infrastructure, and renegotiation of trade agreements. The interconnected nature of global trade in textiles compounds the lock-in of unsustainable water footprints, as companies and consumers depend on suppliers along a complex value chain. If the core problems of industry-led pollution and unsustainable water withdrawals are not addressed, shifting production simply externalizes the same impacts in new locations.

**21** World Resources Institute (2023), 'Aqueduct 4.0 Water Risk Atlas', https://www.wri.org/data/aqueduct-water-risk-atlas; Intergovernmental Panel on Climate Change (2022), 'AR6 WGII, Chapter 10: Asia', https://www.ipcc.ch/report/ar6/wg2.
**22** Choubey, A. and Paul, R. (2024), 'Bangladesh garment industry short on cotton as floods worsen protest backlog', Reuters, 30 August 2024, https://www.reuters.com/world/asia-pacific/bangladesh-garment-industry-short-cotton-floods-worsen-protest-backlog-2024-08-30; Al Jazeera (2022), 'Hottest summer ever: Many Indian states under 'severe' heatwave', 29 April 2022, https://www.aljazeera.com/news/2022/4/29/hottest-summer-ever-many-india-states-facing-severe-heatwave.

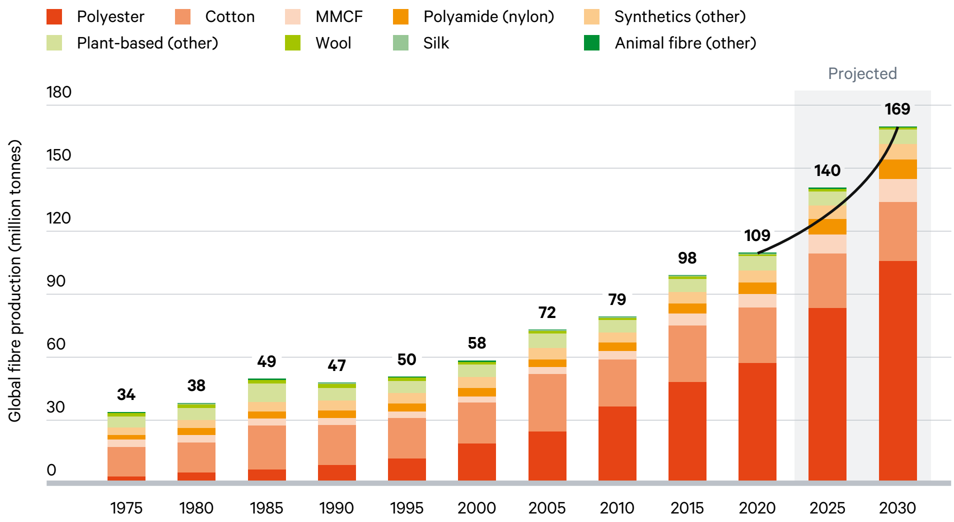
Trade flows, which can be measured in either volume (million tonnes) or value (US dollar value), are used in this section to provide a representative view of current trading relationships.[23] Each of these flows has a story to tell, and helps shed light on the difference between local impact versus economic influence or dependence. Here, the water footprint is evaluated alongside the volume of production, to understand the local impact of that production and to be able to assess the virtual water traded with those products. The value of trade for top exporters or importers is then analysed to understand the economic importance of different actors along the value chain, while baseline water stress is used to identify the level of water risks across the supply chain.[24] Addressing textiles-related water issues requires an understanding of these trade dynamics, along with coordinated efforts by all actors along the value chain to reduce social and environmental costs.

## Raw materials production

The initial stage of textile production involves the cultivation of natural fibres (e.g. cotton, flax or hemp) or the manufacturing of man-made cellulosic (e.g. viscose or lyocell) and synthetic fibres (e.g. polyester). Once the raw material is produced, it may be used domestically, traded with other countries to manufacture textile commodities, or transformed into another product that is then traded. Production of fibre globally has nearly quadrupled since 1975, reaching a record 132 million tonnes in 2024. Per person, it has almost doubled, from 8.3 kg to 16.2 kg in 2024. At current trends, absolute production could climb from 109 million tonnes in 2020 to 169 million tonnes by 2030 (Figure 1).[25]

**23** Volumes are important for understanding the pressure that production is putting on a specific location and the physical flows of a traded good; while value indicates the relative economic concentration or market power a producer or consumer has, which may come not only through volumes traded but also through trading in higher-value products.
**24** Baseline water stress measures the ratio of total water demand to available renewable water supplies.
**25** Textile Exchange (2025), *Materials Market Report 2025*.

**Figure 1.** Global fibre production (recorded and projected), million tonnes, 1975–2030

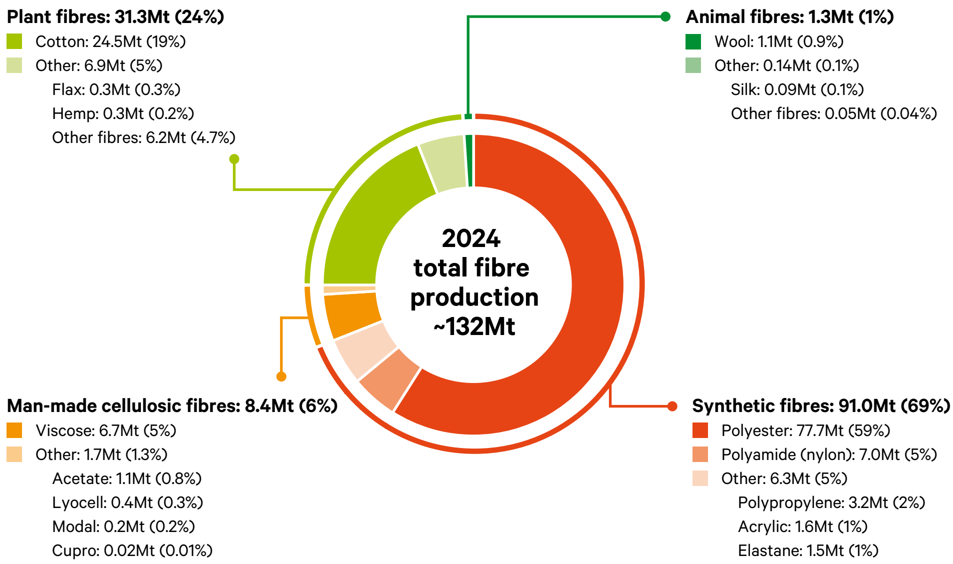



Note: The calculation of the percentage of production shares for different commodities may differ due to divergence in methodology and the inclusion of plant fibres and other wool, down and silk fibres.

Source: Textile Exchange (2025), *Materials Market Report 2025*, https://textileexchange.org/knowledge-center/reports/materials-market-report-2025. (Textile Exchange compilation based on data from ICAC, FAO, IWTO, Mohair South Africa, CIRFS, IVC, Maia Research, and its own modelling. Volumes of certain 'minority' fibres such as PTT, carbon, aramid, PLA, PBS, and PEF are not included. Cotton production volumes are collected in accordance with the harvest year used by ICAC, which runs from August 1 to July 31, with volumes allocated to the later calendar year (for example, 2023/24 cotton production is allocated to the 2024 calendar year) except for Brazil, for which data are collected by calendar year and aligns with the earlier year (for example, Brazil's 2023 cotton production is reported as 2023/24) as per the methodology of ICAC and USDA, revised in 2023. MMCF and synthetic fibre volumes include staple fibre and filament. Note that the percent market shares may differ from other total sources due to: (1) the overview including other plant fibres, other wool and silk – all of which are often excluded from global statistics; and (2) different cotton year allocations. In general, all global figures are estimates.)

In 2024, synthetic fibres accounted for 69 per cent of global fibre production, plant fibres for 24 per cent, man-made cellulosic fibres (MMCF) 6 per cent, and animal fibres 1 per cent (Figure 2). Each fibre type has its own production and trade patterns, as well as substantial freshwater implications. This paper concentrates on three principal fibre types used in the textile industry: synthetics, with a focus on polyester; cotton; and MMCF. Combined, these account for almost 95 per cent of annual fibre production worldwide.

**Figure 2.** Global fibre production by type, million tonnes and percentage share, 2024




Source: Textile Exchange (2025), *Materials Market Report 2025*, https://textileexchange.org/knowledge-center/reports/materials-market-report-2025. Textile Exchange analysis drawn from CIRFS, FAO, ICAC, IVC, IWTO, Maia Research, Mohair South Africa and modelling by Textile Exchange. Recycled fibres are included in these estimates.

## Synthetic fibres

Since the mid-1990s, synthetic fibres have dominated the global fibre market. By 2024, around 91 million tonnes of global fibre production – equivalent to some 69 per cent of the total – was fossil fuel-based synthetics.[26] With an annual production volume of around 78 million tonnes in 2024, or 59 per cent of global fibre production, polyester is the most widely used fibre.[27] Polyester fibres are in the form of either staple fibres, which are short lengths of yarn commonly used in blended or woven fabrics, or filament yarns that are used in lightweight fabrics or textiles needing high strength. China is the primary producer and exporter of polyester fibres, accounting for around 60 per cent of global production.[28] In 2024, China exported five times more polyester fibre than the next largest exporter, India. Other major exporters include South Korea, Thailand and Turkey.[29] Primary importers of polyester fibres are the US, Turkey, Brazil, Pakistan and Indonesia.[30]

**26** Textile Exchange (2025), *Materials Market Report 2025*.
**27** Ibid.
**28** CCFGroup (2025), 'Status Quo and Future Development of China's Polyester Industry', https://scic.sg/media/attachments/2025/05/21/7-4-status-quo-and-future-development-of-china_s-polyester-industry-charles-guo-from-ccfgroup.pdf.
**29** World Integrated Trade Solution (2026), 'Textured yarn of polyesters, nprs exports by country in 2024, https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2024/tradeflow/Exports/partner/WLD/product/540233 (accessed 23 Jul. 2026); World Integrated Trade Solution (2026), 'Synthetic staple fibres, of polyesters, not car exports by country in 2024', https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2024/tradeflow/Exports/partner/WLD/product/550320 (accessed 23 Jul. 2026).
**30** World Integrated Trade Solution (2026), 'Textured yarn of polyesters, nprs imports by country in 2024', https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2024/tradeflow/Imports/partner/WLD/product/540233 (accessed 23 Jul. 2026); World Integrated Trade Solution (2026), 'Synthetic staple fibres, of polyesters, not car imports by country in 2024', https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2024/tradeflow/Imports/partner/WLD/product/550320 (accessed 23 Jul. 2026).

Table 1 presents the countries with the highest polyester fibre trade values, based on 2024 data, alongside the level of baseline water stress in the exporting and importing countries.

**Table 1.** Baseline water stress of top five exporting and importing countries (by US dollar value) of polyester fibres

**Polyester fibres**

| | Major exporters | | Major importers |
|---|---|---|---|
| 1 | China | 1 | US |
| 2 | India | 2 | Turkey |
| 3 | South Korea | 3 | Brazil |
| 4 | Thailand | 4 | Pakistan |
| 5 | Turkey | 5 | Indonesia |

**Baseline water stress**
Low | Low-medium | Medium-high | High | Extremely high

Note: The trade data drawn on are for polyester fibres HS codes 540233 and 550320. Baseline water stress measures the ratio of total water demand to available renewable water supplies. Water withdrawals include domestic, industrial, irrigation and livestock consumptive and non-consumptive uses. Available renewable water supplies include surface and groundwater supplies, and considers the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users.

Source: Authors' compilation. Top five exporters and top five importers for product type from trade data, WITS (2024). Baseline water stress in colour-graded scale from World Resources Institute Aqueduct 4.0 Country Rankings.

### Water footprint of synthetic fibres

When assessing the water footprint of synthetic fibres such as polyester, nylon and acrylic, it is important to take account of all production processes – from oil exploration to the final manufacturing of fibres. Derived from petrochemicals, synthetic fibre manufacturing generates significant industrial wastewater that often contains hazardous substances. Industrial production phases, such as oil refineries, petrochemicals, polyester fibre production and the water management practices applied during oil exploration, drilling and extraction, are the largest contributors to the water footprint of polyester. Failure to account for these stages of synthetic fibre manufacturing will lead to a gross underestimation of the blue and grey water footprint. (See Box 2 for definitions.)

One study, published in 2017, found the combined blue and grey water footprint of polyester fibres ranges from approximately 50,000 litres per kg (l/kg) to 70,000 litres per kg (l/kg), some 99 per cent of which being the grey water footprint.[31]

**31** Freitas, A., Zhang, G. and Mathews, R. (2017), *Water Footprint Assessment of polyester and viscose and comparison to cotton*, Water Footprint Network, https://static1.squarespace.com/static/68072ac61a73e928f07fcc66/t/6810b0d54f90ec2b07452507/1745924313897/WFA+Polyester+and+Viscose+2017_May.pdf. In the interests of comparability of data in this research paper, we have converted all water footprint figures to litres per kilogram.

All production phases – from oil exploration to final fibres – contribute to the grey water footprint, while the blue water footprint comes primarily from fibre manufacturing. Polyester filament yarn has a 40 per cent higher blue water footprint than staple fibres because steam is needed to melt the fibres during spinning. Two-thirds of the locations included in the 2017 study were in hotspots for water scarcity, water pollution, or both.[32]

As already noted, synthetic fibres formed nearly 69 per cent of global fibre production in 2024.[33] This dominance largely reflects the reality that polyester and other virgin fossil fuel-based synthetics are cheaper and quicker to produce in large volumes – and are more durable – than natural or other fibres. However, the supply chain for synthetics is also deeply entrenched in existing petrochemical infrastructure, meaning it is exposed to petrochemical price fluctuations and supply-chain instability – as experienced most recently with the effective closure of the Strait of Hormuz in the spring and early summer of 2026.

### Cotton fibre

Cotton accounted for around 19 per cent of all fibre production in 2024, and almost 80 per cent of natural fibre production (see Figure 2). To produce cotton fabric, seed-bearing bolls are harvested and ginned to separate the fibre, called cotton lint, from the seed. Cotton lint is then used for spinning into yarn and ultimately woven or knitted into fabric. In 2024, Brazil was the largest exporter by volume of cotton lint (2.77 million tonnes), followed by the US (2.3 million tonnes), Australia, India and Benin. The largest importer of cotton lint in 2024 was China (2.6 million tonnes), followed by Bangladesh, Vietnam, Turkey and Pakistan.[34]

Table 2 presents the countries with the highest cotton lint trade values, based on 2024 data, alongside the level of baseline water stress in the exporting and importing countries.

**32** Ibid.
**33** Textile Exchange (2025), *Materials Market Report 2025*.
**34** Chatham House resourcetrade.earth (2026), https://resourcetrade.earth/?year=2024&category=691&units=value&autozoom=1 (accessed 23 Jul. 2026).

**Table 2.** Baseline water stress of top five exporting and importing countries (by US dollar value) of cotton lint

**Cotton lint**

| | Major exporters | | Major importers |
|---|---|---|---|
| 1 | Brazil | 1 | China |
| 2 | US | 2 | Bangladesh |
| 3 | Australia | 3 | Vietnam |
| 4 | India | 4 | Turkey |
| 5 | Benin | 5 | Pakistan |

**Baseline water stress**
Low · Low-medium · Medium-high · High · Extremely high

Note: The trade data drawn on are for cotton lint HS code 5201. Baseline water stress measures the ratio of total water demand to available renewable water supplies. Water withdrawals include domestic, industrial, irrigation and livestock consumptive and non-consumptive uses. Available renewable water supplies include surface and groundwater supplies and considers the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users.

Source: Authors' compilation. Top five exporters and top five importers for product type from trade data, Chatham House resourcetrade.earth (2026). Baseline water stress in colour-graded scale from World Resources Institute Aqueduct 4.0 Country Rankings.

