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Water Unequal Exchange: Embedded Groundwater, Chemicals, and Wastewater in Textile Trade from Bangladesh to the EU and the USA (2000–2023)

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Abstract: Textile dye production requires significant amounts of water and chemicals, generating substantial wastewater, which places significant burdens on local environments and water resources. Bangladesh is a global textile dye hub, exporting primarily to the EU and the USA. This research explores Water Unequal Exchange (WUE), which arises when high-income countries (HIC) externalize water use and pollution from consumption and production to low-income countries (LIC), driving environmental degradation beyond their borders. To determine WUE, this paper measures wastewater, groundwater, and chemicals embedded in Bangladesh's textile trade to the EU and USA between 2000 and 2023. This is based on the net weight of the top 18 textile imports from Bangladesh, provided by the UN Comtrade Database. This paper finds that 3,942,091 million liters of groundwater, 10,792,675 million grams of chemicals, and 2,860,420 million liters of wastewater are embedded in these textile imports. The prices per kg of textiles differ depending on product type, and the highest volume of textile product categories have the lowest price per kg. In conclusion, the textile trade from Bangladesh to the EU and the USA represents a case of WUE, where Bangladesh disproportionately internalizes resource over-extraction and environmental impacts from dye production for low economic gain.

Keywords: textile dye; Water Unequal Exchange; groundwater; chemicals; wastewater; Bangladesh; EU; USA

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1. Introduction

The global production, consumption, and disposal of textiles have a significant impact on local water resources, environmental sustainability, human health, and broader society due to their heavy reliance on clean water and the use of toxic chemicals. The textile industry is responsible for 20% of global wastewater pollution, is the second-largest consumer of water worldwide, and uses over 15,000 different chemicals, some of which are toxic to human health and the environment [1,2]. Textile production has grown exponentially and is expected to keep rising in the coming years, leading to a 50% increase in water consumption by 2030 [2]. In addition, water insecurity and chemical pollution are interconnected and increasingly important aspects of the climate crisis. Over the past two decades, global chemical production almost doubled from 1.2 to 2.3 billion tons and is expected to triple by 2050 [3,4]. As a result, thousands of synthetic chemicals are released into the environment without the scientific ability to meaningfully assess the volume, composition, and toxicity that the Earth system can tolerate [4–6]. Although toxic chemicals and water use are prevalent across the entire global textile value chain (GTVC), from the

production of raw materials through to the disposal of clothes, textile dye, also referred to as wet processing, uses the most water and toxic chemicals [2,7,8] and the impacts are unequally distributed across the globe. Most dye factories are located in China (44%) and Bangladesh (28%), placing a significant burden on local freshwater resources and causing chemical pollution [9,10]. While the EU and the USA are the most significant consumers and importers of clothes, the majority of the chemicals and water used in textile production occur outside the EU and the USA [2,11]. To reveal the unequal impacts of textile trade, this study applies the concept of ecological unequal exchange (EUE), which arises when high-income countries (HIC) shift the environmental burdens of consumption and production to low-income countries (LIC) and contribute to the overuse, pollution, and degradation of their natural resources [12]. Since EUE is yet to be applied to water, textiles, and Bangladesh, and acknowledging that water and chemical use form the main environmental burdens from textile dye production, this paper limits the scope of EUE to water and chemicals. This involved investigating the Water Unequal Exchange (WUE) by measuring wastewater, groundwater, and chemicals embedded in Bangladesh's textile trade to the EU and USA between 2000 and 2023. Through these calculations, this paper reveals the hidden environmental cost of textile over-consumption and production and showcases how the international textile trade compromises sustainable development in the context of production.

Bangladesh is the world's second-largest textile exporter, disproportionately dependent on this industry. Textiles represent 89% of total exports, making the country economically vulnerable to global fluctuations in prices and demand [13,14]. In addition, Bangladesh primarily produces cotton products and is, therefore, the world's largest net importer of cotton [15,16]. Compared to China, Bangladesh scores low in terms of economic complexity (−1.03), ranking 113 out of 132 countries, confirming an overreliance on a narrow range of exported goods [17]. The textile industry is also the second largest employer within the country, employing around 4.10 million people, of whom 65% are women [16,17]. The EU (57%) and the USA (17.7%) are Bangladesh's largest textile export markets, accounting for around three-quarters of the overall total [18]. On the contrary, Bangladesh remains a small trading partner to the EU and the USA. Only 6.14% of the USA's total textile imports come from Bangladesh, and this is around 18% for the EU [14,19]. Compared to the USA, Bangladesh is the EU's second-largest supplier of textile products, benefitting from the EU's Everything But Arms (EBA) scheme, which allows for tariff-free imports from least developed countries (LDCs) [19,20]. In return, the EU's main exports to Bangladesh are Machinery (39.5%) and Chemicals (19.7%) (19). This reinforces a trade structure in which high-value products flow from the EU to Bangladesh, while Bangladesh produces low-value goods for export and disproportionately faces the environmental risks and harms associated with production. In addition, the USA's main exports to Bangladesh consist of iron/steel (26.3%), raw cotton (15.4%), soybeans (14.6%), minerals and petroleum (14.8%), and organic chemicals (4.74%) [18]. While no tariffs are added by the EU, a rate of 15.2% is imposed on Bangladesh's textile goods in the US market [21].

Due to its high reliance on water and chemicals, textile dye production has a significant impact on the environment in Bangladesh. Most textile dye factories are concentrated along the river systems of the Dhaka division, including the Buriganga, Dhaleshwari, Shitalakshya, and Turag Rivers [22,23]. This has contributed to the degradation of local water systems, including groundwater depletion, river contamination, and loss of aquatic biodiversity. As a result of declining aquatic ecosystems, citizens face unsafe drinking water and health implications, agriculture and fishing industries experience declining stocks, and communities experience diminishing wellbeing [13,22,24]. Textile dye production has contributed to the over-extraction of groundwater in Dhaka, causing a significant decline in

the water table—roughly three meters per year compared to the country's overall average of 0.50–1 m [25]. The Bangladesh Government has made several attempts to minimize textile pollution and protect the environment. For instance, the Bangladesh Environment Conservation Act 1995 mandated measures aimed at regulating wastewater discharge and promoting safer waste disposal [26]. In 2009, the Department of Environment declared Dhaka's rivers ecologically critical [24]. In 2019, the High Court of Bangladesh ruled that these rivers are 'legal entities' with similar rights to living things [22]. Despite these legislative efforts, water resources remain over-extracted and highly polluted, leaving the issue unresolved. This may emerge from a combination of factors, including rapidly growing textile demands, power asymmetries between the national government and international companies, lack of funding and personnel to strengthen enforcement of national regulations, and weak international efforts to minimize toxic chemical use.

To evaluate whether WUE exists within Bangladesh's textile exports, this paper measures chemicals, groundwater, and wastewater embedded in textiles traded to the EU and USA between 2000 and 2023. The trade data stem from the UN Comtrade Database, which provides time series data for EU and USA textile import data from Bangladesh in net weight, while the footprint calculations stem from Uddin et al. (2023) [16]. As outlined in Section 2, this study is grounded in a review of the existing research on EUE application, various methodologies applied to reveal resource use and environmental impacts in global value chains, as well as the impact of textile dye on water resources in Bangladesh. This highlights that EUE is underexplored within textiles and is yet to be applied to water and Bangladesh, which this study aims to explore. Section 3 shows the methodology applied, data sources used, and the limitations of this study, which reveals the originality of the definition, calculations, and conceptualization of WUE that this paper represents. In addition, Section 4 illustrates the trends in Bangladesh's textile trade value and weight by HS products (2000–2023) as well as the volume of wastewater, groundwater, and chemicals embedded in textile imports to the EU and USA between 2000 and 2023. Lastly, Section 5 evaluates the existence of WUE in this case study and concludes in Section 6 that the textile industry has led to the degradation of water resources in Bangladesh.

2. The Existing Literature

2.1. Ecological Unequal Exchange (EUE)

Ecological Unequal Exchange (EUE) is a theoretical concept initially emerging from the Dependency and World System theory [27]. The concept reveals the inequality embedded in global value chains by highlighting the distribution of natural resource overuse and environmental consequences across countries [28]. The textile industry is a consumer-driven value chain due to the economic value being concentrated within consumer markets and international companies [29]. Most textile products are designed and consumed within HIC, while LIC often manufactures and disposes of these products and tends to bear the negative environmental externalities of production [12,30,31]. As a result, economic gains are concentrated in HIC, where international clothing companies' headquarters are often located, and design, marketing, and consumption take place [12,30,31]. Due to this, global value chains tend to cause a structural dependence where LICs are locked into a long-term reliance on the overextraction of resources, low environmental regulations, and substantial pollution and ecosystem degradation for limited and short-term economic gain [12,30,31]. The literature often distinguishes between peripheral and core regions, in which core regions represent HICs that dominate global trade, finance, and innovation, while periphery regions represent LICs that tend to supply natural resources and cheap labor and often face economic dependence and exploitation [32,33].

Some studies have applied EUE as a quantitative measure to showcase the asymmetric flow of resource inputs and environmental impacts, in which most results confirm the existence of EUE within GVCs. Dorninger et al. (2021) investigate asymmetric net transfers of resources through international trade and show how HIC tends to accumulate capital and over-extract resources in LIC [30]. Zhai et al. (2024) find that agricultural trade primarily contributes to cropland soil erosion in LIC, while HIC receives higher economic gains [34]. This study also suggests that within major agricultural societies, the environmental costs outweigh the economic gains. However, most studies focus primarily on greenhouse gas (GHG) emissions [34]. Zhang et al. (2023) confirmed EUE by showing GHG emissions being much higher from China's exports to the EU than GHG emissions from the EU's exports to China [35]. Similarly, Tunç et al. (2022) found that GHG emissions from Turkey's exports to the EU exceed the EU's GHG emissions from its exports to Turkey [36]. This is supported by Prell and Feng (2016), who examined carbon trade imbalances among 172 countries and identified a pattern whereby HICs import more carbon-intensive goods and outsource emissions to producing countries [37]. Only a small subsection of studies focuses on water and chemical pollution. Fitzgerald and Auerbach (2016) investigated how exports from LICs affect their water resources and found that HICs lower their production-related water footprint and vertical water exports by relying on LICs [27]. Tong et al. (2022) quantify the emissions from polybrominated diphenyl ethers (PBDEs) trade, showing that core regions benefit from product use while offloading toxic pollution to semi-core and peripheral regions [38]. Yu et al. (2014) assessed the unequal exchange of emissions, water, and land between China and 186 countries. This study finds that core regions, such as the USA, the EU, Japan, and South Korea, externalize adverse environmental impacts by importing goods produced in China [39]. Taken together, this literature review illustrates that water is an underexplored domain of EUE, and no studies were identified applying EUE to Bangladesh or the textile trade.

2.2. Environmental Impact Assessment Tools Applied to Products and Trade

Most EUE studies apply the Multi-Regional Input–Output model (MRIO), which measures the flow of environmental resources and pollution, such as embedded emissions or water [35,37,39–41]. However, these calculations are often combined with footprint analysis or Life Cycle Assessment (LCA) to ascertain the resources consumed and pollution associated with the product under analysis. For instance, Water Footprint (WF) analysis measures the total volume of direct and indirect freshwater used to produce a good, whereas MRIO shows the resource flows across global supply chains [42]. Limited studies have analyzed the WF of textile dye products in Bangladesh. However, Uddin et al. (2023) conducted interviews in 18 factories to identify chemical and water use in wet processing [16]. These factories are located within the four textile clusters of Dhaka, including Savar, Tongi, Narayangani, and Gazipur. The results demonstrate that, on average, producing 1 kg of textiles requires 164 L of groundwater, generates 119 L of wastewater, and uses 449 g of chemicals. Their study also indicates that water and chemical use differ depending on fiber type and the color of dye needed [16]. For instance, 1 kg of textile processing uses 80–300 L of water and 152–705 g of chemicals. Most of the factories assessed are cotton-based, which involves a higher demand for reactive dyes. In addition, dark-colored fabric represents half of production and demands more water, dyes, and chemicals to produce [16]. These findings align with other research within the existing literature. UNEP (2022) establishes that, on average, 1 kg of textile during wet processing requires 580 g of chemicals [1], while Niinimäki et al. (2020) highlight that a European company uses over 466 grams of chemicals per kg of textiles during wet processing [2]. In addition, LCA is a measure used to evaluate the environmental impacts

of a product throughout its entire life cycle [43]. Although several studies apply LCA to textiles, limited papers were found specific to Bangladesh. One exception is Alam et al. (2023), who conducted the LCA of knitwear production in Bangladesh by focusing on environmental impacts and water usage [44]. Their paper highlights that the dyeing process and fiber production, particularly cotton cultivation, are the primary contributors to the environmental burdens in the country. Islam et al. (2024) investigated the environmental impact of 1000 cotton polo shirts in Bangladesh using the LCA method [45]. Their research revealed that during the wet processing stage, the production of these polo shirts consumed significant resources: 77,174 L of water, 668 kilowatt-hours of electricity, 3458.7 cubic meters of gas, and 242.11 L of steam [44]. Additionally, this process generated large amounts of wastewater, amounting to 79,232.6 L, and solid waste of 86.96 kg [44]. Piyash and Dipu (2024) combine WF and VWT to investigate the water usage and pollution associated with the textile sector, focusing on dyeing, printing, and finishing within three companies, KDS, FOURH, and AMBER [46]. This study finds that these industries result in significant water usage and pollution, and that a substantial amount of water is embedded in trade [46]. Besides this paper, limited studies have applied LCA or WF and Virtual Water Trade (VWT) to Bangladesh's textile exports.

Similar to EUE, the VWT measures the volume of water embedded in traded goods and relies on WF or LCA calculations of a product as the foundational methodology [42]. VWT measures water embedded in products traded and assesses a nation's dependence on water resources in other countries [47]. According to Oki et al. (2017), as freshwater is unequally distributed globally, VWT allows water-scarce countries to import water-intensive goods, which enhances economic efficiency, while acknowledging that countries with high GDP per capita have greater potential to mitigate water stress through trade [48]. Most studies applying VWT to textiles focus on China, where most studies found that China was a net exporter of industrial VW trade [49–54]. Wang and Zhou (2023) highlight that textiles were one of China's main sectors for virtual water (VW) exports, characterized by high water use, significant pollution, and low value added [49]. The primary destinations for these industrial VW exports are the USA, the EU, and Japan [48]. While both VWT and EUE explore the international water flow embedded in trade, VWT is more commonly applied. EUE, on the other hand, places greater emphasis on the unequal local environmental effects of water resources associated with international trade. Overall, while both EUE and VWT have been extensively studied in the context of China, there has been comparatively limited research on their application in Bangladesh.

2.3. Water and Chemical Use in Textile Dye Production

The impact of textile dye production on local water resources is widely researched. Studies find that the textile dye process relies on substantial quantities of chemicals and clean water, causing significant resource extraction and environmental pollution [55,56]. Several studies review the chemicals used in textile dye production and find that many are toxic, harming local aquatic ecosystems and human health [57–62]. Synthetic dyes are the primary source of coloring. Azo dyes represent the largest type of these, accounting for over 50% of dyes used in textile production globally [55,61]. Several studies group synthetic dyes based on chemical structure and application, including azo, anthraquinone, sulfur, phthalocyanine, and triarylmethane, while the applications include reactive, direct, dispersed, basic, and vat dyeing [59–61,63]. However, the volume of chemicals and water added depends on the fiber used, such as cotton or silk, and the color needed, such as black or red. For instance, in Bangladesh, dark-colored fabrics represent half of the production, which demands more water, dyes, and chemicals than lighter shades of clothing [16]. In addition, textile dye also relies on heavy metals for bold colors, such as chromium, nickel,

lead, manganese, zinc, copper, and arsenic [57,60,64,65]. These metals are discharged as wastewater from textile industries into the surrounding environment, where they accumulate and cause various human health problems. Several case studies in Bangladesh assessed heavy metals and found high concentrations in rivers, impacting surrounding communities [16,24,66–70]. Persistent Organic Pollutants (POPs) and per- and polyfluoroalkyl substances (PFAS) chemicals are also applied during this stage [1]. These similarly accumulate in the environment, persist indefinitely, and pose significant risks to human health [5,71]. Morales-McDevitt et al. (2022) measured PFAS in Dhaka's water and air, finding particularly high concentrations around textile production sites [71].

In addition, the textile dye industry depends on high-quality and large volumes of clean water, straining water resources and diminishing access to safe drinking water for surrounding communities [10,16,72]. According to Chakraborty and Ahmad (2022), in Bangladesh, producing 1 kg of knitted fabric requires 120–220 L of clean water during the dyeing process, while a 1 L reduction will translate to a 12.80% reduction in chemical consumption [10]. This causes a significant amount of wastewater to be released into surrounding water systems. This is supported by Zhang et al. (2023), who find that wet processing constitutes 72% of the total water consumption by the textile industry, in which 100–180 L of water is used to dye 1 kg of textile [8]. In addition, Nahar et al. (2024) find that the textile dye industry in Bangladesh primarily relies on groundwater, leading to a significant decline in the water table around the textile clusters [17]. This study claims that 250 to 300 L of water is required to produce 1 kg of fabric in Bangladesh [17]. Due to the high amounts of clean water used and chemicals added, substantial wastewater is produced and released into the surrounding ecosystems. According to Khan et al. (2023), both treated and untreated wastewater carry chemicals with organic contaminants [57]. Hossain and Hossain (2020) find that in Bangladesh, textile dye production generates high amounts of wastewater, of which only 50% is estimated to be treated [73]. This wastewater is high in color, biochemical oxygen demand (BOD), chemical oxygen demand (COD), temperature, and toxic chemicals, which are highly disruptive to aquatic ecosystems. This impairs photosynthesis, inhibits plant growth, causes bioaccumulation, promotes toxicity, and enters food chains [22,57,59,60,64,65,70,74].