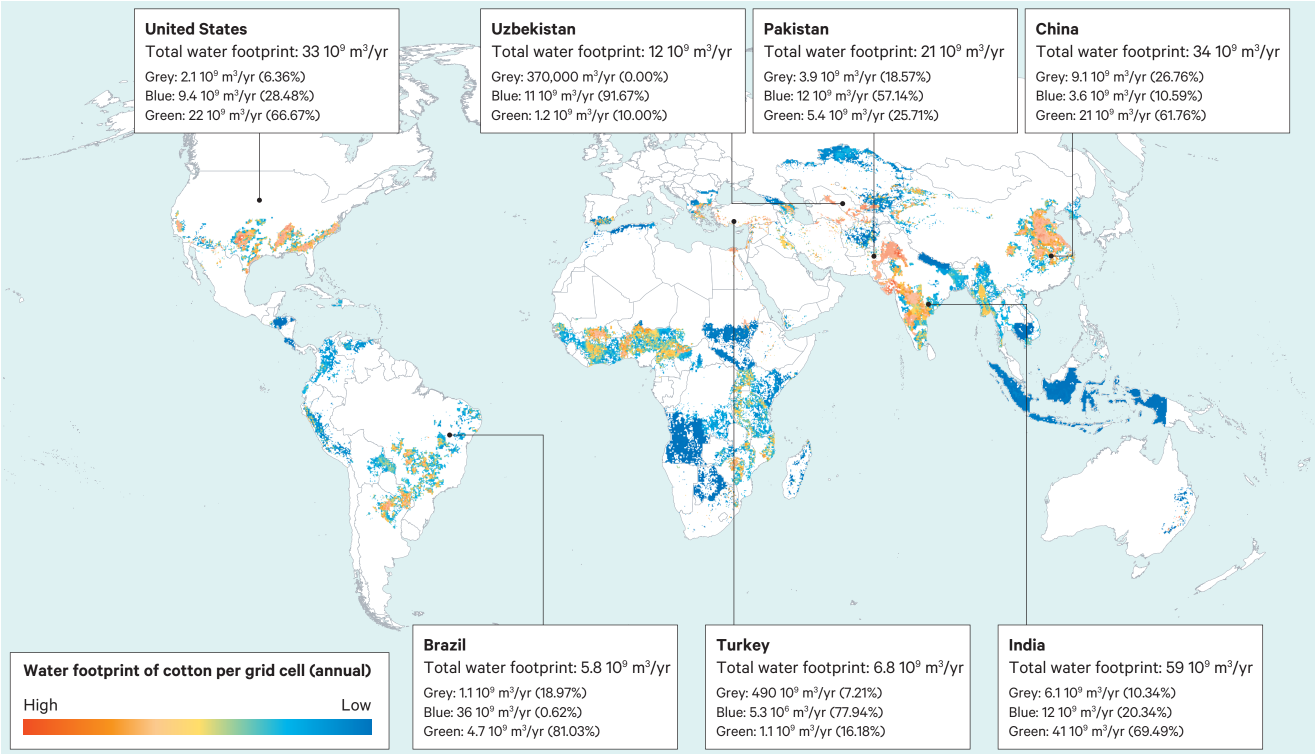
### Water footprint of cotton fibre

Cotton accounts for 3 per cent of the total water footprint (green, blue and grey – the latter based on modelled nitrogen use) of all crop production.[35] Production of cotton is responsible for 8 per cent of the global blue water footprint of all crop production, and for 10 per cent of the total unsustainable blue water footprint.[36] Due to substantial exploitation of surface and groundwater, the unsustainable blue water footprint of global cotton production rose by almost 20 per cent between the periods 1972–76 and 2014–18, from an average of 59.3 billion cubic metres per year ($m^3$/y) to 70.9 billion $m^3$/y.[37] Importing countries are thus reliant on this unsustainable water use in producing countries. In the period 2014–18, for example, 71 per cent of the total global unsustainable blue water used for cotton production was traded virtually.[38] It should be noted, too, that this figure does not include cotton used to manufacture textiles domestically and then exported.

Figure 3 shows the average annual total water footprint (green, blue and grey) of cotton seed production for the period 1996–2005, highlighting the countries with the highest overall footprint values.

**35** The largest contributors are wheat (15 per cent), rice (13 per cent) and maize (10 per cent). Mekonnen, M. M. and Hoekstra, A. Y. (2010), *The green, blue and grey water footprint of crops and derived crop products*, Value of Water Research Report Series No. 47, Delft, UNESCO-IHE, https://www.waterfootprint.org/resources/Report47-WaterFootprintCrops-Vol1.pdf.
**36** Demeke, B. W., Rathore, L. S., Mekonnen, M. M. and Liu, W. (2024), 'Spatiotemporal dynamics of the water footprint and virtual water trade in global cotton production and trade', *Cleaner Production Letters*, 7, 100074, https://doi.org/10.1016/J.CLPL.2024.100074.
**37** Ibid.
**38** Ibid.

**Figure 3.** Total average annual water footprint (green, blue and grey) of global seed cotton production, 1996–2005

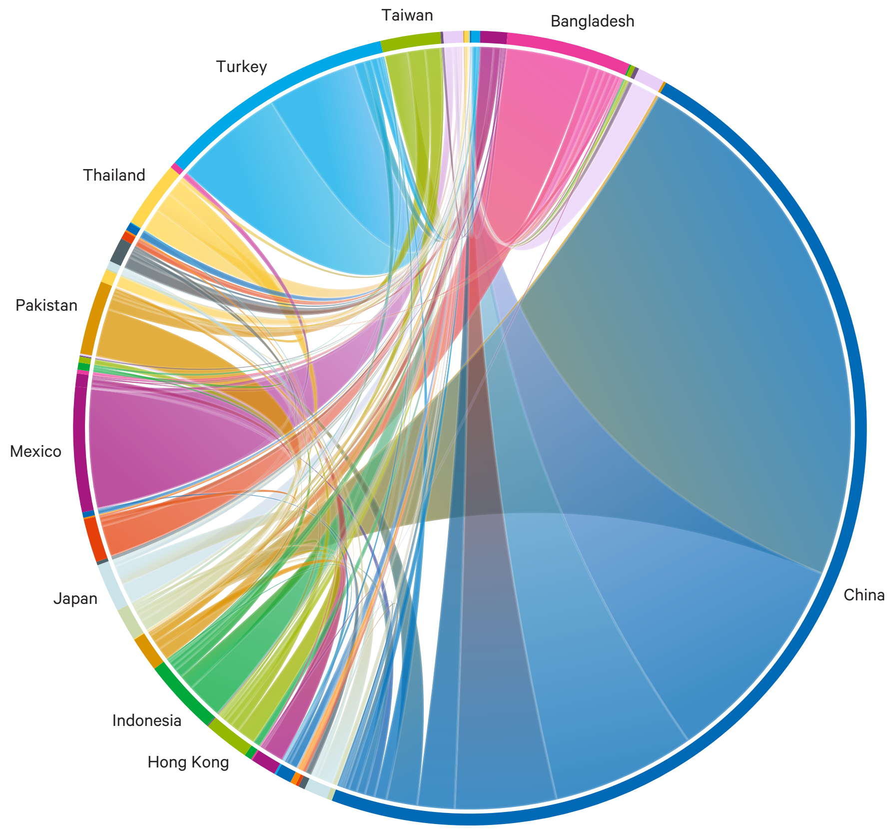



Sources: Water Footprint Assessment Tool, https://www.waterfootprintassessmenttool.org/world/accounting/map/total/328. Data used in the calculation of the water footprints of cotton are drawn from Mekonnen, M. M. and Hoekstra, A. Y. (2010), *The green, blue and grey water footprint of crops and derived crop products*, Value of Water Research Report Series No. 47, Delft, UNESCO-IHE, https://www.waterfootprint.org/resources/Report47-WaterFootprintCrops-Vol1.pdf. The grey water footprint is based on modelled nitrogen use.

In 2015, 42 per cent of the unsustainable virtual water trade from the US was from cotton exports.[39] For the period 2014–18, China had the highest volume of unsustainable blue water imports for cotton production, while India's virtual exports of unsustainable blue water were higher than those of any other country.

**39** Rosa, L. et al. (2019), 'Global unsustainable virtual water flows in agricultural trade', *Environmental Research Letters*, 14, 114001, https://doi.org/10.1088/1748-9326/ab4bfc.

**Figure 4.** Unsustainable blue water footprint of global cotton imports (by volume), 2015

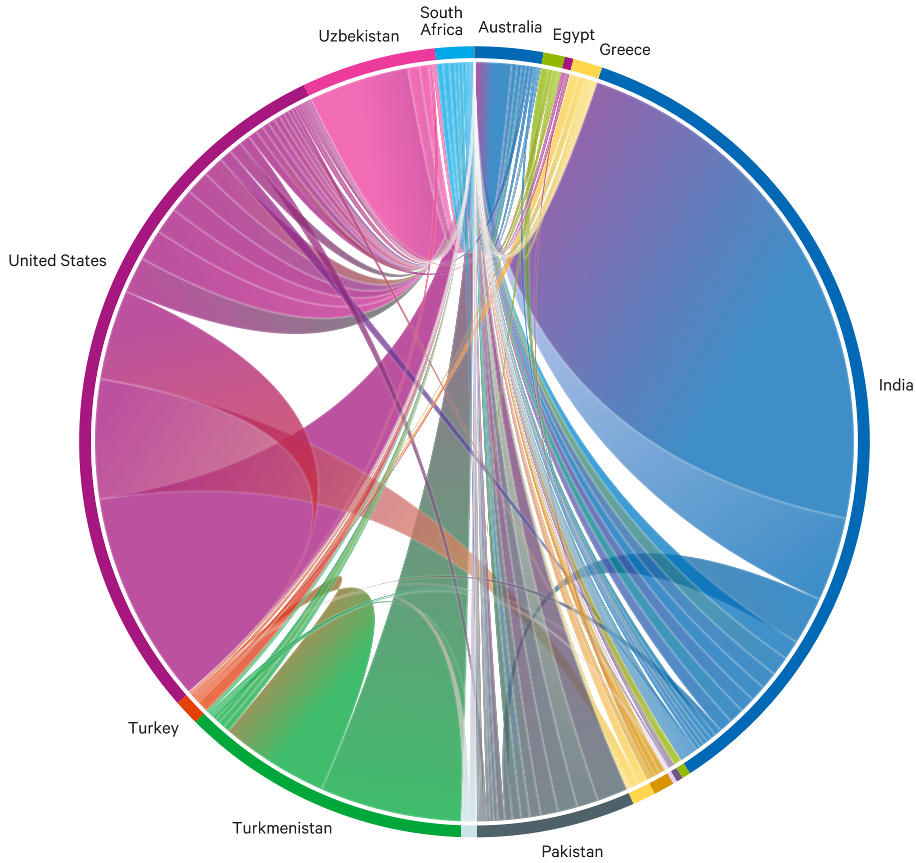



Note: The circumference of the circle represents the volume of unsustainable blue water imports embedded in the global cotton trade. The size of each country's arc is proportional to its import volume. The chord between two countries represents the bidirectional trade; the width of the chord at the end where it meets an importing country's arc represents the share of the volume imported from that country to the other.

Source: Authors' compilation, calculated from Rosa, L. et al. (2019), 'Global Unsustainable Virtual Water Flows in Agricultural Trade', *Environmental Research Letters*, 14(11), 114001, https://doi.org/10.1088/1748-9326/ab4bfc.

Reliance on unsustainable blue water extraction creates multiple risks along the value chain. In China, for instance, cotton imports depend heavily on unsustainable water use occurring in other producing countries (see Figure 4). Meanwhile in India, cotton exports' reliance on overexploitation of freshwater resources for cotton production internalizes the environmental costs of excessive abstraction (see Figure 5). Dependencies on unsustainable blue water extraction can create vulnerability for downstream supply-chain stakeholders to future shocks from changes in water availability and access.

**Figure 5.** Unsustainable blue water footprint of global cotton exports (by volume), 2015




Note: The circumference of the circle represents the volume of unsustainable blue water exports embedded in the global cotton trade. The size of each country's arc is proportional to its export volume. The chord between two countries represents the bidirectional trade; the width of the chord at the end where it meets an exporting country's arc represents the share of the volume exported from that country to the other.

Source: Authors' compilation, calculated from Rosa, L. et al. (2019), 'Global Unsustainable Virtual Water Flows in Agricultural Trade', *Environmental Research Letters*, 14(11), 114001, https://doi.org/10.1088/1748-9326/ab4bfc.

In the years 1972–76, among the major cotton producers, the US had the largest fraction of unsustainable blue water footprint for its cotton production, at 94 per cent, followed by China (89 per cent), Mexico (84 per cent) and Pakistan (79 per cent). Cotton production in these countries contributed to reduced river flows and groundwater levels and related social and environmental impacts. During the period 2014–18, among all cotton producers, Benin had the largest unsustainable blue water footprint fraction, at 91.8 per cent, followed by China (90 per cent), Greece (89 per cent) and Pakistan (88 per cent). That the percentages for China and Pakistan were broadly unchanged between 1972–76 and 2014–18 indicates limited progress towards fair water footprints for cotton in these countries.[40]

**40** Demeke, Rathore, Mekonnen and Liu (2024), 'Spatiotemporal dynamics of the water footprint and virtual water trade in global cotton production and trade'.

Cotton lint has a global combined green and blue water footprint averaging some 6,000 l/kg. In reality, depending on soil, climate and agricultural practices, footprints may vary from around 2,500 l/kg to as much as 40,000 l/kg, although the higher water footprints are largely or completely reliant on green water use.[41] The water footprint of cotton production is expected to grow due to changes in yields from the combined climate change effects of rising temperatures, decreased water availability and higher atmospheric evaporative demand.[42] There may also be greater exposure to pests as a result of climate change, with increased use of pesticides contributing to a larger grey water footprint.[43]

**The water footprint of cotton production is expected to grow due to changes in yields from the combined climate change effects of rising temperatures, decreased water availability and higher atmospheric evaporative demand.**

There is significant variation in the water footprint of cotton depending on where it is grown, climatic factors and the agricultural practices used. This variability can be seen by comparing the share of global production and related blue water footprint of individual producer countries. For example, Pakistan accounted for 8 per cent of all cotton production and 19 per cent of the total global blue water footprint of cotton in 2014–18. Over the same period, India contributed 24 per cent of global production and 30 per cent of the total global blue water footprint. China, in contrast, produced 25 per cent of global cotton, but its contribution to the global blue water footprint of cotton production was only 9 per cent.[44] These percentages indicate a comparative advantage in the production of cotton in China based on the blue water footprint; however, 90 per cent of that blue water footprint is unsustainable. This underscores the need to take multiple criteria into account when assessing the sustainability of production in trade agreements.

Turning to pollution associated with cotton cultivation, depending on the use of fertilizers and pesticides, the grey water footprint can add substantially to the total water footprint of cotton. One comparative study of agricultural practices for cotton in three states in India found grey water footprints ranging from 4,184 l/kg to 338,039 l/kg, representing a range from 50 per cent to nearly 99 per cent of the total water footprint.[45]

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**41** Kranthi, K. R. (2025), *Water Footprint in Cotton 2020-2024: A Global Analysis*, International Cotton Advisory Committee, https://www.icac.org/wp-content/uploads/2025/04/WATER-PAPER-Summary-note.pdf.
**42** Atmospheric evaporative demand is the capacity of the atmosphere to absorb moisture; it can increase the evapotranspiration of plants and draw moisture from soils.
**43** Rani, S. U. et al. (2025), 'Climate change and its impact on cotton production: a systematic literature review', *Journal of Water and Climate Change*, 16(9), pp. 2760–85, https://doi.org/10.2166/wcc.2025.018.
**44** Demeke, Rathore, Mekonnen and Liu (2024), 'Spatiotemporal dynamics of the water footprint and virtual water trade in global cotton production and trade'.
**45** Safaya, S., Zhang, G. and Mathews, R. (2016), *Toward sustainable water use in the cotton supply chain: A comparative assessment of the water footprint of agricultural practices in India*, https://waterfootprint.org/resources/Assessm_water_footprint_cotton_India.pdf. Grey water footprint calculations in this study included data collected on pesticides used by farmers, in contrast to modelled nitrogen use in global water footprint figures.

### **Box 3.** Cotton production – Brazil case study

*This box presents a case study on cotton production in Brazil, and illustrates the benefits that can arise when sustainable agriculture practices are combined with Brazil's comparative advantage related to climate and land availability, along with supportive policies.*

There has been a resurgence in cotton production in Brazil in the 21st century,[46] notably following the establishment, in 1999, of the Brazilian Association of Cotton Producers (Associação Brasileira dos Produtores de Algodão – Abrapa).[47] To promote the expansion and improvement of cotton production in Brazil, Abrapa's focus has been on four areas: quality, traceability, sustainability and promotion. This has led to a turnaround in trade, with Brazil becoming one of the world's leading exporters of cotton. Exports of cotton lint reached a record volume of 2.83 million tonnes in the 2024/25 market year, surpassing those of the US – previously the world's largest exporter – for the first time on record. Brazil's cotton exports generated revenues of $4.85 billion in 2024/25, with Vietnam, Pakistan and China (together accounting for some 52 per cent this total), Bangladesh and Turkey being the five largest importers.[48]

Brazil's success in expanding its production as well as its share of the global cotton market results from a combination of heavy investment in R&D to develop region-specific cotton varieties, precision agriculture, biotechnology and effective pest management. New land was also opened up for cotton production, with support from the Embrapa Cotton Research Center; the states of Mato Grosso and Bahia are now producing, respectively, 73 per cent and 17 per cent of Brazil's cotton fibre.[49]

Prior to the mid-1990s, cotton yields were well below those of the US in particular, and below the world average in general. With the introduction of practices such as no-till farming, cover cropping, mulching, biochar application and crop rotation, which have helped to improve soil fertility and moisture retention and thus reduced run-off, cotton yields are now more than double the world average.[50] In 2024/25, Brazil had the highest cotton yields in the world for non-irrigated crops, at an average of 1.8 tonnes per hectare.[51] Complementing Brazil's comparative advantages of climate and availability of arable land, this success from applying regenerative agricultural practices in the production of cotton demonstrates a viable alternative to conventional cotton farming. This has resulted in substantial economic benefits at a lower water-use-related environmental cost than cotton production elsewhere in the world.