The significant water and chemical use produces substantial wastewater, which, in turn, causes high water pollution. Many case studies establish a clear link between chemicals used in textile dye and water pollution in Bangladesh. Hossen and Mostafa (2023) applied a heavy metal pollution index (HPI) to analyze the concentration of 12 types of heavy metals and demonstrated that 83.3% of water bodies exceeded the standard threshold limit [66]. Their study also finds that heavy metal concentrations were highest in Dhaka, where 10 out of 11 samples were deemed unsafe for drinking [66]. These results were supported by Hossain and Hossain (2020), who illustrated that most indicators crossed the standard limit within the five rivers of Dhaka [73]. Uddin et al. (2023) similarly highlight that Dhaka's lake water is severely contaminated with heavy metals [69]. Uddin and Alam (2023) also observe that heavy metal pollution in rivers and canals around Dhaka, Narayanganj, and Gazipur is high due to untreated textile wastewater [67]. By contrast, Shamsuzzaman et al. (2021) find that only 40% of factories produce clear wastewater before releasing the effluent into the environment [74]. Taken together, while the case studies investigate different rivers, factories, and types of chemicals, they collectively illustrate that the textile industry is considered one of the major polluters in Bangladesh in general and in its ground- and surface-water reservoirs, in particular [16,22,24,59,61,67–70,72,74,75]. The case studies also show that water does not meet basic requirements for domestic, drinking, fishing, and industrial uses [24,66,69].

Moreover, there is a general consensus that textile dye affects humans in the place of production. Rahman et al. (2021) find that Bangladesh's river water is unsuitable for swimming or supporting aquatic life due to the high concentrations of toxic chemicals from textile dye [76]. Rahman and Rahman (2024) find that the poor water quality of the wastewater released in the Madhabdi area of Bangladesh is harmful to human health and makes surface water unsuitable for agricultural irrigation [77]. Sharma et al. (2021) suggest that when aquatic habitats become contaminated, the contaminants enter the food chain and cause health implications [61]. These health impacts stem from the use of chemicals such as azo dyes, which can be carcinogenic and cause skin irritation and allergic reactions [59]. Similarly, the intensive use of heavy metals in textile dye and their release into the surrounding environment can also cause problems, including bone disorders, cancer, kidney failure, brain damage, and memory problems, among others [64]. Although there are many case studies on how textile dye impacts local environments, there is less focus on the broader textile trade and the unsustainable inequalities it represents.

3. Methodology, Data, and Limitations

3.1. Methodology

Given that water resources in Bangladesh are overused and polluted by textile dye production, this paper investigates the theoretical concept of WUE by measuring the volume of groundwater (GW), chemicals (C), and wastewater (WW) embedded in textiles imported by the USA and the EU. This concept stems from EUE and is limited to water. As such, WUE arises when HICs shift the water-related burdens of their consumption and production to LIC, contributing to the depletion and degradation of water resources and externalizing these negative environmental impacts beyond their borders [12]. Figure 1 visualizes this conceptual framework by showing the three interconnected steps involved. First, WUE is defined by selecting the relevant environmental indicators, GW, C, and WW. Second, the existing footprint analysis is used to determine the GW, C, and WW embedded in 1 kg of textiles. In this case, Uddin et al.'s (2023) footprint analysis findings revealed that 164 L of GW, 119 L of WW, and 449 g of C are used in 1 kg of cotton textile dyed in Bangladesh [16]. Third, core and periphery regions are selected to represent WUE within the textile trade, in this case, Bangladesh, the EU, and the US.

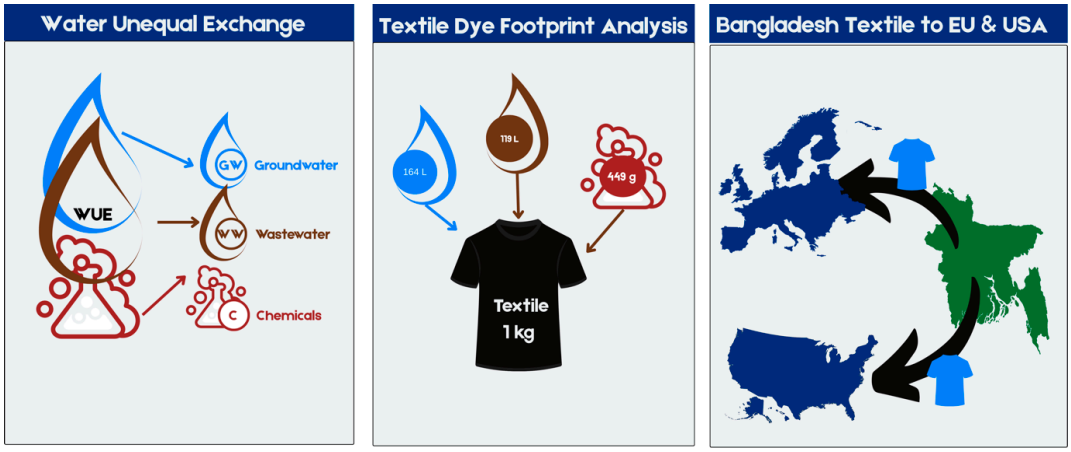


Figure 1. Conceptual framework.

The calculations of groundwater, chemicals, and wastewater embedded in textile imports into the EU and USA from 2000 to 2023 combine footprint analysis from Uddin et al. (2023) with annual net kilo weight per textile product from UN Comtrade data [16,78]. These products were limited to Bangladesh's top 18 exported textile products [14].

The calculations underpinning Section 4 illustrate the total amounts of GW, C, and WW embedded in the textile trade from 2000 to 2023. T = Annual textile import in kg by HS code. For GW, the overall quantity of textiles imported per year is multiplied by the total liters of groundwater used, where a = 164 L of groundwater used per cotton textile kg. This is outlined in the following formula.

$$GW = \sum_{i=2000}^{n=2023} T \times a$$

The calculations applied for chemical use (C) multiply the overall weight of textiles during this period by b = 449 g of chemicals in each kilogram of cotton textiles, based on the equation below.

$$C = \sum_{i=2000}^{n=2023} T \times b$$

To determine wastewater produced (WW) in annual textile imports from 2000–2023, the quantity was multiplied by c = 119 L of wastewater produced in cotton textile (kg).

$$WW = \sum_{i=2000}^{n=2023} T \times c$$

Section 4 also examines the difference between value and weight within the textile trade between Bangladesh, the USA, and the EU by outlining the value generated alongside the volume traded between 2000 and 2023. In addition, this section shows the volume disaggregated by the 18 different types of textiles imported to the EU and the USA between 2000 and 2023. This is designed to highlight the discrepancy among the products while also calculating the difference in price per kilogram for each type of textile product imported into the USA and EU between 2000 and 2023. The formula applied is provided below.

$$HS_{value} = \frac{\text{Total Economic Value}}{\text{Net weight}} \quad (1)$$

HS values refer to the economic value of the Harmonized System (HS) code for textiles, expressed in USD per kilogram (USD/kg). The total economic value is represented in USDs for each HS code, while the net weight is measured in kilograms (kg) for each HS code.

3.2. Data Selection and Source

The trade data in weight and value by HS code stem from UN Comtrade data (2025), while the selection of textiles stems from OEC data (2025) [14,78]. UN Comtrade data capture the weight and import value into the EU and USA, which refers to the value of textiles when they arrive at their destination. OEC data primarily focuses on export value from Bangladesh, indicating the value of textiles at the point of export. The value captured and the volume traded within the GTVC are two separate measurements, and international trade data are primarily shared in terms of value. UN Comtrade data provide a more comprehensive account, showing both value and weight. The WUE calculations are based on quantifying the GC, C, and WW volume embedded in textile products. The top 18 exported textile products from Bangladesh as of 2023 were selected from the OEC data platform [14]. Table 1 outlines the names and harmonized system (HS) codes of these products, the percentage share of textile exports, and the value generated in 2023 [14]. HS codes classify the textile products traded and are an international standardized system set by the World Customs Organization (WCO) to regulate and monitor international trade. The assigned HS code can be 2, 3, or 6 digits long, depending on the level of classification detail [79]. Given that weights are only reported by the 4-digit HS code, this paper performs

the product disaggregation at this level. As shown in Table 1, the 18 products included represent 91.68% of total textile exports from Bangladesh in 2023 and accounted for USD 44.9 billion in 2023.

Table 1. Textile products by HS codes included in WUE calculations.

No	Name	HS Code	Share of Textile Exports in 2023	Value (Billion USD) in 2023
1	Knit T-shirts	6109	16.00%	7.83
2	Non-knit men's suits	6203	15.70%	7.68
3	Knit sweaters	6110	13.60%	6.68
4	Non-knit women's suits	6204	11.50%	5.64
5	Knit women's suits	6104	6.31%	3.09
6	Non-knit men's shirts	6205	5.20%	2.54
7	Knit women's undergarment	6108	2.77%	1.36
8	Knit men's shirt	6105	2.76%	1.35
9	Non-knit men's coats	6201	2.49%	1.22
10	Knit men's suits	6103	2.24%	1.09
11	Knit men's undergarments	6107	2.20%	1.08
12	Knit babies garment	6111	2.12%	1.04
13	Non-knit women's coats	6202	1.97%	0.965
14	Non-knit women's shirts	6206	1.69%	0.827
15	Felt or coated fabric garments	6210	1.37%	0.668
16	Other women's undergarments	6212	1.29%	0.632
17	Other knit garments	6114	1.27%	0.621
18	Non-knit active wear	6211	1.20%	0.588
	Total		91.68%	44.901

Source: Authors' own illustration based on OEC Data (2025) [14].