**46** For a detailed study of the history of cotton production in Brazil, see Klein, H. S. and Vidal-Luna, F. (2023), 'The complex evolution of Brazilian cotton production', *América Latina en la historia económica*, 30(2), e1374, https://doi.org/10.18232/20073496.1374.
**47** Abrapa (2025), 'Cotton Brazil Market Report 2025', 15 August 2025, https://cottonbrazil.com/wp-content/uploads/2025/09/ABRAPA-COTTON-BRAZIL-REPORT-2025-08.pdf.
**48** Ibid. The market year aligns with the cotton crop year; 2024/25 refers to exports from 1 August 2024 to 31 July 2025.
**49** Klein and Vidal-Luna (2023), 'The complex evolution of Brazilian cotton production'.
**50** United States Department of Agriculture Economic Research Service (2011), *Brazil's Cotton Industry: Economic Reform and Development*, CWS-11d-01, https://ers.usda.gov/sites/default/files/_laserfiche/outlooks/35849/6125_cws11d01_1_.pdf.
**51** Cotton Brazil (2026), 'Sustainability', https://cottonbrazil.com/sustainability; Cotton Brazil (2026), 'Brazilian cotton', https://cottonbrazil.com/brazilian-cotton.

Brazil's average combined green and blue water footprint for cotton lint is approximately 3,000 litres per kilogramme (l/kg).[52] This is well below the global average of 6,000 l/kg, meaning that Brazilian cotton is comparatively water-efficient per unit of cotton lint produced. Importantly, too, only 9 per cent of all cotton from Brazil is produced in irrigated regions, contributing to its lower blue water footprint.[53]

The introduction and uptake of regenerative agricultural practices have helped reduce the grey water footprint of cotton farming by increasing the soil's biodiversity, making crops more resistant to pests by providing biological control through natural enemies, beneficial microbes and disruption of pest life cycles. In the state of Mato Grosso, after six years of applying regenerative farming, one farming group reported a 48 per cent reduction in the use of chemical pesticides in the 2020/21 growing season.[54]

The Better Cotton Initiative (BCI) maintains the BCI Standard System, which is a holistic approach to sustainable cotton production.[55] Abrapa became a programme partner of BCI in 2010; and in the 2011/12 crop year it launched the Responsible Brazilian Cotton (Algodão Brasileira Responsável – ABR) programme, which promotes sustainable management of farms through the progressive evolution of good social, environmental and economic practices.[56] By 2022/23, 82 per cent of Brazil's cotton lint production (2.55 million tonnes, of total production of 3.1 million tonnes) was BCI-certified – amounting to more than 35 per cent of the certified BCI cotton produced globally.[57]

Brazil has also partnered regionally with Argentina, Bolivia, Colombia, Ecuador, Haiti, Paraguay and Peru through the +Cotton initiative, launched by the UN Food and Agriculture Organization (FAO) in 2013.[58] The initiative brings together government representatives, extension workers, researchers, academics and representatives of farmers' unions and the textile sector, with the shared goal of promoting sustainable cotton production. It works along four axes – sustainable technologies, strategic alliances, social innovation and inclusive markets – and notably recognizes and supports the vital role of women farmers and community members involved in cotton cultivation, processing and marketing.[59] Cotton+ has strengthened family farming through support for smallholder cotton farmers, enabled knowledge transfer of Brazil's technical expertise, promoted local processing and textile value chains, fostered regional networks, and emphasized environmental and social sustainability in cotton production. Such programmes build on the impact of advances in cotton cultivation in Brazil not just through continued support for its sustainable development, but by facilitating knowledge transfer to other cotton-producing countries.

**52** Kranthi (2025), *Water Footprint in Cotton 2020–2024*.
**53** Ibid.
**54** Cotton Brazil (2022), 'Brazil has a Success Story of Regeneratively Grown Cotton', https://cottonbrazil.com/brazil-has-a-success-story-of-regeneratively-grown-cotton.
**55** Better Cotton (undated), https://bettercotton.org.
**56** Cotton Brazil (2021), 'How the Responsible Brazilian Cotton program (ABR) fosters sustainability in farms', 24 June 2021, https://cottonbrazil.com/how-the-responsible-brazilian-cotton-program-abr-fosters-sustainability-in-farms.
**57** Cotton Brazil (2026), 'Sustainability'.
**58** Food and Agriculture Organization of the United Nations (undated), 'Cotton Sector', https://www.fao.org/in-action/program-brazil-fao/projects/cotton-sector/en.
**59** Food and Agriculture Organization of the United Nations (2025), *Gender Dimension in the Cotton Sector: Characterising the Role of Women*, https://openknowledge.fao.org/server/api/core/bitstreams/14ab3870-db52-461c-803a-afd00c4032b7/content.

### Man-made cellulosic fibres

The primary raw material for producing man-made cellulosic fibres (MMCF) is dissolving wood pulp, although MMCF can also be produced from bamboo and cotton.[60] By value, the principal exporters of dissolving wood pulp in 2024 were South Africa, Indonesia, Brazil, the US and Chile; while the largest importers were China, India, Germany, Indonesia and the US.[61] The global market for MMCF is undergoing a rapid expansion, having doubled since 1990, with about 8.4 million tonnes produced in 2024 – representing around 6 per cent of global fibre production.[62] The market share of MMCF has been growing in recent years in response to increasing demand for circularity and sustainability, along with concerns about synthetic microfibre pollution.

Table 3 presents the countries with the highest dissolving wood pulp trade values, based on 2024 data, alongside the level of baseline water stress in the exporting and importing countries.

**Table 3.** Baseline water stress of top five importing and exporting countries (by US dollar value) of dissolving wood pulp

**Dissolving wood pulp**

| | Major exporters | Major importers |
|---|---|---|
| 1 | South Africa | China |
| 2 | Indonesia | India |
| 3 | Brazil | Germany |
| 4 | US | Indonesia |
| 5 | Chile | US |

**Baseline water stress**

Low · Low-medium · Medium-high · High · Extremely high

Note: The trade data drawn on are for dissolving wood pulp HS code 4702. Baseline water stress measures the ratio of total water demand to available renewable water supplies. Water withdrawals include domestic, industrial, irrigation and livestock consumptive and non-consumptive uses. Available renewable water supplies include surface and groundwater supplies and consider the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users.

Source: Authors' compilation. Top five exporters and top five importers for product type from trade data, WITS (2024). Baseline water stress in colour-graded scale from World Resources Institute Aqueduct 4.0 Country Rankings.

**60** 'Dissolving wood pulp' refers to the grade of pulp that can be used in making the cellulosic fibres. It is processed by chemical dissolution, to produce 'dissolved wood pulp'.
**61** Exports: World Integrated Trade Solution (WITS), 'Chemical wood pulp, dissolving grades exports by country in 2024', https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2024/tradeflow/Exports/partner/WLD/product/470200 (accessed 21 Jul. 2026); Imports: World Integrated Trade Solution (WITS), 'Chemical wood pulp, dissolving grades imports by country in 2024', https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2024/tradeflow/Imports/partner/WLD/product/470200 (accessed 21 Jul. 2026).
**62** Textile Exchange (2025), *Materials Market Report 2025*.

Around 80 per cent of MMCF production is viscose (rayon), with a total production volume of 6.7 million tonnes in 2024, followed by cellulose acetate (13 per cent), lyocell (4 per cent), modal (3 per cent) and cupro (0.2 per cent).[63] Around 65 per cent of MMCF production capacity is in the Asia-Pacific region, with China and Indonesia being key hubs.[64]

#### Water footprint of MMCF

The water footprint of viscose can range from around 1,000 l/kg for staple fibres to 3,500 l/kg for filament yarn using batch washing, and 30,000 l/kg using continuous washing.[65] In all cases, the grey water footprint is over 90 per cent of the total, reflecting the chemical-intensive processing that can contribute to water pollution through the discharge of untreated or inadequately treated effluents.

### Textile wet processing

Wet processing includes textile washing, dyeing (bleaching or scouring, dye application and post-dye wash-off) and finishing processes, and represents a major source of water consumption and pollution along the textile value chain. Each of these processes uses chemical agents that, if left untreated or inadequately treated, can contaminate rivers, lakes and aquifers, impacting workers along with local communities and biodiversity.

**Approximately half of the water consumed in the textile garments supply chain is in the wet processing and garment production phase.**

Approximately half of the water consumed in the textile garments supply chain is in the wet processing and garment production phase.[66] The scale of water consumption depends on the product and the process, with more water generally required for natural fibres compared with synthetics. Estimates of water consumption in linear facilities with effluent discharge can vary from 40 l/kg of fabric to 500 l/kg. In a facility with water recycling, the water consumption will be lower; whereas in a zero liquid discharge facility, it can be less than 10 l/kg.[67] One study of industrial water uses in Bangladesh estimated average factory water consumption of 250–300 l/kg of fabric produced.[68]

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**63** Ibid.
**64** Business Insights (2025), *Dissolving Wood Pulp (DWP) Market, Global Outlook and Forecast 2023–2035*, 10 September 2025.
**65** Freitas, Zhang and Mathews (2017), *Water Footprint Assessment of polyester and viscose and comparison to cotton*. Note: Batch washing is a stop-and-hold process where fabric or yarn is washed in discrete lots inside a machine, with liquor filled, agitated, and drained in cycles. Continuous washing is an uninterrupted process where fabric moves through successive wash or rinse stages. Continuous washing requires larger amounts of zinc input.
**66** Arup (2019), *An analysis of industrial water use in Bangladesh with a focus on the leather and textile industries*, https://www.textilepact.net/wp-content/uploads/2019/12/an_analysis_of_industrial_water.pdf.
**67** A conventional facility uses fresh water once and discharges wastewater without significant recovery or reuse. A linear facility with water recycling reuses process water internally, but wastewater is still discharged after partial recovery. A zero liquid discharge facility is a closed-loop system that recovers and reuses all process water, leaving no liquid effluent; remaining dissolved solids are removed as a dry residue.
**68** Arup (2019), *An analysis of industrial water use in Bangladesh with a focus on the leather and textile industries*.

The washing-dyeing-finishing stages contribute to the textile industry's grey water footprint, with a lack of effective wastewater treatment systems in many manufacturing facilities causing the release of untreated or partially treated effluents.[69] Even where adequate wastewater treatment facilities exist, these can be expensive to run and require adequate monitoring and incentivization to operate effectively. Large volumes of untreated effluents can be discharged directly into rivers and lakes, subsequently entering groundwater. Conventional dyeing techniques involving large volumes of water mixed with chemical dyes, salts and fixing agents lead to substantial wastewater generation.[70] The effluent from these processes can contain hazardous heavy metals, carcinogenic amines, chlorine-based and peroxide-based bleaching agents and persistent organic pollutants; if not treated properly, these can enter freshwater systems, posing risks to both aquatic ecosystems and human health.[71] Since the complex chemical compositions used in textile dyes do not readily degrade naturally, they can accumulate in the environment. The discharge of chemicals such as oils, waxes and pectin from cotton or starch sizing used in the weaving process, while biodegradable, can lead to catastrophic de-oxygenation and the formation of hypoxic areas within water bodies, where oxygen levels are too low to support aquatic life. Additionally, use of salts in dyeing and finishing processes alters the chemical composition of water, increasing its salinity and making it unsuitable for human consumption or irrigation.

### **Box 4.** Textile wet processing – Bangladesh case study

*This box presents a case study on the growth of the washing-dyeing-finishing industry in Bangladesh, and the related challenges of overconsumption of groundwater and wastewater pollution of surface waters. It highlights the trade-offs between economic growth and water security for communities surrounding industrial clusters.*

Bangladesh's rise to become the world's second largest apparel exporter, first achieved in 2010, is one of the most striking development stories of recent decades.[72] From a modest base in the early 1980s, the ready-made garment (RMG) sector generated over $38.48 billion in 2024,[73] and contributed 8.5 per cent of the country's gross domestic product.[74] In the 2024/25 financial year, Bangladesh's apparel sector contributed 81.5 per cent of the country's total export earnings.[75] Textiles are Bangladesh's largest

**69** Sakamoto, M., Ahmed, T., Begum, S. and Huq, H. (2019), 'Water Pollution and the Textile Industry in Bangladesh: Flawed Corporate Practices or Restrictive Opportunities?' *Sustainability*, 11(7), 1951, https://doi.org/10.3390/su11071951.
**70** Azanaw, A., Birlie, B., Teshome, B. and Jemberie, M. (2022), 'Textile effluent treatment methods and eco-friendly resolution of textile wastewater', *Case Studies in Chemical and Environmental Engineering*, 6, 100230, https://doi.org/10.1016/j.cscee.2022.100230.
**71** Dutta, S. et al. (2024), 'Contamination of textile dyes in aquatic environment: Adverse impacts on aquatic ecosystem and human health, and its management using bioremediation', *Journal of Environmental Management*, 353, 120103, https://doi.org/10.1016/j.jenvman.2024.120103.
**72** Mirdha, R. U. (2025), 'Bangladesh retains 2nd spot in global apparel exports', *Daily Star*, 8 July 2025, https://www.thedailystar.net/business/news/bangladesh-retains-2nd-spot-global-apparel-exports-3935421.
**73** Apparel Views (2025), 'Bangladesh garment exports grow 7.23% in 2024 despite domestic and global challenges', 16 January 2025, https://www.apparelviews.com/bangladesh-garment-exports-grow-723-in-2024-despite-domestic-and-global-challenges; Bangladesh Garment Manufacturers and Exporters Association (2025), 'Export Performance: Comparative Statement on Export of RMG & Total Export of Bangladesh', https://www.bgmea.com.bd/page/Export_Performance.
**74** World Bank (2024), 'GDP (current US$) – Bangladesh', World Bank Open Data, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=BD (accessed 27 Apr. 2026).
**75** Bangladesh Garment Manufacturers and Exporters Association (2025), 'Export Performance', https://www.bgmea.com.bd/page/Export_Performance.

industrial sector and second largest employer after agriculture.[76] The sector directly employs 4.1 million workers, some 65 per cent of whom are women – many of them young women from migrant or marginalized ethnic groups.[77]

In the 1980s and 1990s, Bangladesh's role in the global apparel sector was largely in cut-make-trim (CMT) operations using imported fabrics. From the 2000s, massive investment in washing, dyeing and finishing capacity allowed the country to capture more value domestically. By 2010, for instance, over 90 per cent of knitwear exports were supported by local wet processing, compared with less than 20 per cent in the early 1990s.[78] But Bangladesh's transformation into a textile 'powerhouse' also locked the industry into a model of intensive groundwater abstraction and chemical use. Simply put, every T-shirt manufactured and exported carries not only cotton and colour, but also hundreds of litres of groundwater drawn from one of the world's most stressed aquifers.

Bangladesh's textile sector is centred in 10 industrial clusters in and around the capital, Dhaka. The primary water source is groundwater, with about 1,500 million cubic metres extracted annually for industrial use in Bangladesh.[79] Groundwater also supplies 87 per cent of all the capital's drinking water. Dhaka WASA, the city's water utility, depends on groundwater for 80 per cent of its supply, creating direct competition between factories and households. In peri-urban communities near textile hubs, shallow tube wells often run dry, forcing families to drill deeper or purchase water at high cost. The dependence on groundwater for households, industry – primarily textiles – and agriculture is exceeding recharge rates that would keep groundwater levels stable.[80] As the distance to the groundwater table increases, costs for pumping also grow; these costs are disproportionately more onerous for lower-income households. The combined demands for water have led to the groundwater level declining an average of 2.5 metres per year in the textile cluster areas, threatening industrial and agricultural water uses as well as household drinking water supply. One study published in 2021 projected an increase in the average depth of the groundwater table in some clusters from about 78 m to 132 m by 2030, with an annual depletion rate of 5.1 m.[81] The quality of the groundwater is also deteriorating, requiring costly pretreatment and contributing to increased water consumption per kg of textile due to water losses during pre-treatment.