Taken together, this paper used OEC data for the selection of textile products based on value. As these data only show value and not the volume of goods, UN Comtrade data were used to determine the amount of kilograms traded. The data used from the UN Comtrade Database (2025) rely on the EU and the USA's textile imports from Bangladesh in net weight by HS code between 2000 and 2023, as there are no time series data available from Bangladesh on textile exports [78]. These two regions, the EU (57%) and the USA (17.7%), were selected because they are Bangladesh's most significant export markets [14]. In addition, as UN Comtrade data only show the weight in four-digit HS codes, the products were selected based on four-digit HS codes instead of a higher level of analysis, such as two-digit HS codes.

3.3. Limitations and Assumptions

There are several limitations to account for in this paper. First, the central assumptions underpinning the measurements stem from the reviewed literature and presuppose that the products traded are dyed within Bangladesh, cotton-based, and solely rely on groundwater for their production. Bangladesh is the world's largest net importer of cotton, and most textiles produced in Bangladesh are cotton-based [15,16]. It also relies solely on groundwater for its production and produces high amounts of wastewater [16,17]. Second, the footprint analysis involves calculating the average GW, C, and WW embedded in textile products. However, as discussed earlier, these three indicators fluctuate significantly depending on the fiber used and the color needed. Since cotton makes up the largest share of fiber used in Bangladesh, textile HS codes do not distinguish between fiber types, and no time series data were found on the fiber used in Bangladesh's textile exports; this study relies on cotton textile footprint calculations. Third, Bangladesh is the biggest net importer of raw cotton, and cotton also leaves a significant water footprint during the agricultural stage [10,15,45]. These calculations did not account for the water used for cotton cultivation during the agricultural stage, which adds to the complexity of WUE, as these imports represent a

high water footprint that is not internalized by Bangladesh. Fourth, GTVCs are complex, and the insights revealed by international trade data are limited. Given that direct export and import data from Bangladesh are not readily accessible, reliance on USA and EU import data means that it is not possible to identify the quantity of textiles imported into Bangladesh. This makes it difficult to determine the exact percentage of garments exported from Bangladesh that are dyed domestically. As a result, the calculations presuppose that all textiles exported are also dyed within Bangladesh, which may not be the case in practice. Fifth, textile production involves substantial waste and scraps, including cutting shapes or achieving unwanted colors in the fabric, for instance, which are not accounted for in these calculations [14]. Sixth, the EU consists of 27 countries, excluding the UK, as of 2021 [19]. However, UN Comtrade does not state whether it excludes the UK from the EU regional data from 2021 onward due to Brexit. Given that these are time series data, the UK is likely included until 2021, but it has not been added to the 2021, 2022, and 2023 reporting years, which may indicate a drop in import weight. Seventh, there are a few data points that are either missing or far too high, indicating reporting errors. For instance, the EU 2001 data reported extremely high amounts for 6107 and 6108, while no data were provided in 2008 for HS6204, HS6202, and 6210 by the USA [78]. To overcome this issue and significant outliers in the graphs, the weight for the previous year was applied instead.

4. Results

4.1. Trends in the Value and Weight of Bangladesh's Textile Trade (2000–2023)

Bangladesh is the second-largest exporter of textiles in the world, and its most significant export markets are the EU and the USA [14]. The value generated from Bangladesh's textile exports has increased markedly and remains a significant proportion of the total export value over time. Figure 2 shows that the value generated from textile exports increased from USD 5.85 Bn in 2000 to USD 48.9 Bn in 2023, while the value generated from total exports increased from USD 7.25 Bn in 2000 to USD 54.5 Bn in 2023. This means that the textile sector's share of total export value increased from an already high base, rising from 80.69% in 2000 to 89.72% in 2023 [18].



Figure 2. Bangladesh's Textile and Total Value (USD Bn) From Exports between 2000 and 2023.

This study examines Bangladesh's textile trade from two perspectives: the value captured and the volume traded. An overall increase in value does not necessarily indicate a higher price per kilogram. Figure 3 illustrates the trend in the average price per kilogram for 18 textile products imported by the USA and EU from Bangladesh from 2000 to 2023. While import volumes have significantly increased during this time, the average price

received from the EU and USA only rose from USD 13.23 in 2000 to USD 14.76 in 2023, despite rising production costs, including wages and resources.

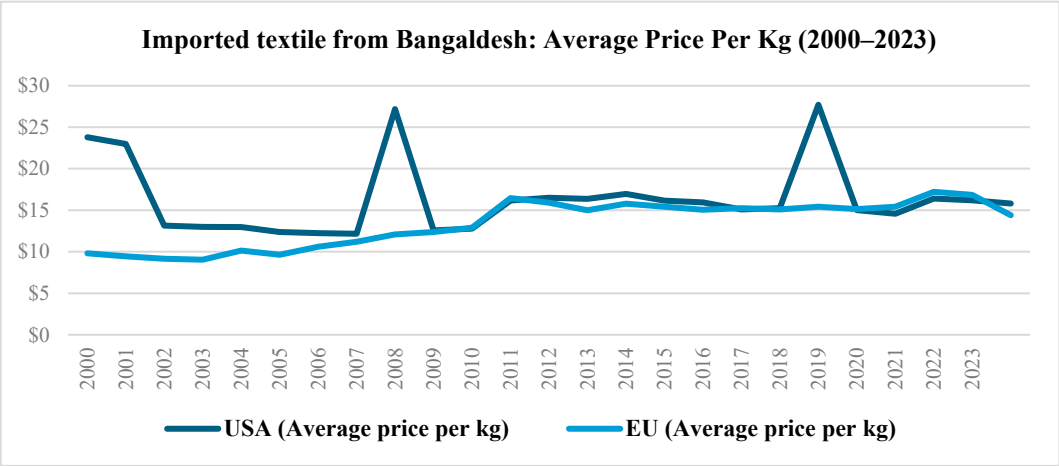


Figure 3. Imported Textile from Bangladesh: Average Price Per Kg (2000–2023).

Moreover, Figure 3 clarifies that the average price fluctuates and differs between the EU and the USA. For example, the price per kilogram for textiles imported into the EU was USD 9.80 in 2000 and USD 14.40 in 2023. In contrast, the price for the USA decreased from USD 23.79 in 2000 to USD 15.80 in 2023. Despite this decline, the price paid by the USA remained higher than that paid by the EU throughout this period. The graph for the USA also shows significant spikes in price per kilogram in 2008 and 2019. These spikes might be due to the 2008 financial crisis and the tariffs imposed by the Trump Administration in 2018. Specifically, prices increased by USD 15 from 2007 to 2008 and USD 12.44 from 2018 to 2019. In both instances, these price spikes were followed by a rebound the next year.

Figure 4 illustrates the EU's most imported textile products from Bangladesh between 2000 and 2023, demonstrating significant growth, with noticeable drops in 2020 and 2023. The graphs indicate that the most imported product in the EU from Bangladesh is knit t-shirts (HS6109), which increased from 76,083,214 kg in 2000 to 262,549,566 kg in 2023—a nearly fivefold rise. Knit sweaters (HS6110) are the second most imported product, growing from 39,264,342 kg in 2000 to 194,046,482 kg in 2023. The third, fourth, and fifth most imported products are men's suits (HS6203), women's suits (HS6204), and women's t-shirts (HS6104), respectively.

Although Figure 3 presents the average price per kilogram of all 18 textile products, the value generated and the price paid for each type of textile depend on various factors such as product complexity and quality demands, among others. In contrast, Figure 5 illustrates the price per kilogram of textile products imported into the EU, categorized by HS Codes from 2000 to 2023. The data reveal significant fluctuations in both the value and price per kilogram of textiles. The graph shows that knit t-shirts (HS6109) represent the majority of textile imports but are also the lowest-priced items compared to other products. For example, the price per kilogram of knit t-shirts increased from USD 7.16 in 2000 to USD 14.15 in 2023, yet it remains the lowest-valued product. In contrast, other women's undergarments (HS6212) command the highest price per kilogram. This is attributed to the complexity of the products, the use of higher-quality materials, and the greater value added. In 2000, the EU paid USD 30.45 for one kilogram of HS6212, which rose to USD 40.20 by 2023. Additionally, the graphs indicate that prices per kilogram vary considerably, likely due to changes in demand, inflation, resource input costs, and labor costs. Notably, the price for coated fabric garments (HS6210) also experienced significant changes from 2000 to 2023, starting at USD 19 in 2000 and reaching USD 26.30 in 2023. Coated fabrics

are waterproof and chemical-intensive, commonly used to make raincoats and backpacks. This product saw its weight increase dramatically, rising from 2,349,736 kg in 2000 to 11,455,848 kg in 2023.