The wet processing stage of textile production is heavily polluting. A variety of substances are used in each of the stages of washing, dyeing and finishing, among them salts and alkalis, dyes, formaldehyde and, for durable water-repellent finishes,

**76** Nahar, N., Haque, M. S. and Haque, S. E. (2024), 'Groundwater conservation, and recycling and reuse of textile wastewater in a denim industry in Bangladesh', *Water Resources and Industry*, 31, 100249, https://doi.org/10.1016/j.wri.2024.100249.
**77** Bangladesh Garment Manufacturers and Exporters Association (2021), *BGMEA Sustainability Report 2020*, Dhaka: BGMEA, https://download.bgmea.com.bd/BGMEA%20Sustainability%20Report%202020.pdf.
**78** World Bank (2019), *Toward Greater Diversification and Value Addition in Bangladesh's Textile Sector*, Washington, DC: World Bank.
**79** 2030 Water Resources Group, World Bank (2019), An Analysis of Industrial Water Use in Bangladesh, Dhaka: World Bank.
**80** Parvin, M. (2019), 'The Rate of Decline and Trend Line Analysis of Groundwater underneath Dhaka and Gazipur City', *Journal of Water Resource and Protection*, 11, pp. 348–56, https://doi.org/10.4236/jwarp.2019.113020.
**81** Haque, M. S., Nahar, N. and Sayem, S. M. (2021), 'Industrial water management and sustainability: Development of SIWP tool for textile industries of Bangladesh', *Water Resources and Industry*, https://doi.org/10.1016/j.wri.2021.100145.

PFAS (per- and polyfluoroalkyl substances). Untreated effluents discharged into rivers such as the Buriganga and Shitalakshya degrade surface water quality, further undermining safe drinking water access.[82]

The costs of such water use – falling groundwater tables, polluted rivers, household water insecurity and land subsidence – are borne locally, while the benefits of cheap clothing accrue globally. Jobs in the sector are often low paid and have poor labour protection, with insufficient access to safe and adequate water, sanitation and hygiene (WASH) facilities. Neighbouring communities are vulnerable to contamination of their primary water sources by wastewater from factories.

In some instances, global buyers have pushed for compliance with initiatives such as the ZDHC (Zero Discharge of Hazardous Chemicals) Foundation's Roadmap to Zero Programme, which restricts toxic inputs and sets wastewater guidelines.[83] Larger, export-oriented factories have invested in effluent treatment plants (ETPs), water recycling and chemical substitution to meet these standards. However, many small and medium-sized enterprises (SMEs) lack incentives to comply, creating a two-tier industry. National groundwater licensing and enforcement remain weak, and cluster-level solutions such as centralized ETPs are still limited.

Greater investment in cluster-level infrastructure, stricter groundwater governance and transparent benchmarking of water use could help safeguard both industry and communities. Importing countries and global brands that benefit from Bangladesh's exports could themselves co-invest in water-saving technologies, wastewater treatment and aquifer recharge. Critically, too, trade agreements and buyer commitments could embed such shared responsibility, ensuring that the costs of sustainability are borne not solely by producers, but also by consumers of Bangladesh's textile exports.

### Trade in finished textiles

Following the washing, dyeing and finishing processes, finished textiles, including (but not limited to) ready-made garments and other ready-to-use goods, are distributed for local use or traded internationally. China is by far the largest exporter of finished textiles, with exports valued at some $290–294 billion in 2023.[84] The largest importers are the EU (before disaggregation), the US and the UK.[85]

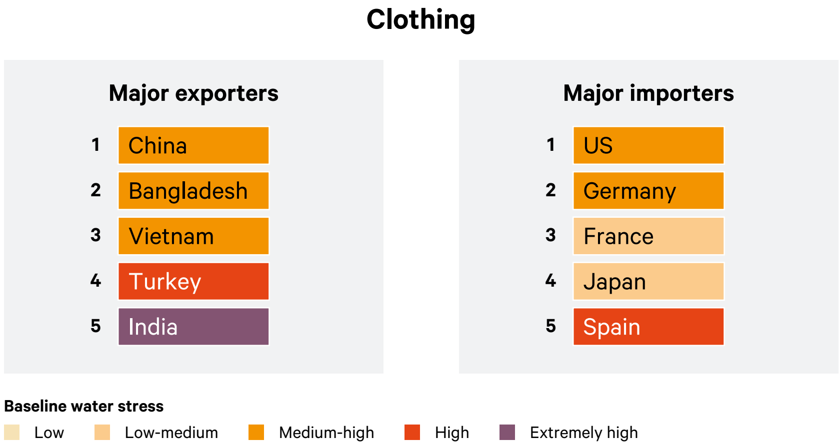
Intra-Asian trade flows are also significant, as finished textiles move between China, South Korea, Japan, Bangladesh, Vietnam, India and Pakistan. For countries such as Bangladesh and Pakistan, the textile sector is central to the economy. In the case

**82** Hossain, M. A. and Hossain, M. I. (2020), 'The Environmental Impacts of Textile Dyeing Industries in Bangladesh', *International Research Journal of Advanced Engineering and Science*, 5(2), pp. 113–16, https://irjaes.com/wp-content/uploads/2020/10/IRJAES-V5N2P97Y20.pdf.
**83** For resources, see ZDHC Foundation (2026), 'Roadmap to Zero: Paving the way for sustainable chemical management within the fashion industry'. https://www.roadmaptozero.com.
**84** State Council Information Office of the People's Republic of China 2024 (2024), 'China's textile industry profits up 7.2% in 2023', 4 February 2024, http://english.scio.gov.cn/pressroom/2024-02/04/content_116985104.htm; World Integrated Trade Solution (2026), 'China Product Exports 2023 > Textiles and Clothing', https://wits.worldbank.org/CountryProfile/en/Country/CHN/Year/2023/TradeFlow/Export/Partner/All/Product/50-63_TextCloth (accessed 21 Jul. 2026).
**85** Authors' calculations from World Integrated Trade Solution data, via https://wits.worldbank.org/CountryProfile/en/Country/WLD/Year/2023/TradeFlow/Export/Partner/ALL/Product/50-63_TextCloth (accessed 23 Jul. 2026).

of Bangladesh, textiles account for 80–85 per cent of total export revenue.[86] For Pakistan, export earnings from textiles and apparel amount to some $16 billion–$17 billion annually,[87] and contributed approximately 60 per cent of the country's export earnings in 2023.[88]

Table 4 presents the countries with the highest clothing trade values, based on 2024 data, alongside the level of baseline water stress in the exporting and importing countries. The table draws on clothing trade data specifically (HS code chapters 56–63), and excludes other non-clothing textile products. (See the note accompanying the table for more information.)

**Table 4.** Baseline water stress of top five exporting and importing countries (by US dollar value) of global clothing trade




Note: The trade data drawn on are for HS code chapters 56–60 – Fabric Materials, 61 – Knitted or Crocheted apparel items, 62 – Woven apparel or accessories, 63 – Other made-up textile articles. HS code chapters 50–55 – Raw fibres are not included in these figures. Baseline water stress measures the ratio of total water demand to available renewable water supplies. Water withdrawals include domestic, industrial, irrigation and livestock consumptive and non-consumptive uses. Available renewable water supplies include surface and groundwater supplies, and consider the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users.

Source: Authors' compilation. Top five exporters and top five importers for product type from trade data, WITS (2024). Baseline water stress in colour-graded scale from World Resources Institute Aqueduct 4.0 Country Rankings.

**86** Siddiqi, D. M. (2025), *What's happening in Bangladesh's garment industry?* Economics Observatory, 26 March 2025. https://www.economicsobservatory.com/whats-happening-in-bangladeshs-garment-industry; Bangladesh Garment Manufacturers and Exporters Association (2025), 'Export Performance' [2024/25 fiscal year], https://www.bgmea.com.bd/page/Export_Performance; Workman, D. (2025), *Bangladesh's Top Exports 2024*, https://www.worldstopexports.com/bangladeshs-top-10-exports.
**87** Nasir, S. et al. (2025), 'Critical evaluation of the textile industry of Pakistan and way forward', Khyber Journal of Public Policy, 4(1), https://www.nipapeshawar.gov.pk/KJPPM/PDF/CIP/RG-9.pdf.
**88** Khan, A. R. (2025), *Greening the Textile Industry: An Analysis of the Policy Landscape of Pakistan*, Project Paper No 2, UNCTAD, https://unctad.org/system/files/information-document/unda2030d02-pakistan-textile-industry_en.pdf.

## Consumer use

The water footprint of textiles extends beyond production into consumer use and disposal. In the case of the EU, total household purchases of consumer textiles (clothing, footwear and household textiles) in 2022 were based on the extraction and use of some 234 million tonnes of raw materials, equivalent to an average of 523 kg per person.[89] This volume of textiles is estimated to have required about 5,300 million $m^3$ of blue water, equivalent to around 12$m^3$ per person.[90] However, around 85 per cent of the blue water use for fibre production and manufacturing to fulfil EU demand for textiles takes place elsewhere, mainly in Asia.[91]

Laundry processes contribute to ongoing freshwater consumption, although advances in efficiency have been shown to drive significant reductions in water consumption in recent decades. For washing machines sold across the EU, for instance, current design regulations have reduced average water consumption per wash cycle to approximately 9 l/kg of clothing in 2020, from 32 l/kg in 1990.[92]

**Around 85 per cent of the blue water use for fibre production and manufacturing to fulfil EU demand for textiles takes place elsewhere, mainly in Asia.**

Washing any fabric releases microfibres into wastewater streams, which pass through treatment facilities or directly enter natural water bodies. In addition to laundering during consumer use, significant microfibre release occurs in the initial washing of textiles during washing, dyeing and finishing phases of production. Microfibres persist in the environment and can release dyes and other chemicals, further contributing to long-term pollution. This can cause risks for human and environmental health, and increases the upfront investment required for effective wastewater treatment to mitigate contamination of water sources. Synthetic fibres in particular shed microplastics into water and the air, through washing, wear and abrasion. Globally, an estimated 200,000–500,000 tonnes of microplastics from textiles enter the marine environment every year,[93] and synthetic textiles are estimated to contribute 16–35 per cent of all microplastics entering the oceans.[94]

Before products enter the largest consumer markets, the most significant water-related impacts are concentrated in the regions where raw materials used to meet international demand for textiles are produced and processed. This means that the most severe water impacts of consumer demand are often 'outsourced'

**89** Saskia, M. et al. (2025), *Textiles and the environment – The role of digital technologies in Europe's circular economy*, European Topic Centre on Circular economy and resource use, p. 22, https://www.eionet.europa.eu/etcs/etc-ce/products/etc-ce-report-2025-6-textiles-and-the-environment-2013-the-role-of-digital-technologies-in-europe2019s-circular-economy.
**90** Ibid., p. 23.
**91** Ibid.
**92** European Commission (undated), 'Washing Machines: Energy labelling and ecodesign requirements apply to this product: https://energy-efficient-products.ec.europa.eu/product-list/washing-machines_en.
**93** European Environment Agency (2022), 'Microplastics from textiles: towards a circular economy for textiles in Europe', Briefing, https://www.eea.europa.eu/en/analysis/publications/microplastics-from-textiles-towards-a-circular-economy-for-textiles-in-europe.
**94** Ibid.

to areas far from the consumer. In contrast, consumer regions that are the primary drivers of global markets for textiles experience far fewer direct impacts on their water resources, and remain insulated from the worst effects of still-growing demand to manufacture textiles. This spatial disconnect limits consumer awareness of the social and environmental consequences of their purchasing decisions.

## Downstream textile waste and circularity

### Used textiles (including worn clothing and other household or consumer textile articles)

Global growth in textile consumption also contributes to increased trade in used textiles and greater end-of-life impact, creating an opportunity to redistribute garments to regions with high demand for reuse, therefore extending their lifespan. Each year, millions of tonnes of used and surplus garments flow from wealthier countries in Europe, North America and East Asia into markets across Africa, South Asia, Latin America and Eastern Europe.[95] While this trade is typically framed as a form of reuse and affordability, there is mounting evidence that much of it functions as waste displacement, shifting environmental and economic burdens of processing waste from textile consumption in parts of the Global North to importing countries in the Global South. A significant share of shipments of 'secondhand clothing' is little more than textile waste disguised as trade.[96]

As used textiles have become a growing component of global trade, so have the ecologically and socially harmful consequences that arise in practice. In 2024, the top exporters of used clothing were the US, China, the UK, South Korea and Pakistan. The top importers were Pakistan, Guatemala, Kenya, Ukraine and Chile.[97] Table 5 presents the countries with the highest used textile trade values, based on 2024 data, alongside baseline water stress in the exporting and importing countries.

**95** Niinimäki, K. et al. (2020), 'The environmental price of fast fashion', *Nature Reviews Earth & Environment*, 1, pp. 189–200, https://doi.org/10.1038/s43017-020-0039-9.
**96** United Nations Environment Programme (2023), *Sustainability and Circularity in the Textile Value Chain – A Global Roadmap*, https://www.unep.org/resources/publication/sustainability-and-circularity-textile-value-chain-global-roadmap.
**97** Exports: World Integrated Trade Solution (WITS), 'Worn clothing and other worn articles exports by country in 2024', https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2024/tradeflow/Exports/partner/WLD/product/630900; Imports: World Integrated Trade Solution (WITS) 'Worn clothing and other worn articles imports by country in 2024', https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2024/tradeflow/Imports/partner/WLD/product/630900 (accessed 23 Jul. 2026).

**Table 5.** Baseline water stress of top five exporting and importing countries (by US dollar value) of used textiles

**Used textiles**

| | Major exporters | Major importers |
|---|---|---|
| 1 | US | Pakistan |
| 2 | China | Guatemala |
| 3 | UK | Kenya |
| 4 | South Korea | Ukraine |
| 5 | Pakistan | Chile |

**Baseline water stress**

Low | Low-medium | Medium-high | High | Extremely high

Note: The trade data drawn on are for worn clothing and other worn articles HS code 630900. Baseline water stress measures the ratio of total water demand to available renewable water supplies. Water withdrawals include domestic, industrial, irrigation and livestock consumptive and non-consumptive uses. Available renewable water supplies include surface and groundwater supplies and considers the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users.

Source: Authors’ compilation. Top five exporters and top five importers for product type from trade data, WITS (2024). Baseline water stress in colour-graded scale from World Resources Institute Aqueduct 4.0 Country Rankings.

Many imported used textiles cannot be resold because of poor quality and/or sheer volume, often leading to disposal by open burning or dumping at unmanaged sites.[98] High and growing volumes of synthetic textiles – fossil fuel-based and non-biodegradable – also pose increasing end-of-life pollution risks to water, air and soil.

Low recycling rates further compound this challenge. The overall demand for recycled fibres was 7.6 per cent in 2024, having peaked at 8.5 per cent in 2021. Output is dominated by recycled polyester, which accounted for 6.9 per cent of global fibre production in 2024 – 98 per cent of this being derived from PET plastic bottles.[99] With recycling infrastructure not keeping pace with demand, and given poor uptake in fibre-to-fibre recycling,[100] most synthetic waste ends up in landfill rather than being used as feedstock for new products. Less than 1 per cent of global fibre production was from the recycling of pre- and post-consumer textile waste in 2024.[101] True fibre-to-fibre recycling, to turn used textiles into new fibres, remains negligible.

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**98** European Environment Agency (2024), ‘The destruction of returned and unsold textiles in Europe’s circular economy’, Briefing, https://www.eea.europa.eu/en/analysis/publications/the-destruction-of-returned-and-unsold-textiles-in-europes-circular-economy.
**99** Textile Exchange (2025), *Materials Market Report 2025*.
**100** The term fibre-to-fibre recycling is used to describe recycling routes in which fibres, polymers or monomers are recovered to be reintroduced into new textile fibres. See Silva, A. C. et al. (2026), ‘Fibre-to-Fibre Recycling in Textiles: Strategies, Limitations and Industrial Perspectives’, *Textiles*, 6(1), 30, https://doi.org/10.3390/textiles6010030.
**101** Textile Exchange (2025), *Materials Market Report 2025*. Pre-consumer textile waste refers to the waste generated before consumer use (e.g. fabric scraps, defective or damaged goods, overproduction, selvages and trimmings).

Despite initial investments in using recycled PET bottles in fibre production as a viable alternative to virgin fossil-based synthetics, turning high-grade PET bottles into low-grade synthetic textiles – which are prone to microplastic shedding and unlikely to be further recycled – does not truly address the broader plastic waste problem.[102] Greater recognition of closed-loop recycling as a means of strengthening circularity has prompted some clothing brands to move away from recycled polyester made from PET bottles. Instead, they are investing in closed-loop recycling and committing to a 30 per cent fibre-to-fibre polyester goal from recycled textile waste by 2030.[103]

Existing customs codes categorize worn clothing broadly, stopping short of differentiating between reusable material of good quality and degraded materials. (See Box 5 for a fuller discussion of the dynamics of the used textiles trade and shifting of responsibilities.) With inadequate regulatory enforcement and underinvestment in recycling and reuse, importing countries can struggle to direct the high volumes of used textiles they receive to profitable uses.

### Water footprint of pre- and post-consumer textile waste

Robust and standardized quantitative data on water footprints for pre- and post-consumer textiles waste are limited. While some methodologies do exist to estimate water use at this stage, they are normally embedded in life cycle assessments of specific products and case-specific assumptions around garment care and end-of-life processes. Therefore, water-related impacts are qualitatively discussed here for pre- and post-consumer textiles.

The rising consumption of textiles not only drives high water use and pollution levels during production and processing; it also amplifies downstream risks. From the limited data that are available on the scale of pre-consumer textile waste, it is estimated that as much as 25 per cent of the fabric used in manufacturing is discarded during the garment production process;[104] and industry estimates suggest that excess stock represented a loss, in terms of sales value, of between $70 billion and $140 billion in 2023.[105] Of the expected 15.2 million tonnes of textile waste generated in the EU in 2025, around 13.3 million tonnes was post-consumer textiles,[106] equivalent to roughly 26 kg per person.[107]

After consumer use, improper disposal of discarded textiles contributes to multiple water-related challenges. For example, in many low- and middle-income countries, poor waste collection and recycling systems mean that discarded textiles frequently end up in uncontrolled landfills, burning sites or unauthorized dumps. Such

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**102** Shen, L., Worrell, E. and Patel, M. K. (2010), 'Open-loop recycling: A LCA case study of PET bottle-to-fibre recycling', *Resources, Conservation and Recycling*, 55(1), pp. 34–52, https://doi.org/10.1016/j.resconrec.2010.06.014.
**103** Sustainability Directory (2025), 'Major Brands Commit to True Clothing Recycling, Ending Bottle-Based Polyester', 21 October 2025, https://news.sustainability-directory.com/fashion/major-brands-commit-to-true-clothing-recycling-ending-bottle-based-polyester.
**104** De Silva, R. (2023), 'Waste isn't waste until we waste it', https://circulareconomy.europa.eu/platform/sites/default/files/2023-10/WearnRepair_casestudy.pdf.
**105** Balchandani, A. et al. (2024), *The State of Fashion 2025*, The Business of Fashion and McKinsey & Company, p. 15, https://www.mckinsey.com/industries/retail/our-insights/state-of-fashion-2025.
**106** Boston Consulting Group (2026), *Advancing textile circularity Europe's textile waste surge: The case for a system level scale up*, p. 9, https://circulareconomy.europa.eu/platform/en/knowledge/advancing-textile-circularity-europes-textile-waste-surge-case-system-level-scale.
**107** Authors' calculation, based on January 2025 EU27 population data.

environments facilitate the leaching of dyes, microfibres and hazardous chemicals into soils and water bodies, and contribute to air pollution when discarded textiles are burned.

The recycling of textiles, though a potential avenue for reducing reliance on virgin materials, still presents challenges for freshwater use and requires accelerated technological innovation. Chemical recycling, which dissolves fibres into their original components for repurposing, is more effective in maintaining fibre quality, but often requires significant water usage. Pre-processing and chemical recycling of synthetic fibres and dissolution of MMCFs are particularly water-intensive processes. Additionally, the wastewater generated from chemical recycling processes contains dyes, synthetic polymers and chemical residues that require specialized treatment to be safely discharged. Mechanical recycling, which involves shredding old textiles into fibres, is less water-intensive but has limitations in fibre quality and durability unless accompanied by better product design. Recycling is one component of circularity, and when combined with reuse, repair and resale, it reduces reliance on much more water-intensive virgin fibres and lowers total freshwater demand over the full life cycle.

**Recycling is one component of circularity, and when combined with reuse, repair and resale, it reduces reliance on much more water-intensive virgin fibres and lowers total freshwater demand over the full life cycle.**

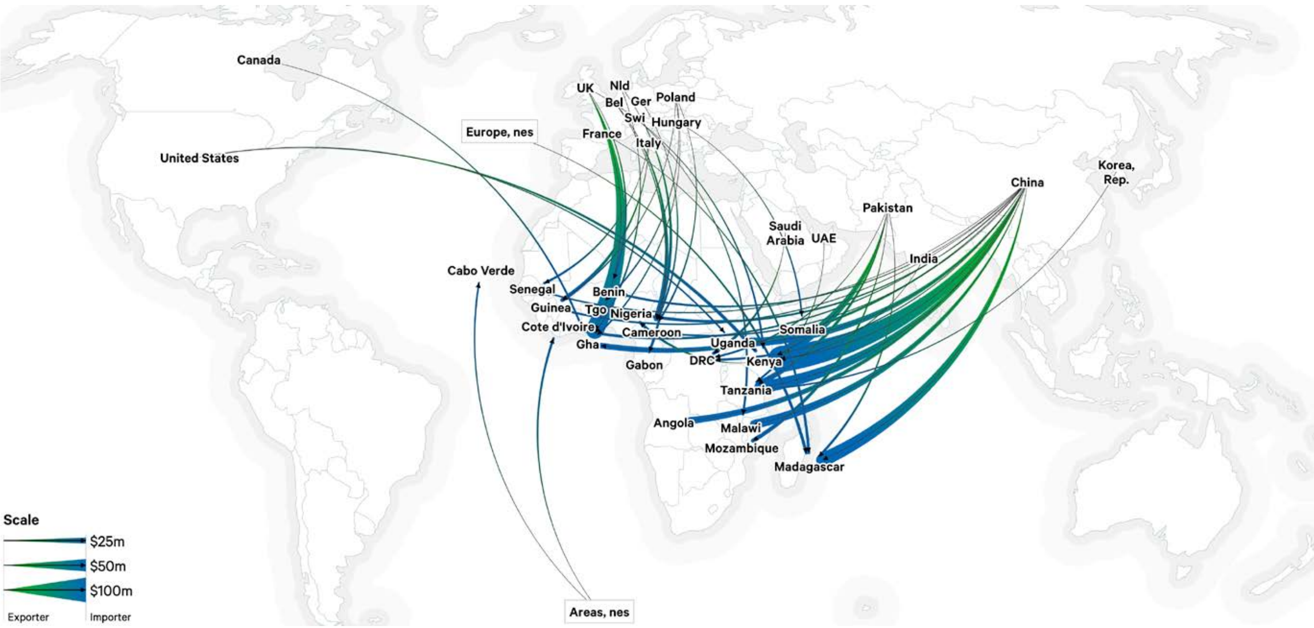
The sheer volume of end-of-life textiles exported for recycling often means that importing countries receive quantities of used textiles beyond their capacity to reuse or recycle, resulting in excessive uncontrolled waste. In Ghana, for instance, textile waste dumped on the banks of the Korle Lagoon has clogged waterways and leached contaminants into the marine environment;[108] while in Chile's Atacama Desert, more than 39,000 tonnes of clothing are dumped annually, contaminating soil and water and releasing toxins when burned.[109] Within Europe, an investigation into one used textiles supply chain found that second-hand clothing entering Romania under the banner of 'reuse' was, in some cases, dirty, stained or unsorted waste. Local communities reported illegal dumping in fields and rivers; while in some of the poorest areas, households burned jeans and shoes for heating, releasing toxic fumes into the air.[110]

**108** Nkatha, K. (2023), 'How fast fashion is fuelling the fashion waste crisis in Africa', Greenpeace, 21 November 2023, https://www.greenpeace.org/africa/en/blog/54589/how-fast-fashion-is-fuelling-the-fashion-waste-crisis-in-africa.
**109** Johnson, S. (2024), 'Castoffs to catwalk: Chile's vast clothes dump visible from space', *The Guardian*, 8 May 2024, https://www.theguardian.com/global-development/article/2024/may/08/castoffs-to-catwalk-fashion-show-shines-light-on-vast-chile-clothes-dump-visible-from-space.
**110** Ciurcanu, A. (2024), 'How Europe's Secondhand Clothes Are Trashing Romania', Organized Crime and Corruption Reporting Project, 19 November 2024, https://www.occrp.org/en/investigation/how-europes-secondhand-clothes-are-trashing-romania.

There are emerging policy responses. The EU's Strategy for Sustainable and Circular Textiles introduced binding ecodesign requirements to ensure garments are durable, repairable and recyclable. It mandates extended producer responsibility (EPR) schemes, requiring producers to finance collection and recycling, and proposes a Digital Product Passport to improve traceability. Crucially, it also seeks to deter burden-shifting by restricting exports of textile waste outside the EU.[111] UNEP's global roadmap echoes these calls, urging reforms to customs coding, quality standards for exports, and investment in domestic reuse and recycling infrastructure.[112] To ensure that exported textiles enter the circular economy, trade policy itself must be aligned with circular economy goals, ensuring that exports support – rather than undermine – domestic circularity in importing countries.[113]

The story of trade in used clothing is thus not one of simple reuse, but of global inequalities, regulatory blind spots and unclear definitions. Without reform, it risks continuing as a waste export system in disguise, with attendant water impacts. However, with harmonized legal definitions, robust enforcement and EPR requirements, along with investment in local circular economies, importing countries could shift from being dumping grounds to hubs of repair, upcycling and recycling. The challenge is to ensure that circularity is not only about closing material loops, but also about accountability, fairness – including gender equity and empowerment of marginalized peoples – and shared responsibility across borders.

**Figure 6.** Global exports of used and waste textiles to sub-Saharan Africa, by value, 2024




Source: Chatham House circulareconomy.earth (2026).

**111** European Commission (undated), 'Sustainable and Circular Textiles Strategy', https://environment.ec.europa.eu/strategy/textiles-strategy_en.
**112** United Nations Environment Programme (2023), *Sustainability and Circularity in the Textile Value Chain*.
**113** Barrie, J., Schröder, P. and Schneider-Petsinger, M. (2022), *The role of international trade in realizing an inclusive circular economy*, Research Paper, London: Royal Institute of International Affairs, https://doi.org/10.55317/9781784135393.

## **Box 5.** Used textiles

*This box examines the issues related to pre- and post-consumer waste flows, primarily from the Global North to the Global South. It highlights some of the impacts of used clothing and textile waste imports, and the shift of responsibilities for their reuse and disposal from exporting to importing regions. It identifies that the sustainability challenge is also one of governance and enforcement.*

Each year, millions of tonnes of used textiles are exported from wealthier regions to lower-income countries. This trade is presented as reuse, but often acts as a way to offload textile waste. In many cases, so-called 'second-hand' shipments include low-quality or unusable items, effectively shifting the environmental and economic burden of disposal to importing countries.

Particularly with the rise of fast fashion, garments are produced cheaply, with an intentionally short lifespan, and are often made with fibre blends that are difficult to recycle. As a result, the quality of clothing entering the secondhand trade has declined sharply. What once might have been durable cotton shirts or wool coats are now polyester blends that lose shape after a few washes. As a result, traders at importing hubs often find that as much as 30–40 per cent of used clothing is unsellable, and is destined instead for dumpsites, rivers or open burning.

The global trade in used textiles carries complex water implications for importing countries. While the reuse of garments by secondary consumers extends their lifespan, the influx of often low-quality clothing frequently overwhelms local waste management systems and creates new water burdens. Processes such as washing or re-dyeing of textiles draw on local water resources and generate wastewater that may flow untreated into already fragile urban and rural water infrastructures. Microfibres are shed during laundering, further contaminating waterways, while open dumping of textile waste allows dyes and finishing chemicals to leach into surface and groundwater during rainfall.

The US is the world's largest exporter of used clothing, much of it sourced from donations to major charities. Some countries, such as Mexico, restrict imports of used clothing, but while Mexico's customs officials focus on large importers, high demand for cheaper used clothing has resulted in the rise of smaller quantities – but cumulatively very large volumes – of clothing being smuggled into the country.[114] This is particularly concerning as northern Mexico suffers high levels of water stress through severe, multi-year droughts, overexploited aquifers, critically low reservoir levels and low rainfall.

Such trade flows are not accidental. They exploit loopholes in customs codes, which lump all 'worn clothing' under a single category, making it impossible to distinguish between high-quality second-hand clothing and textile waste. The impacts are

**114** Gauthier, M. (2007), 'Fayuca Hormiga: The Cross-border Trade of Used Clothing Between the United States and Mexico', in Brunet-Jailly, E. (ed.) (2007), *Borderlands*, Ottawa: University of Ottawa Press, https://books.openedition.org/uop/1602.

particularly stark and concentrated in some regions. Although the trade creates jobs in importing countries, in many cases it also pushes workers into low-value, hazardous handling of waste[115] and exposes them to severe risks.

Combined, sub-Saharan African countries received textile waste imports with a value of some $1.5 billion in 2024 (Figure 6).[116] In markets such as Kantamanto in Accra, Ghana, one of the world's largest secondhand clothing hubs, traders and informal workers sift through mountains of garments, salvaging what they can.[117] The rest piles up in informal dumps that contaminate local water systems or wash into the sea, contributing to flooding and marine pollution. Incidents such as the major fire that destroyed much of Kantamanto market in January 2025[118] underscore the vulnerability of the informal, high-density markets supporting the used textiles trade, with the impacts largely being borne by local workers, traders and communities. Cities across Kenya and Mozambique similarly suffer the harmful impacts of the handling of imported used clothing. In Kenya and Tanzania, too, local textile industries have long emphasized that the influx of cheap imports undermines domestic production, eroding jobs and manufacturing capacity.[119] To defend their economies against some of these impacts, several African countries have implemented measures to restrict or even ban imports of used textiles.[120]

The inequities are clear. Environmental burdens from imported textile waste put increased pressure on scarce water resources; and local waste management services can easily be overwhelmed by large quantities of used textile imports, resulting in increased water contamination. The United Nations Office on Drugs and Crime (UNODC) has framed such trade in used clothing and textile waste as a form of environmental crime. Fraudulent declarations, falsified documents and bribery at ports allow waste to move across borders under the guise of legitimate trade. In some cases, shipments carry two sets of paperwork – one for customs, another for consumer protection – masking the true contents. This is not simply a sustainability challenge. It is also a governance and enforcement problem, where organized networks exploit weak regulation and fragmented definitions of 'waste' versus 'product'.[121]

**115** Barrie, J. (2024), *Circular textile trade scenarios between the EU and Ghana: Exploring the impact of EU textile policies on trading partner countries*, Technical Study, London: Royal Institute of International Affairs, https://doi.org/10.55317/9781784136314.
**116** Chatham House circulareconomy.earth (2026), https://circulareconomy.earth/trade?year=2024&importer=ssf&category=39&units=value (accessed 3 Jul. 2026).
**117** For a more detailed study, see Barrie, J. (2024), *Circular textile trade scenarios between the EU and Ghana*.
**118** Johnson, S. (2025), 'Massive cleanup under way in Ghana after fire destroys one of world's biggest secondhand markets', *Guardian*, 3 January 2025, https://www.theguardian.com/global-development/2025/jan/03/massive-cleanup-under-way-after-fire-destroys-one-of-worlds-biggest-secondhand-markets-ghana.
**119** Ibid.
**120** Barrie, Schröder and Schneider-Petsinger (2022), *The role of international trade in realizing an inclusive circular economy*.
**121** United Nations Office on Drugs and Crime (2022), *Turning the Tide: A Look Into the European Union-to-Southeast Asia Waste Trafficking Wave*, https://www.unodc.org/documents/bmb/environmental-crime/FINAL_for_printing_-_Turning_the_tide.pdf.

## Textile-related water standards

Textile trade flows have created interdependencies between countries and distributed responsibilities for sustainability across the value chain. Since businesses aim to keep production costs as low as possible and maximize operational efficiency, raw materials and finished products are often sourced from different regions of the world – in line with comparative advantage in, for instance, where crops are grown (available land, amenable climate and access to water), where labour is cheap, where industrial know-how is concentrated, and what trade incentives exist. Although value-chain decisions are evaluated and optimized at each stage, 'business as usual' practices cumulatively generate significant water-related risks, exposing governance gaps and driving demand for more robust oversight.

**Although textile value-chain decisions are evaluated and optimized at each stage, 'business as usual' practices cumulatively generate significant water-related risks, exposing governance gaps and driving demand for more robust oversight.**

In this context, social and environmental concerns have prompted a proliferation of legal and voluntary initiatives applicable to the textile sector – among them global strategies and roadmaps, regulations, sectoral coalitions, and standards and certification schemes. However, few of these have adequately addressed the severity of water-related impacts. Coverage has tended to be partial, targeting specific commodities (e.g. cotton) or isolated metrics (e.g. water-use efficiency) rather than the sector's full water footprint. This means that the broader linkages between environmental and social dimensions of the impacts of industrial-scale water use have at times been missed. One such example would be where standards are placed on water-use efficiency at the factory level, neglecting the wider question of equitable water withdrawal and how a water-efficient factory may still deplete a community's water resources.

Nonetheless, some standards bodies and voluntary initiatives are moving to address this gap, paving the way for cohesive and unified benchmarks for meeting essential ecological health, social equity and climate resilience thresholds. As such, global governance for sustainable textiles is increasingly shaped by a suite of interlinked initiatives that promote transparency, accountability and environmental integrity across supply chains.

### International, multilateral and regional standards

While not textile-specific, the 2023 **OECD Guidelines for Multinational Enterprises on Responsible Business Conduct**[122] provide an important foundational framework. These guidelines are widely used across sectors to benchmark corporate

**122** Organisation for Economic Co-operation and Development (2023), *OECD Guidelines for Multinational Enterprises on Responsible Business Conduct*, Paris: OECD Publishing, https://doi.org/10.1787/81f92357-en.

sustainability efforts, underpinning many national and regional regulations. They encourage companies to assess and mitigate environmental and human rights risks, including water pollution and labour conditions, through due diligence practices that extend across borders.