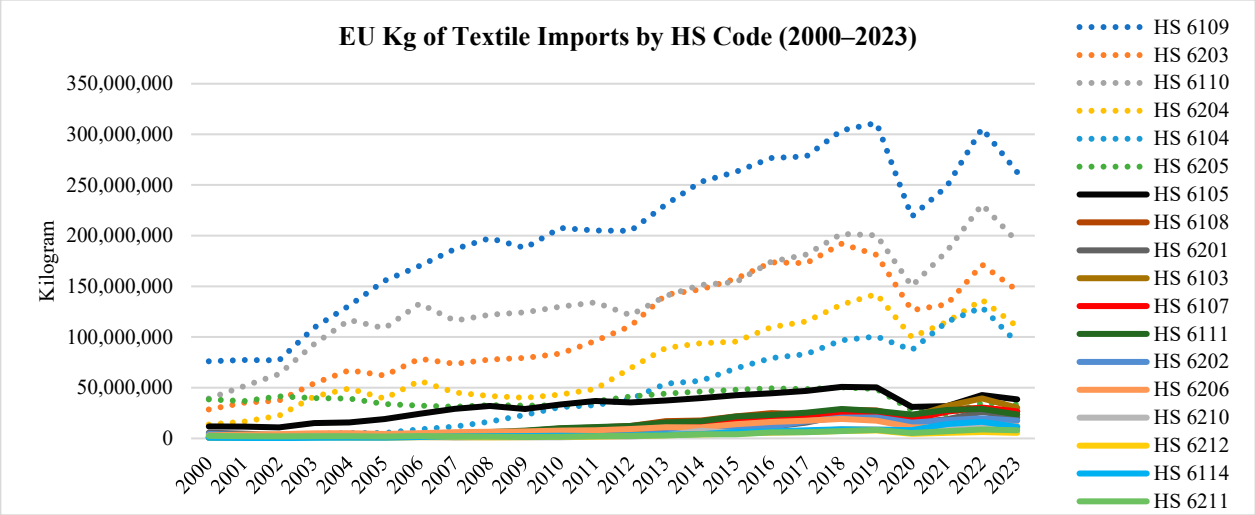


Figure 4. EU Textile Import Weight by HS Code (2000–2023).

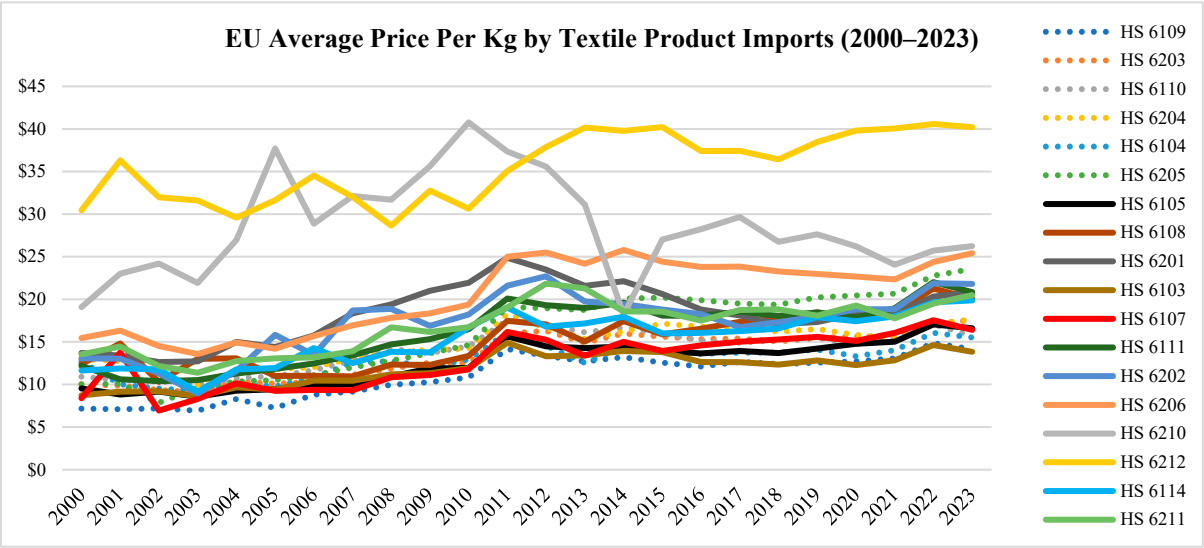


Figure 5. EU average price per kg by textile product imports (2000–2023).

Figure 6 demonstrates the total weight of textile products imported to the USA from Bangladesh by HS code. Compared to the EU, non-knit men's suits (6203) account for most of the textiles imported, as the graph illustrates a nearly tenfold increase from 13,696,246 kg in 2000 to 126,346,141 kg in 2023. Non-knit women's suits (6204) are the second most imported textile product, increasing from 11,674,722 kg in 2000 to 63,120,941 kg in 2023. Lastly, knit t-shirts (HS6109) and knit sweaters (HS6110) represent the third most traded products in 2023, with HS6110 rising significantly after 2019. Figure 6 also shows a significant change in the volume of the various textile products imported throughout the last two decades, with sharp drops recorded in 2008 and 2019. In addition, the most significant amount of textile imports occurred in 2022, but this fell again in 2023. This indicates that the type and volume of textile imports fluctuate through time, and many factors influence these fluctuations, such as rising tariffs, inflation, price fluctuations of resource inputs, competition, and changing consumer demand, among others [78].

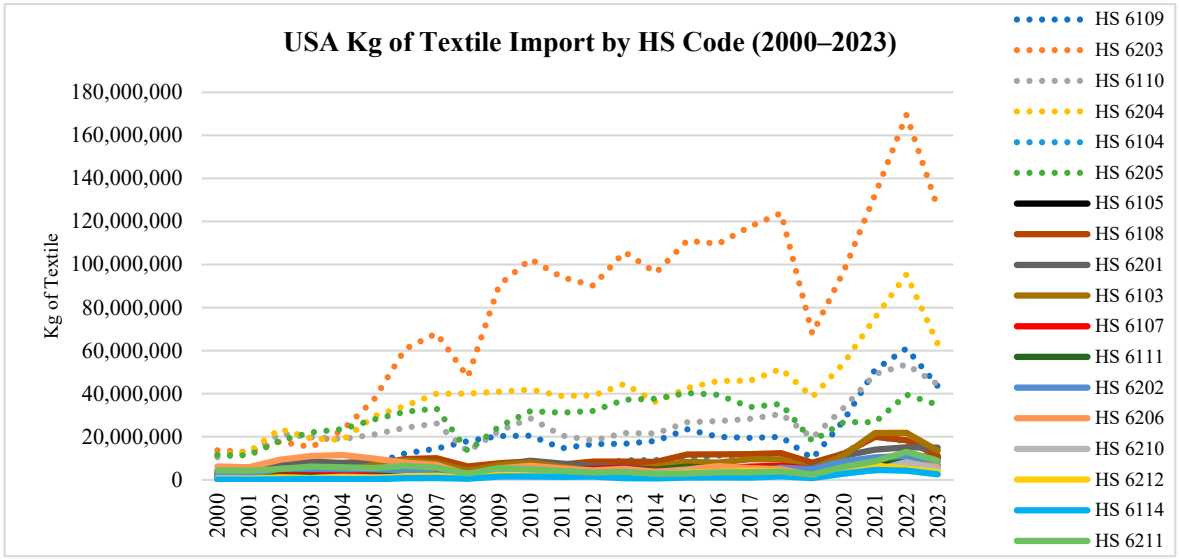


Figure 6. USA Textile Import Weight by HS Code (2000–2023).

The price per kg of HS codes also varies between the EU and the USA. Figure 7 shows the average price per kg of textile products imported to the USA, disaggregated by HS codes from 2000 to 2023. This demonstrates that prices fluctuate significantly over time, and the spike in prices in 2008 and 2019 partly explains the significant drop in imports during the same years. Non-knit men's suits (HS6203) account for the largest textile imports in terms of weight but receive a low price per kg compared to other textile products, decreasing from USD 18.9 per kg to USD 15.1 per kg. In addition, the graph shows that the price per kg of knit men's shirts (HS6105) fluctuated significantly from 2000, where the average price was USD 40.8 per kg, to USD 21.5 per kg in 2023, with a temporary spike to USD 78.1 in 2019. Similar to the EU market, other women's undergarments (HS6212) received one of the highest prices per kg, amounting to USD 56 in 2000 and USD 30.4 in 2023. Also, in line with the EU, HS6109 receives the lowest price per kg. This is USD 18.4 in 2000 and decreases to USD 10.3 in 2023. Despite higher prices paid per kg compared to the EU, USA prices have declined over time and have almost halved when excluding the 2008 and 2019 spikes in prices. By contrast, EU textile prices rose during the period considered [78].

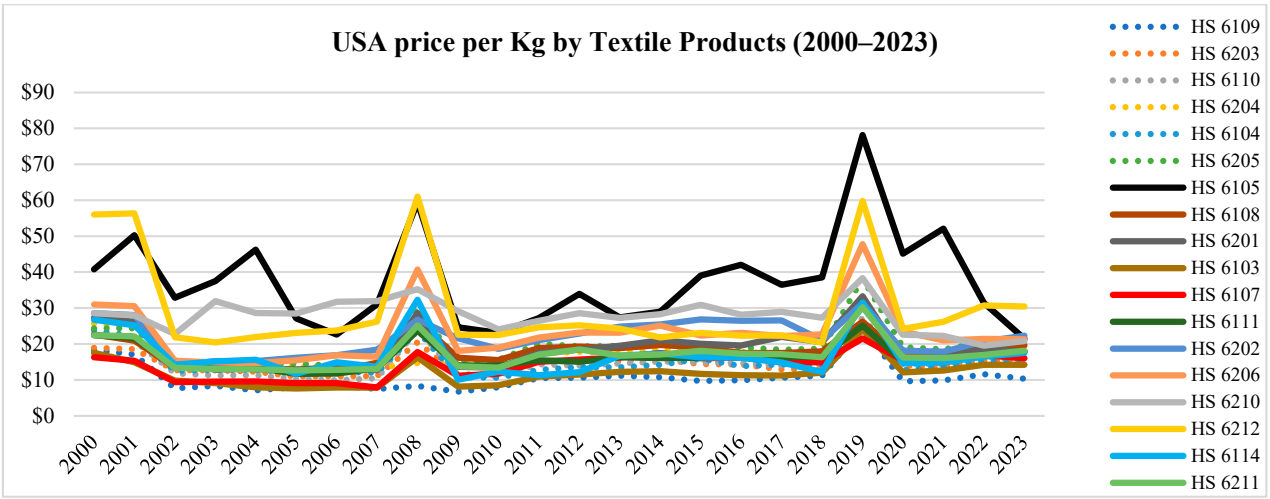


Figure 7. USA average price per kg by textile product imports (2000–2023).

The above figures show a significant gap in the value-to-weight ratio, and higher prices per kg are more likely to align with a lower quantity of textiles imported. Figure 8 shows the total weight imported from the US and the EU by textile products over the last two decades. These graphs show that knit t-shirts (HS6109) represent the highest volume of imports overall, receiving the lowest average price of USD 12.23 in 2023. This is similar to non-knit men's suits (HS6203) (USD 16.32) and knit sweaters (HS6110) (USD 15.71), which are the second and third most imported products. On the contrary, HS6212 has one of the lowest imports in volume and receives the highest price per kg of USD 35.32 in 2023. This is similar to HS6210 and HS6211, which receive USD 23.53 and USD 19.30 per kilogram imported. This suggests that Bangladesh primarily exports high amounts of low-value textiles, meaning that the country relies on exporting large quantities with high resource use and environmental impacts, resulting in low financial gain [78]. Overall, this reflects WUE by showing how Bangladesh bears the environmental costs of production without fair compensation and how the USA and EU reap the benefits and capture the most economic value without internalizing the environmental costs of production.

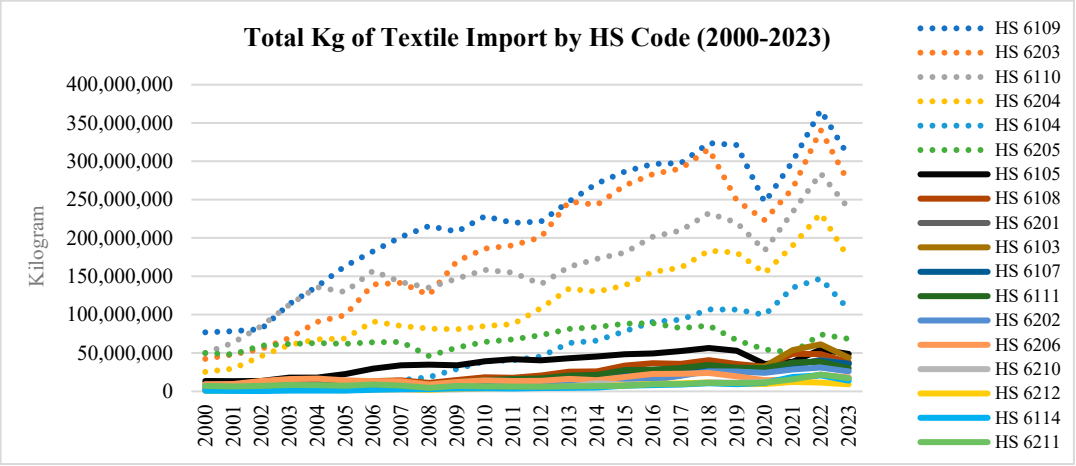


Figure 8. Total weight of textile imports by HS Code (2000–2023).

Figure 9 shows how many millions of kilograms of clothes, for 18 textile products, were imported annually from Bangladesh to the EU and the USA from 2000 to 2023. For the USA, total imports of these products rose from 75.44 million kg in 2000 to 425.38 million kg in 2023, with a cumulative imported quantity of 6305.67 million kg throughout this time period. Similarly, the EU import rose from 232.79 million kg in 2000 to 1072.19 million in 2023. The total accumulated volume of imported textile goods was 1072.19 million kg throughout this period. As a result, the USA and the EU imported an overall total of 24,037.14 million kg of textiles from 2000 to 2023 [78]. In addition, the graph shows a slight and temporary decline in 2008 and 2019 for the USA, 2020 for the EU, and 2023 for both, which might be due to the 2008 financial crisis and tariffs imposed in 2018 for the US, the impacts of the COVID-19 pandemic in 2020 for the EU, and higher inflation and economic uncertainty in 2023 for both importers. Although this shows that Bangladesh is somewhat vulnerable to international economic fluctuations, these import declines tend to quickly rebound, indicating high resilience in GTVCs.

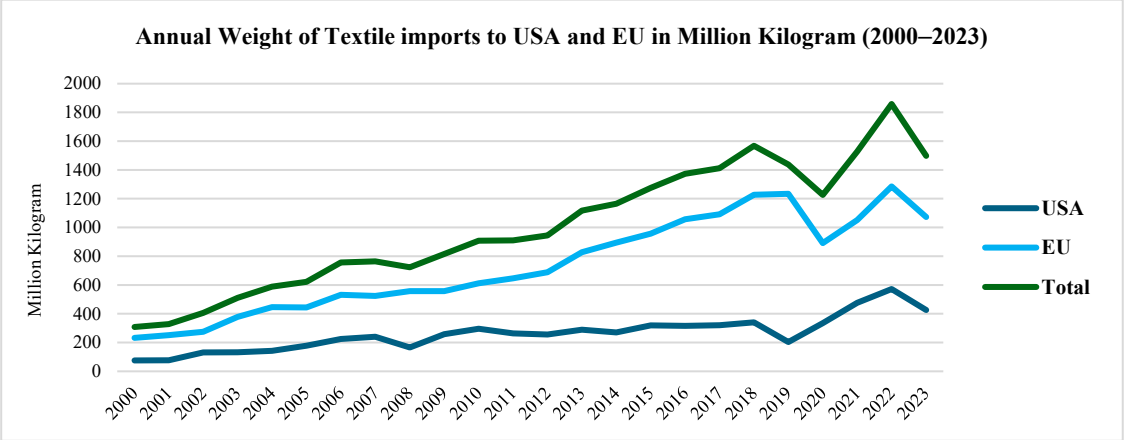


Figure 9. Annual Weight of Textiles imported to the USA and the EU (2000–2023).

4.2. Water Unequal Exchange: Wastewater, Groundwater, and Chemicals in Textile Imports

Compared to the value generated, the volume of textiles imported by the USA and the EU reflects hidden natural resource inputs and environmental impacts as a consequence of production. In particular, textile dye production is associated with the substantial use of water, chemicals, and wastewater, revealing WUE between Bangladesh and the EU and the USA. Figure 10 indicates the total amount of groundwater used during wet processing for the 18 textile products imported to the USA and EU between 2000 and 2023. For the USA, this amounted to 1,034,130 million liters, while 2,907,960.8 million liters of groundwater are used in the textiles imported to the EU. This shows that 3,942,090.8 million liters of groundwater were used to dye and process the EU and USA's imported textile products during this period. Figure 10 also demonstrates that higher amounts of textiles exported are associated with more groundwater use. As a result, the volume of hidden clean water embedded in textile products consumed by the EU and USA represents an asymmetrical exchange where Bangladesh experiences an overextraction of groundwater resources while the EU and USA preserve their own water resources and externalize the environmental impacts of their textile consumption patterns. This WUE amplifies the water scarcity crisis in Dhaka, which has experienced an annual 3 m decline in its water table [25].

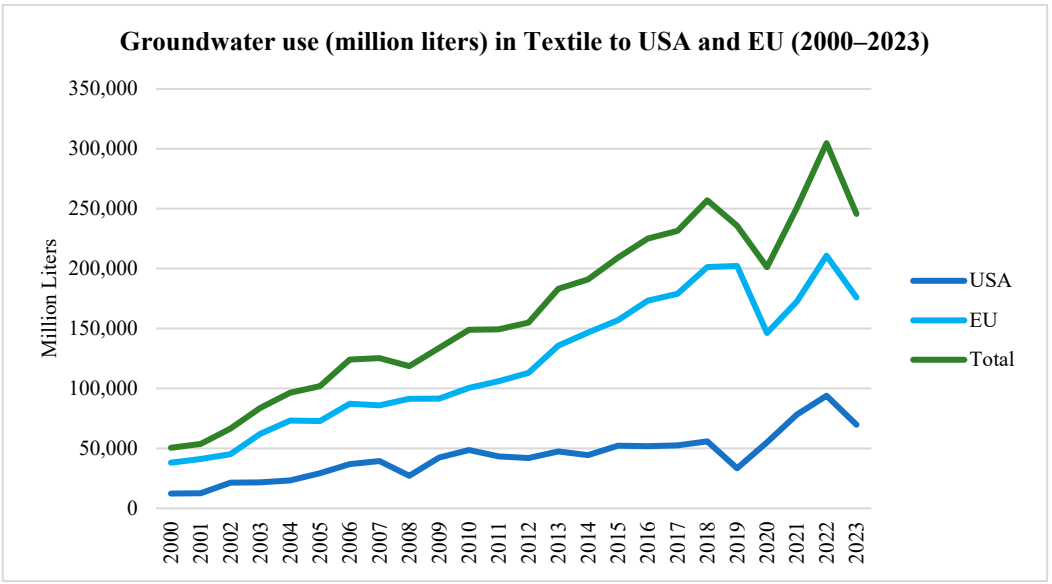


Figure 10. Groundwater use (million liters) in the USA and EU imports from Bangladesh (2000–2023).