The Global Sustainability Standards Board (GSSB) has set widely adopted standards, of which the Global Reporting Initiative (GRI) **GRI 303: Water and Effluents 2018** form a part.[123] This standard revises **GRI 303: Water 2016** to reflect advancements in water stewardship and to align with international best practice, including instruments such as the **CDP water security questionnaire and the CEO Water Mandate Corporate Reporting Guidelines**.[124] GRI 303 sets the required metrics to assess water impact at the basin level;[125] it applies across all sectors and aligns with UN Sustainable Development Goals (SDGs) – including SDG 6 (on clean water and sanitation for all). Concerning textiles, it applies to earlier life cycle stages of raw material production and the manufacturing of finished textiles. It applies to downstream use, such as recycling or disposal facilities, insofar as those activities withdraw and consume water or discharge effluents, then these must be reported under GRI 303. Notably, too, a sector-specific GRI standard for textiles and apparel is under development, and is expected to be approved in late 2026; the new standard will determine best practice for textile production, apparel and footwear manufacturing and retail.[126]

The **UN Alliance for Sustainable Fashion**, launched in 2017, brings together multiple UN bodies to coordinate action across the fashion and textile sectors.[127] It explicitly addresses water use and pollution, promotes circularity and advocates for decent working conditions – including WASH provision for workers. Its multi-stakeholder approach helps align industry practices with the SDGs, particularly SDG 6 and SDG 12 (responsible consumption and production).

The UN Economic Commission for Europe **(UNECE) Traceability for Sustainable Garment and Footwear** initiative offers a globally harmonized framework for supply chain transparency.[128] Developed under the UN Centre for Trade Facilitation and Electronic Business (UN/CEFACT), it supports digital traceability tools – including blockchain[129] – and aligns closely with the EU's Digital Product Passport. While it does not mandate WASH infrastructure, it promotes ethical working conditions and environmental data disclosure, including water impacts. Its relevance to trade is significant: it facilitates cross-border compliance and circular economy transitions by enabling traceable, verifiable product histories.

**123** Global Reporting Initiative (2026), 'Topic Standard for Water and Effluents (GRI 303)', https://www.globalreporting.org/standards/standards-development/topic-standard-for-water-and-effluents-gri-303.
**124** Global Reporting Initiative (2023), 'GRI 303: Water and Effluents 2018 Frequently Asked Questions (FAQs)', https://www.globalreporting.org/media/ubsdd33q/water-and-effluents-topic-standard-faqs.pdf.
**125** GRI 303: Water and Effluents 2018 applies to interactions with water as a shared resource (303-1), management of water discharge-related impacts (303-2), water withdrawal (303-3), water discharge (303-4) and water consumption (303-5).
**126** Global Reporting Initiative (2026), 'Sector Standard Project for Textiles and Apparel', https://www.globalreporting.org/standards/standards-development/sector-standard-project-for-textiles-and-apparel.
**127** UN Alliance for Sustainable Fashion (undated), 'What is the UN Alliance for Sustainable Fashion?', https://unfashionalliance.org.
**128** United Nations Economic Commission for Europe (undated), 'Traceability for Sustainable Garment and Footwear', https://unece.org/trade/traceability-sustainable-garment-and-footwear.
**129** United Nations Economic Commission for Europe (2021), 'Policy Brief: Harnessing the Potential of Blockchain Technology for Due Diligence and Sustainability of Cotton Value Chains', 13 April 2021, https://unece.org/trade/documents/2021/04/session-documents/policy-brief-harnessing-potential-blockchain-technology.

The UN Environment Programme **(UNEP) Global Roadmap for Sustainability and Circularity in the Textile Value Chain** provides a strategic blueprint for governments, industry and civil society. It calls for reduced water intensity, improved wastewater treatment and safe working conditions – including WASH access – across all stages of the textile life cycle. The roadmap also addresses trade-related challenges such as the environmental and social risks of second-hand textile flows and promotes policy coherence across regions.

Reporting frameworks for sustainability disclosures are becoming more comprehensive in scope and moving towards greater interoperability, although water-related disclosures remain less harmonized than is the case for climate disclosures. Standards bodies such as the GSSB and the investor-focused **International Sustainability Standards Board (ISSB)** are pursuing alignment of common disclosures.[130] While some methodological alignment across standards has been piloted, such as GRI 101: Biodiversity Standard and ISSB's Biodiversity, Ecosystems and Ecosystem Services, water-related standards (GRI 303) are not yet in scope. Among existing initiatives addressing water, the most prominent is **CDP's water security questionnaire,**[131] which has evolved into a unified climate, forests and water security questionnaire,[132] whereby companies can report voluntarily on their water use, risks and management strategies in line with industry standards. Further initiatives to drive corporate reporting on water across their value chains are emerging[133] – among them the combined effort by the WRI, WWF, SCS Global Services and the Pacific Institute to develop common terminology and standardized guidance for assessing and addressing water risks for businesses across full value chains.[134]

Together, such initiatives form a robust global architecture that complements and informs regional efforts. The EU, in particular, has been active in standards-setting, given the bloc's position as a major player in both the finished and used textiles trade, with many multinational companies in the textile industry based in EU member countries. **EU-initiated voluntary reporting and regulatory measures** have the potential to make important advances in addressing the environmental and social costs of the textile value chain. Table 6 summarizes the most substantive measures adopted in recent decades.

**130** Global Reporting Initiative (2022), 'IFRS Foundation and GRI to align capital market and multi-stakeholder standards', 24 March 2022, https://www.globalreporting.org/news/news-center/ifrs-foundation-and-gri-to-align-capital-market-and-multi-stakeholder-standards.
**131** CDP (2025), *CDP Full Corporate Scoring Methodology – Water Security*, https://assets.ctfassets.net/v7uy4j80khf8/3NYx1jozh8krIIbvYOiVZ3/86e7758942c3852c616c7f2c695777ef/CDP_Full_Corporate_Scoring_Methodology_2025_-_Water_security.pdf
**132** KPMG (2026), 'CDP releases 2026 questionnaires and deadlines', https://kpmg.com/us/en/frv/reference-library/2026/cdp-releases-2026-questionnaires-deadlines.html.
**133** Jessop, S. (2026), 'Rising water risks drive push for common water reporting rules', Reuters, 22 April 2026, https://www.reuters.com/sustainability/boards-policy-regulation/rising-water-risks-drive-push-common-water-reporting-rules-2026-04-22.
**134** Walker, S., Enright, L., Brill, G. and Morgan, A. (2026), 'Laying the Groundwork to Unleash Water and Climate Resilience Across Value Chains: Water Scopes 1-3', World Resources Institute, 30 April 2026, https://www.wri.org/technical-perspectives/water-scopes-1-3-value-chain-framework.

**Table 6.** Textiles-related regulatory and voluntary innovations in the EU

| | |
|---|---|
| EU Ecolabel for Textiles[135] | • Type: Voluntary standard (in force since 1992; updated regularly)<br>• Applies to: EU production and imports<br>• Life cycle stage: Design, consumer use<br>• Water issues: Yes – includes water use and pollution criteria<br>• WASH services for workers: No – focuses on product life cycle, not workplace conditions<br>• Trade issues: Yes – applies to products sold across EU markets, including imports |
| REACH Regulation[136] | • Type: Regulation (in force since June 2007; continuously updated)<br>• Applies to: EU production and imports<br>• Life cycle stage: Processing<br>• Water issues: Yes – regulates hazardous chemicals affecting water quality<br>• WASH services for workers: Indirect – improves chemical safety but does not mandate WASH infrastructure<br>• Trade issues: Yes – applies to imported goods containing regulated substances |
| Waste Framework Directive (WFD)[137] | • Type: Directive (established 2008, revised version entered into force October 2025; includes textile EPR)<br>• Applies to: EU production<br>• Life cycle stage: End of life<br>• Water issues: Yes – mandates separate collection and proper disposal to prevent water pollution<br>• WASH services for workers: No – focuses on waste management, not workplace conditions<br>• Trade issues: Indirect – influences trade in textile waste |
| Circular Economy Action Plan (CEAP)[138] | • Type: Strategy (adopted March 2020)<br>• Applies to: EU production and imports<br>• Life cycle stage: All stages<br>• Water issues: Yes – targets water use and pollution in production and wet processing<br>• WASH services for workers: Yes – highlights need for safe working conditions including water access<br>• Trade issues: Yes – promotes global standards and restricts waste exports |
| EU Strategy for Sustainable and Circular Textiles[139] | • Type: Strategy (adopted March 2022)<br>• Applies to: EU production and imports<br>• Life cycle stage: All stages<br>• Water issues: Targets water use and pollution in fibre production and wet processing<br>• WASH services for workers: No – highlights due diligence obligations to address environmental and social fairness but no explicit actions on WASH<br>• Trade issues: Promotes global sustainability standards; restricts export of textile waste |
| Waste Shipment Regulation (Revision)[140] | • Type: Regulation (entered into force in 2024; most provisions will apply from May 2026, and most export rules from May 2027; in the interim, provisions of Waste Shipment Regulation 1013/2006 still apply)<br>• Applies to: EU production<br>• Life cycle stage: End of life<br>• Water issues: Indirect – prevents illegal or harmful waste exports that may affect water systems<br>• WASH services for workers: No – focused on transboundary waste flows<br>• Trade issues: Yes – restricts the export of textile waste to non-EU countries |

**135** European Union (undated), 'About the EU Ecolabel', https://environment.ec.europa.eu/topics/circular-economy-topics/eu-ecolabel/about-eu-ecolabel_en.
**136** European Union (undated), 'EU REACH Regulation', https://environment.ec.europa.eu/topics/chemicals/reach-regulation_en.
**137** European Union EUR-Lex (2025), 'Directive (EU) 2025/1892 of the European Parliament and of the Council o f 10 September 2025 amending Directive 2008/98/EC on waste', https://eur-lex.europa.eu/eli/dir/2025/1892/oj/eng.
**138** European Commission (undated), 'Circular Economy Action Plan', https://environment.ec.europa.eu/strategy/circular-economy_en.
**139** European Commission (undated), 'Sustainable and Circular Textiles Strategy', https://environment.ec.europa.eu/strategy/textiles-strategy_en.
**140** European Union EUR-Lex (2024), 'Regulation (EU) 2024/1157 of 11 April 2024 on shipments of waste, amending Regulations (EU) No 1257/2013 and (EU) 2020/1056 and repealing Regulation (EC) No 1013/2006', https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32024R1157.

| | |
|---|---|
| Ecodesign for Sustainable Products Regulation (ESPR)[141] | • Type: Regulation (entered into force July 2024; expected to apply in 2026)<br>• Applies to: EU production and imports<br>• Life cycle stage: Design, use<br>• Water issues: Indirect – encourages durability and reduced environmental impact<br>• WASH services for workers: No – focuses on product performance, not workplace conditions<br>• Trade issues: Yes – introduces Digital Product Passport for traceability across borders |
| Green Claims Directive[142] | • Type: Regulation (proposal adopted March 2023; expected to apply in 2026)<br>• Applies to: EU production and imports<br>• Life cycle stage: Consumer use<br>• Water issues: Indirect – regulates misleading claims about water-related sustainability<br>• WASH services for workers: No – focuses on consumer-facing environmental claims<br>• Trade issues: Yes – applies to environmental claims on both EU-made and imported products |
| Microplastics[143] | • Type: Policy (restrictions adopted September 2023; textile-specific rules under development)<br>• Applies to: EU production and imports<br>• Life cycle stage: Use, washing<br>• Water issues: Yes – targets microplastic shedding from synthetic textiles into water systems<br>• WASH services for workers: No – focused on product emissions, not workplace infrastructure<br>• Trade issues: Indirect – may affect product design and compliance for imported goods |
| Corporate Sustainability Due Diligence Directive (CSDDD)[144] | • Type: Directive (adopted April 2024; applies from 2027)<br>• Applies to: Imports<br>• Life cycle stage: Raw materials, processing<br>• Water issues: Yes – requires companies to assess and mitigate water-related environmental risks<br>• WASH services for workers: Yes – includes human rights due diligence covering access to water and sanitation<br>• Trade issues: Yes – mandates due diligence for global sourcing and supplier accountability |

## Standards applying to life cycle stages

At a time when environmental, social and governance (ESG) frameworks globally may be at risk of dilution, regulations specific to the textile sector remain robust and are expanding to cover the full textile life cycle from water usage for production to end-of-life waste management. Recent emphasis on EPR represents a significant regulatory evolution, making manufacturers financially accountable for their products' entire environmental impact, including water pollution and resource consumption throughout the value chain.[145] Over time, environmental

**141** European Union EUR-Lex (2024), 'Regulation (EU) 2024/1781 of 13 June 2024 establishing a framework for the setting of ecodesign requirements for sustainable products, amending Directive (EU) 2020/1828 and Regulation (EU) 2023/1542 and repealing Directive 2009/125/EC', https://eur-lex.europa.eu/eli/reg/2024/1781/oj/eng.
**142** European Union EUR-Lex (2023), 'Proposal for a Directive on substantiation and communication of explicit environmental claims (Green Claims Directive)'. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2023%3A0166%3AFIN.
**143** European Union EUR-LEX (2018), 'Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A European Strategy for Plastics in a Circular Economy', https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52018DC0028; European Union EUR-Lex (2025), 'Regulation (EU) 2025/2365 of the European Parliament and of the Council of 12 November 2025 on preventing plastic pellet losses to reduce microplastic pollution', https://eur-lex.europa.eu/eli/reg/2025/2365/oj.
**144** European Union EUR-Lex (2024), 'Directive (EU) 2024/1760 of the European Parliament and of the Council of 13 June 2024 on corporate sustainability due diligence and amending Directive (EU) 2019/1937 and Regulation (EU) 2023/2859', https://commission.europa.eu/topics/business-and-industry/doing-business-eu/sustainability-due-diligence-responsible-business/corporate-sustainability-due-diligence_en.
**145** See, for instance, European Commission (2025), 'Revised Waste Framework Directive enters into force to boost circularity of textile sector and slash food waste', https://environment.ec.europa.eu/news/revised-waste-framework-directive-enters-force-2025-10-16_en.

regulations are becoming increasingly stringent around the world, despite the current geopolitical landscape, and textile companies that fail to effectively manage their dependencies on water may suffer severe operational, reputational and financial risks.

### Raw materials

The earliest sustainability standards in the textile sector centred on cotton. In the early 2000s, the **Organic Cotton Standard**, later incorporated into the **Global Organic Textile Standard** (GOTS),[146] established strict prohibitions on synthetic pesticides and fertilizers and set requirements for soil and water stewardship. It also established social safeguards, including provisions for workers' health and sanitation, although it is important to note that organic cotton continues to represent only around 1 per cent of global cotton production. The **Better Cotton Initiative** (BCI), established in 2005, now covers more than 20 per cent of global cotton production. BCI promotes reduced water use and better irrigation practices, and notably advocates for gender equality to bring women and other 'invisible' workers into equal decision-making roles,[147] while embedding decent work criteria that indirectly cover WASH.[148]

#### **Box 6.** Understanding gender perspectives in textile value chains

*This box draws on learnings for gender advocacy and practices embedded in sustainable cotton production, and in textile value chains more broadly.*

Of the 31.5 million farmers who grow cotton, the International Cotton Advisory Council (ICAC) estimates that some 46 per cent are women.[149] The UN Food and Agriculture Organization (FAO), citing International Trade Centre data, highlights that women account for around 65 per cent of the labour associated with cotton picking and 55 percent of the labour in sowing; in India, 90 per cent of workers engaged in cotton picking, and 70 per cent in sowing, are women.[150] Overall, women contribute nearly half of all labour across the cotton production value chain.[151]

Under FAO auspices, the +Cotton initiative (outlined in Box 3), supports the vital role played by women in rural cotton farming;[152] and a gender-focused study across five +Cotton countries – Argentina, Bolivia, Colombia, Paraguay and Peru – analysed constraints on the participation of women in the cotton value chain in order to identify potential areas for empowerment. The study notably highlights where producer organizations have used equity-based approaches to support farm-level management

**146** Global Organic Textile Standard (2020), 'Environmental Criteria', https://global-standard.org/the-standard/gots-key-features/ecological-and-social-criteria.
**147** Better Cotton Initiative (2025), 'Breaking barriers, building futures: recognising women cotton farmers', https://bettercotton.org/breaking-barriers-building-futures-recognising-women-cotton-farmers.
**148** Better Cotton (2025), *Decent Work Strategy: A Roadmap to 2030*, https://bettercotton.org/wp-content/uploads/2026/03/Decent-Work-Strategy_Roadmap.pdf.
**149** Ward, A. (2025), 'Future-Proofing the Cotton Industry: Why Gender Equality and the Sustainability Transition Must Progress in Tandem', in International Cotton Advisory Committee (2025), *Cotton: Review of the World Situation*, 78(2), p.24, https://icac.org/wp-content/uploads/2025/09/Review-April-2025-WiC-final.pdf.
**150** Food and Agriculture Organization of the United Nations (2025), *Gender dimension in the Cotton Sector*, p.5.
**151** Ruiz, L., 'The Role of Women in the Cotton Sector: A Global Analysis', in International Cotton Advisory Committee (2025), *Cotton: Review of the World Situation*, 78(2), p. 5.
**152** Food and Agriculture Organization of the United Nations (2025), *Gender dimension in the Cotton Sector*.

and improve workers' quality of life.[153] These initiatives demonstrate that cotton has historically been the proving ground for social and environmental innovation, and offer a transferable model on lessons learned for implementing a gender-focused framework of best practices that extends across the entire textile value chain.