Similar to groundwater use, the chemicals applied in textile production also rise as textile imports increase. During textile wet-processing, a high amount of coloring, treatment, and finishing is needed, and producing 1 kg of cotton textiles demands, on average, 0.449 kg of chemicals. Figure 11 illustrates the trend of chemical usage embedded in the textile trade between the EU and Bangladesh from 2000 to 2023 [16]. The graph shows a significant increase since 2010, reflecting the rapid expansion of Bangladesh's textile industry. This graph also shows that the total amount of chemicals embedded in the 18 imported textile products to the EU and USA between 2000 and 2023 is 10,792,675,468 kg. For the USA alone, this amounted to 2,831,246,200 kg, while for the EU, textile imports were 7,961,429,268 kg [78]. These chemical inputs, including dyes, bleaching agents, and other processing products, underscore the environmental pressures associated with textile production [55]. This highlights a further instance of unequal exchange, as Bangladesh bears the costs of water pollution from textile dye production while the EU and USA benefit from low-priced textile consumption and avoid the negative impacts resulting from the use of persistent and damaging chemicals.

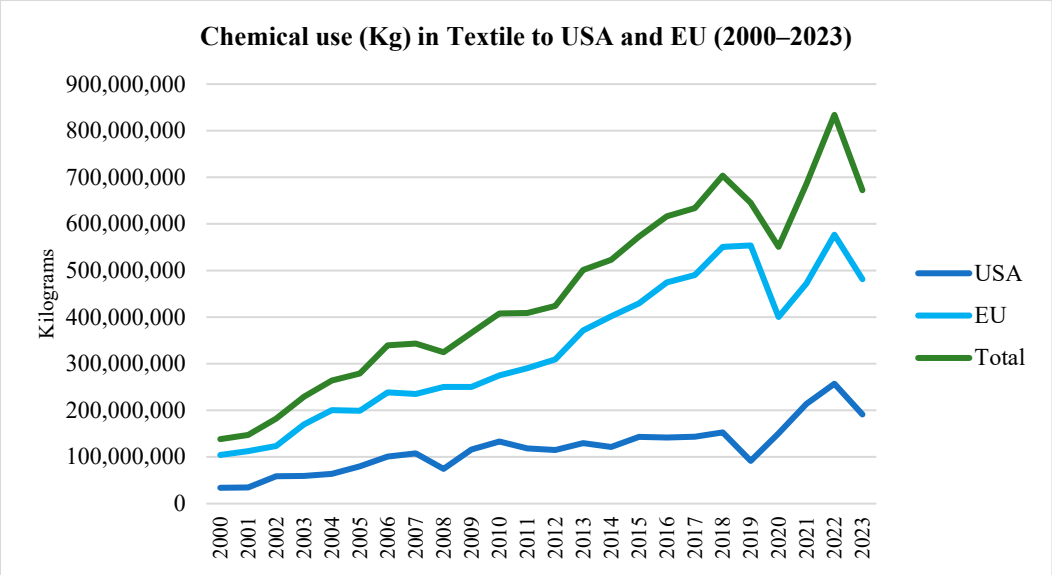


Figure 11. Chemical use (kg) in the USA and EU imports from Bangladesh (2000–2023).

The high water and chemical use translates into a significant amount of wastewater released into the surrounding water systems in Bangladesh. The wet processing of 1 kg of cotton textile can generate 119 L of wastewater, contaminating groundwater and waterbodies, affecting aquatic ecosystems, and harming human health. Figure 12 illustrates the trend of wastewater associated with EU and USA textile imports from 2000 to 2023. The USA textile imports throughout this period contributed to 750,374.8 million liters of wastewater, while EU imports caused 2,110,044.7 million liters of wastewater. This, in total, means that 2,860,419.6 million liters of wastewater were released between 2000 and 2023, resulting from the 18 imported textile products to the EU and the USA. In addition, the graphs show a significant increase over time, corresponding with the rapid growth of Bangladesh's textile industry to meet rising export demands. Peaks in wastewater discharge align with periods of heightened production, particularly after 2010, reflecting the intensive water use and discharge of untreated or partially treated wastewater. This trend aligns with those in groundwater and chemical use and together highlights the environmental burden on local water resources, emphasizing an unequal exchange where Bangladesh shoulders the ecological costs while the EU and USA benefit from affordable textile imports.

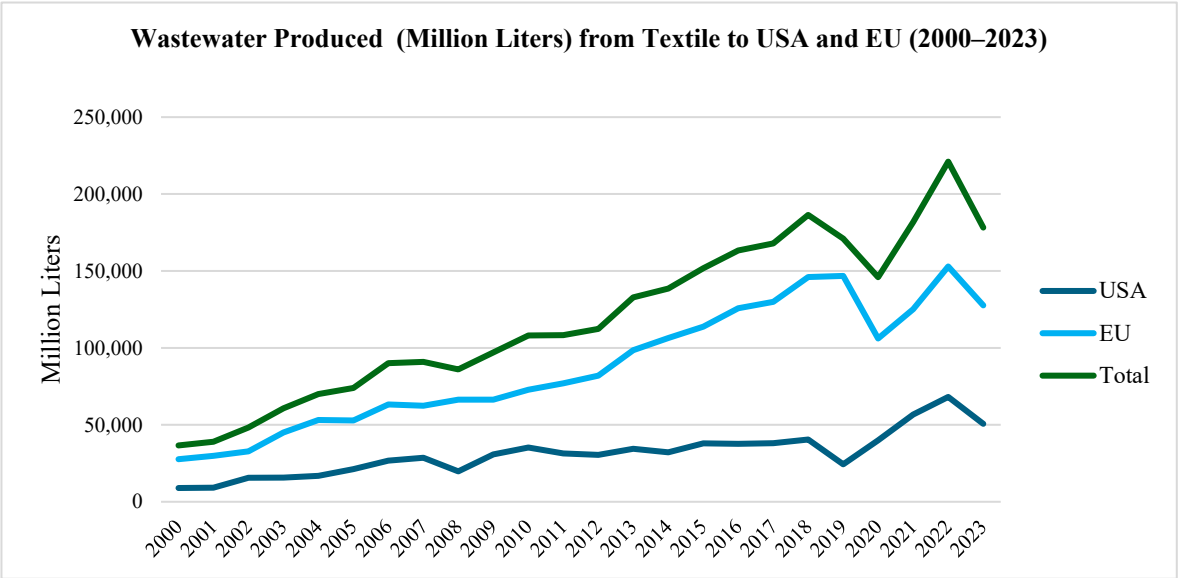


Figure 12. Wastewater Produced (Million Liters) from Textile to USA and EU (2000–2023).

In summary, Figure 13 illustrates the unequal exchange of groundwater, chemicals used, and wastewater released among 18 textile products imported from Bangladesh to the EU and USA between 2000 and 2023. This graph highlights the hidden resource use and environmental costs embedded in the textile trade. WUE suggests that core regions, such as the USA and the EU, externalize water overextraction and ecological degradation to periphery countries like Bangladesh by importing resource-intensive and environmentally damaging goods at a low price per kilogram. In this case, Bangladesh bears the environmental burden of textile dyeing, while the USA and EU benefit from finished products without directly experiencing the associated pollution, environmental degradation, and human health risks associated with textile dye production.

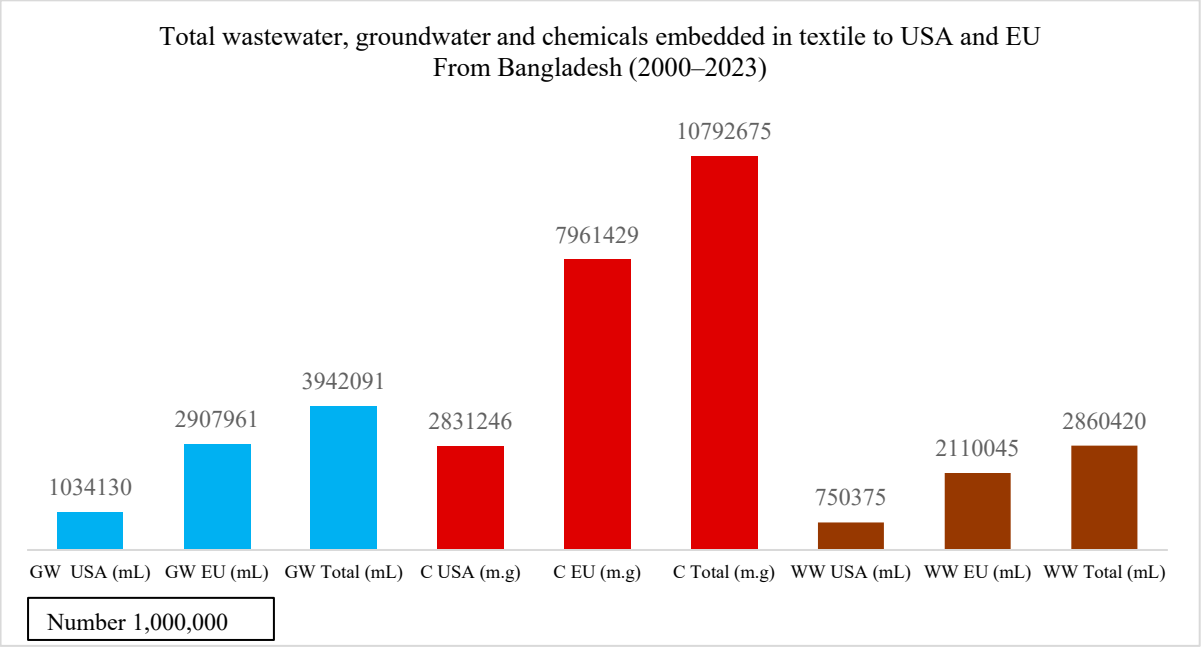


Figure 13. Water Unequal Exchange from Textile Trade Between Bangladesh, EU, and USA.