Given the long-standing concerns about the prevalence of unfair working conditions and exploitative practices in the textile sector, it is notable that textile value chains have been a focus of efforts to improve working conditions in the ready-made garment sector (such as through WASH access),[154] as well as to tackle the harassment of women workers,[155] and to promote gender empowerment in the leadership and future direction of the industry. These aspects underscore the importance of stronger mechanisms to strengthen access, protection, representation and empowerment of the workforce.

Launched in 2013, the **CanopyStyle** initiative focuses on viscose and other MMCFs, with the aim of mobilizing brands to eliminate sourcing from ancient and endangered forests. While its primary concern is deforestation, the initiative indirectly addresses water and chemical issues in viscose production.[156] In parallel, the EU's **Best Available Techniques** (BAT) for viscose production set benchmarks for wastewater treatment and chemical recovery.[157]

Cross-fibre initiatives have also been developed. Textile Exchange's wide-ranging **Materials Matter Standard**, due to enter into effect in late 2026, unifies existing standards, policies, reporting and traceability for the production and primary processing of raw materials. From the end of 2027, for brands or suppliers to be Textile Exchange-certified, their upstream suppliers – mainly in raw material and fibre production – will need to comply with this standard.[158] This replaces their **Fiber and Materials Matrix** (formerly the Preferred Fibers & Materials (PFM) Framework, introduced in 2015), which provides a harmonized reporting tool for brands, including on water-use intensity and pollution.[159] **The Sustainable Apparel Coalition's Higg Index** (Materials Sustainability Index) (2012)[160] benchmarks environmental and social impacts across fibres. These last two are widely used, although their effectiveness depends on voluntary brand uptake and transparency.

**153** Ibid.
**154** International Labour Organization (2017), 'Improving Working Conditions in the Ready-Made Garment Sector', https://www.ilo.org/publications/improving-working-conditions-ready-made-garment-sector.
**155** Kabir, H., Maple, M. and Usher, K. (2025), 'Prevalence and risk factors of sexual harassment in the workplace by female readymade garment workers in Bangladesh', *Front. Public Health*, 13, 1580709, https://doi.org/10.3389/fpubh.2025.1580709.
**156** Canopy (undated), 'CanopyStyle Initiative', https://canopyplanet.org/change-together/canopystyle.
**157** Roth, J. et al. (2023), *Best Available Techniques (BAT) Reference Document for the Textiles Industry*, Luxembourg, Publications Office of the European Union, https://publications.jrc.ec.europa.eu/repository/handle/JRC131874; Suhr, M. et al. (2015), *Best Available Techniques (BAT) Reference Document for the Production of Pulp, Paper and Board*, Luxembourg, Publications Office of the European Union, https://publications.jrc.ec.europa.eu/repository/handle/JRC95678.
**158** Textile Exchange (2026), 'Introducing the Materials Matter Standard, a shared direction for climate, nature, people, and animals', https://textileexchange.org/materials-matter-standard.
**159** Textile Exchange (2026), 'The Fiber & Materials Matrix', https://textileexchange.org/about-materials-matrix.
**160** Sustainable Apparel Coalition (undated), 'Higg Index Product Tools', https://product.higg.org/page/sustainable-apparel-coalition.

### Wet processing

The wet processing stage, where dyeing, finishing and chemical treatments of textiles occur, has long been a hotspot for water pollution. The EU's **REACH Regulation** (2007) plays a critical role in this context, restricting hazardous substances in production and imports with indirect benefits for water quality and worker safety.[161] In 2011, the **ZDHC Roadmap to Zero Programme** was launched by leading brands to eliminate hazardous chemicals and set wastewater discharge limits. It has become a global benchmark for chemical management.[162] Furthermore, ZDHC Foundation and Corporate Water Leaders have aligned global water-stewardship standards to mitigate the financial risk posed by water scarcity and legal risk from water pollution. This unification of standards imposes mandatory water-use and quality requirements on all wet processing sites from 2025–26 to reduce the industrial water pollution caused by textile dyeing and treatment, conform site-level water management to the **Alliance for Water Stewardship Standard** that covers governance, water balance and water quality, and ensure direct discharge suppliers adhere to the ZDHC wastewater standards.[163] In addition, some initiatives – such as Responsible Care within the chemical industry – focus on chemical management more broadly, with no specific focus on textiles.

### Downstream waste and circularity

Attention to the end-of-life stage of textiles accelerated in the 2010s. The **EU Waste Framework Directive** (revised in 2018 and again in 2025) mandated separate collection of textiles by 2025, aiming to reduce landfill and water pollution from unmanaged waste.[164] The **Waste Shipment Regulation** (revision adopted 2024, applying from 2026–27) further restricts export of textile waste to non-EU countries, addressing trade and environmental justice concerns.[165] Globally, the **Global Recycled Standard** (GRS) and **Recycled Claim Standard** apply.[166] These standards reduce reliance on virgin petrochemicals and, indirectly, lower water use, but they do not address other important issues such as microfibre shedding or ensuring WASH provision in recycling facilities. Furthermore, their effectiveness is limited by the challenges of scaling closed-loop fibre to fibre recycling.

## Uncertainties ahead

Any meaningful study of the textile sector needs to take full account of how water travels through interconnected global trade systems. Where water is managed unsustainably, each stage of the value chain can have distinct, adverse impacts on water, creating risks for companies, investors, governing bodies and, most

**161** European Commission (undated), 'REACH Regulation', https://environment.ec.europa.eu/topics/chemicals/reach-regulation_en.
**162** ZDHC Foundation (2026). 'ZDHC Roadmap to Zero Programme', https://roadmaptozero.com/programme.
**163** Ibid.
**164** European Commission (undated), 'Waste Framework Directive', https://environment.ec.europa.eu/topics/waste-and-recycling/waste-framework-directive_en.
**165** European Commission (undated), 'Waste Shipments', https://environment.ec.europa.eu/topics/waste-and-recycling/waste-shipments_en.
**166** For documents on the GRS and RCS, see Textile Exchange (2026), 'The RCS and GRS are designed to boost the use of recycled materials', https://textileexchange.org/recycled-claim-global-recycled-standard.

critically, the local communities that are central to the industry. Along with clear evidence of rising demand and mounting water risks, several uncertainties remain that will shape the evolution of the textile sector.

**Where water is managed unsustainably, each stage of the textile value chain can have distinct, adverse impacts on water, creating risks for companies, investors, governing bodies and, most critically, the local communities that are central to the industry.**

Long-term forecasts indicate a rapidly expanding fibre market, yet the path of future demand remains uncertain. Current projections suggest that global fibre production will reach 169 million tonnes by 2030, from 109 million tonnes in 2020.[167] But future consumption will be sensitive to factors such as economic growth, income distribution and consumer preferences. The rapid growth in numbers of middle-class consumers in Asia and Africa could push demand even higher than current estimates. Conversely, policy measures or shifting social norms may accelerate demand for reuse, rental or second-hand markets, meaning that growth in virgin textile demand may be lower than currently anticipated. Even so, demand for second-hand and used textiles varies, and can sometimes reinforce unsustainable or even illicit practices such as textile dumping that externalize the costs of managing textile waste to other – often poorer – countries.

Given the volumes of water needed to produce, use and recycle textiles, together with the needs of the farmers, textile workers and communities living near production sites, the textile industry is particularly vulnerable to future climate and water stress impacts. While climate models indicate greater drought, flood and heat risks in South and Southeast Asia, for instance, the exact timing and severity of such risks remain uncertain. This creates unpredictability for both local water availability and supply-chain resilience. Localized hydrological changes, such as groundwater depletion rates or shifts in monsoon rainfall, could magnify risks faster than industry or policymakers anticipate.

The dynamics of economic and trade policy, demand and environmental characteristics together create a shifting landscape of producers, exporters and importers. For clothing brands, the impacts of tariffs and trade disruptions in globally fragmented, cost- and labour-intensive supply chains have highlighted the vulnerabilities of the sector's reliance on low-cost labour in distant sourcing countries. Some US brands have increasingly looked to regionalize, or 'nearshore', their supply chains via manufacturing in Latin America, while their European counterparts are turning their focus to suppliers in Eastern Europe, Turkey, Morocco and other North African countries.[168]

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**167** Textile Exchange (2025), *Materials Market Report 2025*.
**168** The Fashion Economist (2025), 'Can Fashion Make Nearshoring Work in a Globalized World?', 8 July 2025, https://www.thefashioneconomist.com/can-fashion-make-nearshoring-work-in-a-globalized-world.

However, moving towards more regionalized supply chains often overlooks the opportunity to embed genuinely sustainable practices, labour standards and regulatory leadership into core operations. Relocating production closer to a country or region where textiles are marketed and consumed may continue to exploit weak labour protections and shortcomings in regulatory frameworks and capacity. Some nearshoring hubs notably face significant water stress. For example, Mexico – leveraging its geographic proximity, existing trade agreements and competitive labour market – is increasingly important as a nearshoring location for US textile and finished garment production. But Mexico is also facing serious water stress, with many northern states projected to suffer deepening scarcity between now and 2050.[169] The regulatory capacity of such hubs remains highly uncertain, bringing significant risks that water stress will shift to new geographies with impacts that are difficult to mitigate.

Among the most promising policy options to address the detrimental environmental impacts of global demand for textiles is the scaling of circular economy measures. The EU has been notably active in this area, including through the EU Strategy for Sustainable and Circular Textiles (see also Table 6), but the timeline for effective implementation and enforcement is not always clear. EPR schemes may take years to operationalize, and are expensive to establish and operate. Outside the EU, circularity policies are patchier, and enforcement of measures to counter illegal waste exports or uncontrolled dumping remains weak. As a result, the global-scale water benefits from circularity remain speculative.

Growers of fibre crops such as cotton need to investigate regenerative agriculture and sustainable production practices. Early results from regenerative cotton pilots in India and Pakistan, for instance, show encouraging reductions in water use and chemical inputs.[170] However, questions remain about scalability across diverse geographies, economic viability for smallholder farmers, and whether yields can be maintained without additional subsidies or premium pricing from brands.

## Adoption of water-efficient production technologies can potentially reduce the water-related impacts in key water-scarce producer regions.

Adoption of water-efficient production technologies can potentially reduce the water-related impacts in key water-scarce producer regions. Case studies from Bangladesh demonstrate the technical feasibility of large-scale water reuse, recovery and recycling.[171] However, widespread uptake is constrained by capital costs, weak regulatory enforcement and low margins across much of the garment

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**169** Middelton, J. (2023), 'Mexico's nearshoring potential undermined by climate and security risks', Maplecroft, 20 December 2023, https://www.maplecroft.com/products-and-solutions/geopolitical-and-country-risk/insights/mexicos-nearshoring-potential-undermined-by-climate-and-security-risks; Gonzalez, K. and Nieto, F. (2023), 'More Mexican states could face water stress by 2050', S&P Global, 4 April 2023, https://www.spglobal.com/sustainable1/en/insights/special-editorial/more-mexican-states-could-face-water-stress-by-2050.
**170** CottonConnect (2025), *Impact Report 2024*, https://www.cottonconnect.org/impact-report-2024.
**171** ESTex (2025), 'A Synthesis Report on Water Reuse: Scope and Potential in Bangladesh', https://estexbd.com/wp-content/uploads/2025/05/A-Synthesis-Report-on-Water-Reuse_Scope-and-Potential-in-Bangladesh.pdf.

sector. Whether such technologies can be rolled out more widely across the industry, rather than being concentrated in flagship facilities serving premium buyers, will determine their long-term impact.

The factors outlined above highlight the degree of uncertainty surrounding how quickly the global textile sector can adopt sustainable production practices. While technological and agricultural innovations show real potential, their effectiveness ultimately depends on a mix of policy incentives and rigour, financial investment, sector-wide adoption of best-practice standards, and changing consumer behaviours.

## Conclusion: transforming the textile value chain

Global production and trade of raw materials, finished textiles and used clothing have a profound impact on local and global water resources at each stage of the textile life cycle – raw materials production, washing-dyeing-finishing, consumer use, and recycling or waste disposal. With rising textile demand, the associated impacts of virtual water trade ripple outwards: depleted and polluted rivers, lakes, aquifers and coastal waters lead to degraded ecosystems as well as loss of livelihoods and access to clean drinking water. Meanwhile, poor labour conditions and unreliable access to water and sanitation compound pressures on workers and local communities. These impacts often occur in countries distant from consumers, yet they reverberate through the value chain, limiting sectoral growth in water-stressed regions, increasing operational costs and, in turn, affecting prices. Given the global nature of the textile value chain, water scarcity and declining water quality at one or more points along the chain can disrupt onward supplies.

Much of the projected growth in textile production in the coming decades will be concentrated in countries in the Global South – both long-established producers and emerging hubs – whose economies rely, or increasingly rely, on the sector. Mounting ecological pressures, including on water availability and quality, bring a range of socio-economic, environmental and geopolitical challenges for countries that are central to the textile value chain. Understanding how textile trade flows embed virtual water that moves between countries, and what implications they carry, is therefore critical for governments, investors, companies, producers and consumers.

Addressing the substantial water footprint of textiles demands a global commitment to water-efficient and non-polluting practices across the value chain, supported by robust water governance and trade policies, supply-chain transparency and investment in innovation, along with sustained efforts to build consumer awareness of the impacts of water-intensive goods. By taking a whole-value-chain approach, collective actions have the potential to transform the textile sector from a driver of water insecurity and pollution to a catalyst for resilience and equity. The challenge is immense, but so too is the opportunity: to build and uphold a textile value chain where water is not wasted, polluted or hidden, but instead respected, safeguarded and shared equitably.

## Strengthening governance frameworks

Strengthening governance of virtual water flows is becoming increasingly urgent as global value chains intensify the movement of water-intensive goods across borders. It is not just established producing and importing countries that need to take action. So do the countries and regions that are in the process of expanding their textile-related economic activity, and are therefore facing new challenges in water and waste management that need to be addressed through strengthened regulatory and enforcement frameworks.

Concern for the social and environmental impacts of textiles has been an impetus for an array of mandatory regulations and voluntary schemes. However, many of these remain siloed – focusing, for instance, on a particular stage of the value chain, or on one or just a few of the associated critical environmental and social issues. Across the industry, uneven adoption of such measures, and the specificity of many, leave gaps and loopholes that impede progress towards sustainable, equitable and secure value chains. Standardization and greater compliance across key regulations and supply-chain disclosure mechanisms are therefore needed.

Some countries are pursuing regulatory reforms to accelerate the shift towards textile production methods that use far less water, lower the emissions footprint of textiles and strengthen the circularity of textile waste. The EU has positioned itself at the forefront of such initiatives: its Ecodesign for Sustainable Products Regulation (2024), for instance, introduces durability, repairability and recyclability mandates, along with Digital Product Passports for almost all products sold in the EU. Amendments to the Waste Framework Directive (2025) mandate the separate collection of textiles from 2025 and introduce EPR schemes.[172] Regarding textiles in particular, such policies are positioned to reduce water use through the use of fibres that are sustainably sourced, and to channel brands' and retailers' resources into water-sensitive collection, sorting and recycling systems. While these measures represent a significant step forward in addressing the environmental impacts of the textile sector – including its water footprint – their success hinges on buy-in at all stages of the value chain. This means that proactive engagement of the private sector to identify and mitigate specific barriers to implementation will be essential to ensuring these measures are operationally viable.

A concerted move towards more sustainable and circular production is needed. Bringing innovative practices to scale will require investment. Fibre cultivation through regenerative methods has shown improvements in soil health, improving water efficiency and supporting biodiversity, and builds ecosystem resilience over time. One obstacle to scalability is context-dependent ecology and supply chains based on traditional, monoculture farming. Expanding the application of regenerative methods requires better peer-to-peer sharing of knowledge on best practices, increased research into localized applications, and a systemic move away from monocultural supplies. But, without deliberate risk-sharing mechanisms, such a shift would deepen inequalities, while producers in exporting countries have

**172** European Union EUR-Lex (2024), Regulation (EU) 2024/1781 of 13 June 2024 establishing a framework for the setting of ecodesign requirements for sustainable products; European Commission (2025), European Commission (undated), 'Waste Framework Directive'.

limited capacity to absorb the short-term costs of transition. Embedding de-risking measures is therefore essential to ensure that supply chain transitions are both effective and fair.

## Using trade levers to bolster water security

With water-related risks expected to intensify across major textile-producing regions, building basin-level resilience and using trade relationships to improve water governance and achieve fair water footprints will be critical to mitigating water scarcity and quality degradation. Given the transboundary complexity of the textile value chain, trade policy is among the few instruments with the reach to address cross-border trade-offs. This means that trade mechanisms can play a vital role in tackling water insecurity. Product classifications are not well suited to monitoring water- or emissions-intensive production directly. While classification systems alone cannot capture these differences, they could support supplementary environmental designations that encourage more sustainable production practices. If added, such designations could be a lever to incentivize producers to act in responsible ways.

In 2024, the Global Commission on the Economics of Water emphasized that the true value of water must be reflected in domestic and trade policies if virtual water flows are to be prevented from exacerbating water scarcity in exporting countries.[173] Trade that fails to factor in the real economic cost of water will otherwise create distorted economic incentives that prevent accurate pricing of traded goods.[174] Trade agreements that value water correctly can foster more balanced trade in virtual water and help achieve sustainable, efficient and equitable water use across value chains. To do so fairly, tiered charges – with higher rates for large-scale industrial withdrawals, especially in water-intensive sectors such as textiles – can be applied by governments, while essential domestic needs remain free or low-cost. This can build incentives for the industry to improve water use efficiency, while avoiding regressive impacts on households and smallholder farmers.

When environmental standards tighten in textile-producing or consuming regions, there is a real risk that the most water-intensive and polluting activities are simply relocated to regions with weaker regulation, lower enforcement capacity or more economic vulnerability. This burden-shifting means a trade-off between progress in one region, and worse social and environmental impacts elsewhere. Trade agreements should incorporate differentiated responsibilities and support mechanisms for textile-exporting countries, such as phased implementation, financial assistance and technology transfer to help regions facing structural constraints maintain equitable access to export markets. To ensure these measures go beyond purely reducing the volume of water used in production, requirements should be guided by principles of fair water footprints, which also emphasize equity, sustainability, accountability and context-specificity.

**173** Global Commission on the Economics of Water (2024). *The Economics of Water*, p. 195, https://economicsofwater.watercommission.org/report/economics-of-water.pdf.
**174** Ibid., p. 194.

## Accelerating uptake of best-practice innovations

Ensuring that textile value chains remain stable and sustainable in a water-constrained world demands rapid acceleration of the development and implementation of innovative practices and technologies. Examples of more sustainable production practices at all stages of the textile value chain are being tested, driven both by consumer demand and recognition on the part of companies and investors of the potential severity of water risk for their supply chains and financial viability. Scaling and advancing innovations need to be supported by governance that encourages innovation, industry platforms that facilitate knowledge transfer, research investments and market-driven incentives.

Regenerative agriculture programmes are notably expanding in cotton cultivation. Under one such scheme, farmers in Gujarat, India, who participated in CottonConnect's REEL Regenerative Programme achieved 14 per cent savings in water use after just two years.[175] Adopting regenerative practices in other cotton-producing countries – including among emerging large exporters such as Tajikistan – combined with strengthened water governance, will be essential for improving the sustainability of future water use across the sector. Although regenerative methods can improve ecosystem resilience over time, scalability is constrained unless there is support, in parallel, for a systemic shift away from monocultural production.

In Bangladesh, factory-level investments in water reuse and efficiency are also proving effective. Some examples of progress under the Partnership for Cleaner Textile (PaCT) initiative have demonstrated that counter-current flow in continuous washing technologies and recovery of cooling water have cut water use by 14 per cent.[176] Another such example identified that installing a caustic recovery plant[177] enables 90 per cent sodium hydroxide reuse, significantly reducing effluent pollution loads. Demonstration projects are also moving towards near-zero liquid discharge. For instance, Bangladesh's first membrane bioreactor effluent treatment plant that recycles treated wastewater for use in textile production processes enables high recovery rates in line with ZDHC standards.[178]

Globally, less than 1 per cent of textiles are recycled to produce new textiles, underlining the need for further deep investments in infrastructure, governance and enforcement.[179] There are also opportunities for value-added industry in countries now burdened by waste. Ghana, for example, has the potential to develop repair and upcycling industries that could re-export higher-value products to Europe,[180] provided EU regulations are designed in such a way that

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**175** CottonConnect (2025), *CottonConnect Impact Report 2024*, https://www.cottonconnect.org/resources/cottonconnect-impact-report-2024.
**176** International Finance Corporation (2021), 'PaCT Case Study: Evince Textiles Ltd', https://documents1.worldbank.org/curated/en/929611627048067203/pdf/Cleaner-Production-Case-Study-Water-Saving-Evince-Textiles-Limited.pdf.
**177** Kar, A. (2012), 'Standout Practices at High-Performing Bangladeshi Textile Mills', National Resources Defense Council, https://www.nrdc.org/sites/default/files/cbd-textile-mills-standout-practices-bangladesh.pdf.
**178** Veolia Water Technologies (2023), 'Bangladesh's first MBR-based effluent treatment plant in the textile industry meets the Zero Discharge of Hazardous Chemicals (ZDHC) aspirational guideline', https://www.watertechnologies.com/case-study/bangladeshs-first-mbr-based-effluent-treatment-plant-textile-industry-meetsthe-zero.
**179** Ellen MacArthur Foundation (2021), *Circular business models: redefining growth for a thriving fashion industry*, https://content.ellenmacarthurfoundation.org/m/60926fc64dbab81d/original/Circular-business-models.pdf.
**180** Barrie, J. (2024), *Circular textile trade scenarios between the EU and Ghana*.

clarifies how such goods can re-enter the market as compliant products rather than being misclassified as waste. Similar opportunities exist in South Asia, where fibre-to-fibre recycling could move beyond low-value downcycling if supported by technology transfer and investment. Designing such initiatives to integrate women and other marginalized groups, including informal workers, in formal EPR schemes, with safe working conditions and fair pay, also brings opportunities to promote circularity that is socially as well as environmentally sound.[181]

## Recommendations

Transitioning towards a water-conscious and circular textile industry is a complex undertaking. But it is critical to ensuring that textile production does not further deplete or contaminate freshwater resources and degrade ecosystems and harm the communities that depend on them, particularly in already water-stressed regions, and to build long-term resilience across supply chains. To support this endeavour, this paper recommends the following:

**Governments should prioritize diplomatic engagement on water as a shared and traded resource to strengthen cooperation across the value chain on reducing the risks of water scarcity and poor water quality.** Trade relationships have an integral role to play in promoting water resilience in textile value chains. Well-designed trade agreements can ensure that social and environmental risks are borne fairly within established and emerging producer countries, and are tackled by consumer markets. Monitoring virtual water flows and using adaptive trade arrangements that respond to changing conditions can help rebalance water risks across the value chain, improving water security within producer regions. Bilateral and multilateral cooperation, supported by national governance, must treat water as a valued and shared resource, the stewardship of which requires fairness across borders. Engaging consumer markets in improving water security across the value chain has the potential to reduce water risk and lift all producing regions to a higher level of sustainability.

**Policymakers and trade bodies should embed water stewardship and circularity criteria into trade policy frameworks, with the goal of preventing social and environmental burdens being displaced across borders and into vulnerable regions.** Making water security central to the design and implementation of trade policies needs to start with a shared understanding across producer and consumer regions of virtual water trade. This requires increased transparency and clearer definitions of traded goods to ensure that their origins and the specificity of product types are easily known. Applied to the textile sector, tracking the invisible water flows in clothing and other textile goods can strengthen policy design to manage water risks across borders. By embedding water stewardship and circularity standards within trade agreements, import requirements and due diligence frameworks, responsible social and environmental practices can be supported across the value chain – from reducing water depletion and pollution in the

**181** Barrie, Schröder and Schneider-Petsinger (2022), *The role of international trade in realizing an inclusive circular economy*; United Nations Environment Programme (2023), *Sustainability and Circularity in the Textile Value Chain*.

production and processing of raw materials, to preventing exports of high volumes of used clothing and textile waste to countries and regions that do not have the infrastructure to manage these.

**National governments and regional trade blocs should progressively embed standardized water footprint metrics and incentives into trade agreements to promote transparency along value chains.** As susceptibility to water-related stressors can arise at various points in the value chain, monitoring of water footprints can and should be strengthened to address pressing water dependencies. This requires systematically assessing products along the textile value chain through the lens of the water footprint – for instance the green water footprint of cotton and pulpwood cultivation, the blue water footprint of irrigation, fibre production, wet processing and recycling, and the grey water footprint of fertilizers, pesticides and inadequately treated or untreated effluents. Consumers are often unaware of the social and ecological impacts of their choices, and are not well equipped with information to enable more sustainable choices. Embedding water footprints in trade metrics, led by national statistical agencies and trade ministries, can help promote transparency along value chains. Alongside this work, measures to promote better labelling and other communication tools on the water footprints of specific products can help build consumer knowledge and boost demand for more sustainable production. Incorporating water footprints into decision-making should not be seen as a signal for divestment from water-stressed countries; instead, it needs to be a signal for investment in sustainable textile production that can lead to a competitive advantage.

**National ministries should cooperate across sectors to ensure water is priced accurately in line with its domestic value, reflecting baseline water stress and appropriate water accounting methods.** Valuing green and blue water using domestic policies and investment decisions is pivotal to reflecting the true economic, environmental and social costs of its use, providing accurate price signals in trade, and ensuring that economic beneficiaries internalize water scarcity and pollution pressures incurred in producing regions. Water pricing can also include the 'polluter pays' principle that places the responsibility for clean water on the originator of the pollution. Accurate water pricing, equitably applied, provides public revenue to fund improvements in water infrastructure and regulatory enforcement. Pricing structures that encourage water efficiency and pollution reduction can be an essential incentive for the deployment of regenerative agriculture and closed-loop and circular technologies. Consultations with water-intensive sectors can help 'future-proof' water pricing by understanding foreseeable impacts to industry from reduced water quality and availability. Water pricing that accurately captures negative externalities, such as the social and environmental impacts of products, can help strengthen price signals to consumers, resulting in higher retail prices for less sustainable products.

**International standards bodies, along with regional and national regulators, need to coordinate to fill gaps across regulatory and voluntary mechanisms, strengthen interoperability and incentivize the move to more sustainable, efficient and equitable production.** Textiles are a vital pathway for economic development, and countries and institutions active in textiles trade and standards-setting have a crucial role to play in engaging with water-stressed producer regions to ensure incentives support the move to sustainable, efficient and equitable production practices. By working together and coordinating across governments, and enabling public–private consultation, a holistic and coordinated approach can help increase transparency, raise water footprint 'literacy', and amplify the positive impacts of sustainable and equitable water management across value chains. Prioritizing enforcement of regulations concerning systems such as zero-liquid discharge and closed-loop recycling can incentivize innovation in production methods that use less water, lower the emissions footprint of textiles and strengthen the circularity of textile waste. Streamlining and encouraging take-up of voluntary standards can lead the way towards strengthening water governance that protects environmental quality and produces social benefits. Through progressive advancements across voluntary and mandatory measures that collectively address all stages of the textile value chain, social and environmental values can be better upheld throughout the life cycle of textiles.

**Private sector actors across the textile value chain should support knowledge exchange and invest in innovation, implementation and monitoring of sustainable, efficient and equitable practices.** By implementing best practices for agriculture, forestry and manufacturing, through deeper investment in regenerative agriculture, conserving forest ecosystems, closed-loop technologies and circularity, the overall impact of the textile sector can be reduced while meeting growing global demand. This requires the industry to both build on existing knowledge and proactively engage in addressing the gaps. Greater investment is needed, for instance, to accelerate closed-loop processes in the manufacturing of textiles and fibre-to-fibre recycling, as well as innovative chemical processes to reduce reliance on virgin cotton and polyester and lower both water consumption and pollution. Countries that import used textiles, supported by international finance and technology transfer, have the potential to build value-added industries in sustainable production practices, repair, upcycling and recycling that turn today's waste into tomorrow's resources and create local employment. Coordination with industry platforms can broker connections across supply chains, and NGOs in producing countries can facilitate trust-based engagement between companies and communities to help ensure more equitable sharing of benefits. Facilitating peer-to-peer exchange of knowledge on regenerative practices, closed-loop technologies and circularity can accelerate their uptake.

**Investors must address the water-related risks and impacts of global textile trade, requiring actors across the value chain to disclose localized water metrics, and de-risk supply chains by incentivizing transparency and financing best practices.** Unmanaged water scarcity poses a material threat to asset valuations, potentially leading to stranded assets, supply-chain disruption and regulatory fines that diminish shareholder value. Nature-related risks can pose considerable macroeconomic impacts, and systematically identifying and monitoring water-related risks and impacts can help implement double-materiality reporting. That is to say, understanding impact materiality (i.e. impact of operations on water resources) and financial materiality (i.e. how resource quality and availability are affecting operations) of water-related risks of the businesses in their portfolio is essential for regulatory compliance, as well as for avoiding financial losses from unmanaged risks and for protecting communities who are dependent on these natural resources. Furthermore, to enhance longer-term resilience, bringing innovative practices such as those outlined in this paper to scale will require continued investment. Investments by financial institutions to de-risk the transitional period can help provide the necessary financial buffer to build a resilient and sustainable textile value chain. Reorienting incentives away from unsustainable extraction of water resources and towards social and ecological outcomes would better reflect the true value of regenerative, circular and closed-loop practices. Embedding de-risking measures is therefore essential to ensuring that supply-chain transitions are both sustainable and just.

**A whole-of-value-chain approach – and collective ambition and responsibility – is needed to support a transition towards a sustainable, efficient and equitable textile sector in which water-efficient and non-polluting practices are embedded and upheld.** Governments and regional bodies have a role to play in ensuring robust water governance and trade policies that address water-related risks as a vital component of secure supply chains, while investors, companies and their suppliers can improve transparency of virtual water flows. Sustained investment and incentives are needed to drive fundamental shifts in agricultural, forestry and industrial practices for fibre production, the use of closed-loop and wastewater treatment systems, and circularity from textile design to end of life. Consumers can also play a pivotal role on the demand side, provided they have the information they need to help them make better buying decisions. This requires clearer product labelling that provides details of sustainable water use, along with communication campaigns to build consumer awareness of the social and environmental costs – and benefits – of textile goods. This transition from a textile sector that externalizes water costs to one that internalizes responsibility requires these actions to occur together. Such collective water stewardship will ultimately determine whether global demand for textiles can be met while preserving the world's most precious resource for future generations.

## About the authors

**Bhargabi Bharadwaj** is a research associate in the Environment and Society Centre at Chatham House, where she has led research on transboundary water governance and bolstering food system preparedness in crisis contexts. Her work seeks to bridge high-level policy and on-the-ground implementation capacity, with a strong emphasis on natural resource governance. Bhargabi is the co-host of The Climate Briefing, a podcast by Chatham House, where she interviews global leaders and experts on the intersection of geopolitics and international climate politics. She also serves as an Intergovernmental Panel on Climate Change (IPCC) Chapter Scientist for Working Group III.

Previously, Bhargabi worked with the UK's Climate Change Committee (CCC), where she led and contributed to the 2023 Statutory Progress Reports to Parliament and Devolved Administrations. Her international experience includes a tenure with the UN in the Democratic People's Republic of Korea, managing humanitarian and development framework coordination. She holds an LLM in Public International Law from the London School of Economics and Political Science, as well as a Bachelor of Laws from the University of Kent.

**Ruth E. Mathews** is a senior water governance specialist and thought leader in water footprint assessment, value chain water risks, cross-sector governance and water stewardship. Her work focuses on strengthening coordination across public, private and civil society actors, and on developing practical methods and guidance that enable organizations to address trade-offs and systemic risks. As founder and principal of Currents Converge, she supports governments, companies and civil society in advancing holistic governance across sectors and ecosystems.

Ruth previously served as executive director of the Water Footprint Network, where she led global efforts to operationalize water footprint assessment. She also directed the Source-to-Sea Programme at the Stockholm International Water Institute, and has held leadership roles with WWF and The Nature Conservancy. She has implemented projects and capacity-development initiatives globally.

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Jack has held several global advisory roles, including as a member of the UK Government Circular Economy Task Force, a specialist adviser to the UN Economic Commission for Europe on ESG traceability of sustainable value chains in the circular economy, a member of the World Business Council for Sustainable Development's Global Circularity Protocol, and a member of the TESS expert group on circular economy and trade. He holds a PhD in circular economy innovation policy (University of Strathclyde), along with degrees from the University of Cambridge, the University of Edinburgh and Aalborg University.

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Cover image: Laundered, used pairs of jeans hung out to dry before being sold in a second-hand clothes market Kolkata, India, on 17 January 2026.
Photo credit: Copyright © Avishek Das/SOPA Images/Getty Images

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