5. Discussion

This study shows how textile trade exacerbates global inequality, causing significant pollution and undermining sustainable development within producing societies. This paper reaffirms that Bangladesh's economy is highly dependent on a concentrated range of textile products, trade partners, and low-value operations. Textile exports were USD 48.9 bn in 2023, forming the overwhelming majority of the total export value of USD 54 bn. In addition, 91.68% of textile exports are concentrated within 18 products. This paper also highlights significant price fluctuations over time and between textile products, making Bangladesh vulnerable to changing consumer demand, tariffs and trade arrangements, local water shortages, water pollution, and increasing input prices. The primary textile export markets are the USA and the EU, and this paper demonstrates that the highest quantities of imported textile products to these economies tend to receive the lowest price per kg traded. As Bangladesh approaches graduation from the LDC status that enables tariff-free access to the EU market, diversifying its economy, textile production, and trade partners will prove essential. In particular, shifting to higher-value-added activities, including design, marketing, and eco-friendly production processes, may serve to increase resilience while minimizing strains on local water resources.

This paper reaffirms that the impacts of the GTVC are unequally distributed, as some countries and communities disproportionately bear the social, economic, and environmental burdens of production without capturing a significant share of the economic value generated. Textile consumption in HIC poses significant sustainability challenges to producing LICs by deteriorating water resources, degrading ecosystems, and damaging human health and wellbeing for present and future generations. The research findings indicate that the core regions of the USA and the EU are benefiting from a constant, growing stream of cheap textiles without internalizing the environmental impacts, while the periphery region, Bangladesh, is overusing and polluting its environment with minimal economic gain and a marginal share in the financial value of textile production. By uncovering the asymmetry in water use and pollution between Bangladesh and its largest export markets, the EU and the USA, this paper confirms the presence of WUE within this case study. As Bangladesh depletes and contaminates its own water resources to sustain the textile trade, global inequality along the GTVC is reinforced.

Textile dye production depends on a healthy ecosystem and natural resources. This paper finds that groundwater, chemicals, and wastewater used in textile dye production have increased significantly over the last two decades, placing significant burdens on Bangladesh's water resources and citizens living close to factories. According to the World Bank (2019), clean water is a key factor for economic growth. Deteriorating water quality is stalling economic development and is globally estimated to eliminate a third of potential economic growth in heavily polluted areas [80]. To sustain the industry in Bangladesh, significant reforms are required. Within Bangladesh, stronger enforcement of national regulations, increased investment in water-efficient dying technologies, and better wastewater management will help improve water quality. The cost must be shared with international companies and not only be borne by the national government and small dye factories. Since the GTVCs operate internationally and production is dispersed across various countries, this paper recommends upgrading international efforts. First, minimizing chemical use and improving water management can involve the mandatory adoption of ISO 14001 on Environmental Management [81], the strengthening of international chemical policies such as the Global Framework on Chemicals [82], and expanding the Water Convention and Protocol on Water and Health in Bangladesh [83]. Second, improving the transparency of water and chemical use can be achieved through tightening environmental corporate disclosure requirements for international clothing companies and compelling them to report on

embedded chemicals in textile products. This can pave the way to more robust eco-labeling and certification schemes. Third, this can be accompanied by environmental clauses in trade agreements that encourage the banning of toxic chemicals, such as azo dyes, and require the use of safer alternatives. Taken together, these would help to minimize WUE embedded in GTVCs and promote sustainable development in the context of production.

Although this study focused on textile trade from Bangladesh to the EU and the USA, the findings indicate a broader pattern between HICs and LICs. The WUE framework developed in this paper can be applied to other highly textile-consuming and producing countries where similar dynamics may be observed. For instance, countries such as Canada, Australia, Japan, and New Zealand, among others, are also high textile consumers, while countries such as China and India also have many textile dye factories. This study was limited to water use and pollution but could also be applied to energy use, CO_2 emissions, and the concentration of various chemicals in the air, among other environmental impacts arising from textile production. In addition, there is a high water and chemical footprint in raw cotton production, which is not included within the scope of this study. Future research may also expand and include more steps within the GTVCs. Given that limited studies have applied the EUE concept to water and textiles, there is space for more research on the water and chemical flows embedded in GTVCs within and beyond the textile sector. Most existing studies apply EUE and virtual water trade concepts to agriculture. As a result, there is a need to further explore the hidden resource use and environmental impacts within the value chains of the chemical industry, other clothing products such as polyester, and other producing countries, such as Vietnam. Taken together, the inequality of resource use and environmental impacts embedded in GTVCs can be further researched, and applying WUE to other cases will become more important as global water quality and quantity diminish.

Furthermore, conducting research from various perspectives, including corporations, governance, policies, and local communities, is important. For example, we should examine the role of corporate sustainability initiatives in mitigating WUE, especially since corporations significantly influence global water use in textile supply chains. We can also explore how WUE varies between countries with strong versus weak environmental regulations and how corporate sustainability efforts interact with these regulatory environments. Additionally, it is essential to analyze how local, national, and trade policies and multi-stakeholder initiatives address water inequities. The impact of intensive water extraction on the health, access to clean water, and livelihoods of local communities should also be considered. Future research in these areas will contribute to a comprehensive understanding of the WUE concept in the global textile chain and may lead to strategies for mitigating WUE for GTVC.

6. Conclusions

This paper investigated the presence of WUE by calculating the groundwater (GW), chemicals (C), and wastewater (WW) embedded in the textile trade from Bangladesh to the EU and USA. The calculations used existing trade data from UN Comtrade and footprint numbers from Uddin et al. (2023) [16,78]. The examination of WUE reveals the environmental inequality embedded in GTVCs by highlighting the overuse and pollution of local water resources within LIC to support growing textile demands in HICs. This paper finds that higher volumes of textiles are associated with more significant natural resource use and pollution. Figure 10 illustrates that GW embedded in USA textile imports was 1,034,130 million liters; for the EU, this was 2,907,961 million liters. This translates into an overall extraction of 3,942,091 million liters of groundwater to dye and process the textile exported to the EU and the USA between 2000 and 2023. Figure 11 shows

that the total amount of C embedded in the 18 imported textile products to the EU and USA between 2000 and 2023 was 10,792,675 million grams. For the USA, this amounted to 2,831,246 million grams, and for the EU, 7,961,429 million grams. Lastly, Figure 12 indicates that 2,860,420 million liters of WW released between 2000 and 2023 stems from the dyeing of EU and USA textile imports. This is 750,375 million liters for the USA and 2,110,045 million for the EU. These figures underscore that GW, C, and WW embedded in textile production have increased significantly over the last two decades. As a result, this paper uncovered an asymmetry in water use and pollution between Bangladesh, the EU, and the USA. This validates the presence of WUE, as Bangladesh depletes and contaminates its own water resources to sustain the textile trade, reinforcing inequality along the GTVC.

This paper also illustrates Bangladesh's growing reliance on textile exports, which increased from 80.69% of total exports in 2000 to 89.72% in 2023, making the country vulnerable to price fluctuations and shifting global demand. This paper demonstrates that textile prices per kg vary by product type, with the highest volume of imports often receiving the lowest price per kg traded. For instance, Figure 4 reveals that knit t-shirts (HS6109) are by far the largest EU-imported textile product, rising from 76 million kg in 2000 to 262 million kg in 2023. In addition, Figure 5 highlights that despite the high import volume of HS6109, this product receives the lowest price per kg, increasing from USD 7.16 in 2000 to USD 14.15 in 2023. On the contrary, other women's undergarments (HS6212) represent one of the lowest product categories in weight but the highest in price per kg, rising from USD 30.45 to 40.2 per kg over the same period. In comparison, Figures 6 and 7 indicate that the USA's most imported product is non-knit men's suits (HS6203), increasing from 13.7 million kg in 2000 to 126.3 million kg in 2023. These pricing patterns indicate a higher demand for cheaper textile products in Bangladesh, that prices do not reflect the environmental burdens of production, and that LICs export large volumes of textiles without capturing a fair share of the economic gain, reinforcing unequal exchange.

Taken together, the exponential growth of the textile industry has led to excessive water extraction and chemical pollution, with long-lasting impacts on ecosystems and natural resources in Bangladesh. This reveals a case of WUE, where water use and pollution are internalized in Bangladesh, while the benefits are largely captured within the EU and the USA.

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