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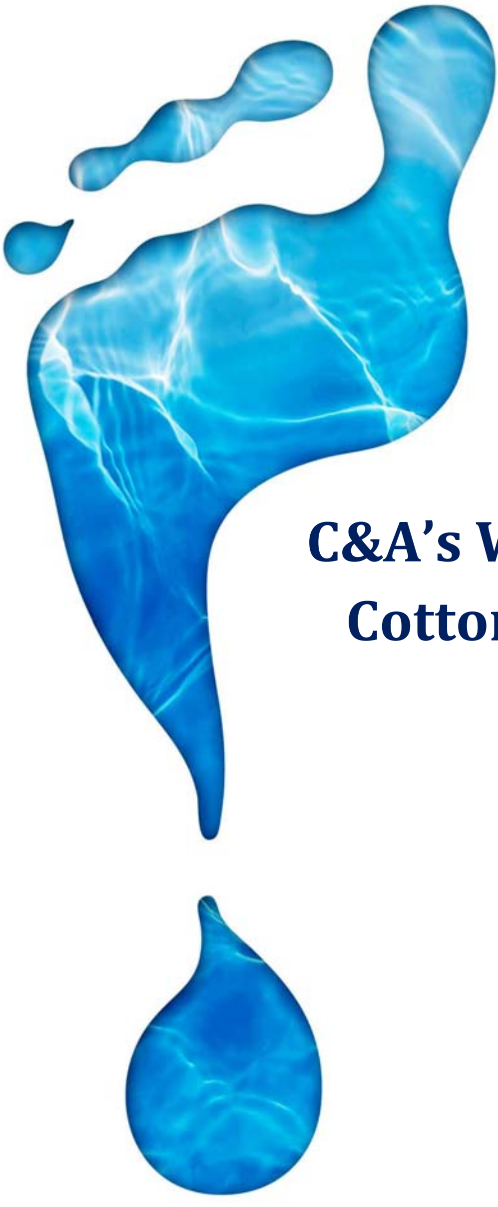

C&A's Water Footprint Strategy: Cotton Clothing Supply Chain

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We would like to thank Prof. Arjen Hoekstra and Dr. Mesfin Mekonnen from the University of Twente, as well as Dr. Guoping Zhang from the Water Footprint Network, for their technical support in applying the water footprint methodology and the review of the report.

We are also grateful to Mr. Phil Chamberlain and Alain Renard from C&A for their support to the Water Footprint Network's mission and for pushing forward the application of the water footprint method at the corporate level, by deciding to explore what this method can offer to a frontrunner company like C&A and the industry as a whole.

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Foreword

Sustainability has a long-standing tradition at C&A, and has been an integral part of corporate management for over 20 years. The availability and quality of water resources is a key concern for textile companies as population growth, changing lifestyle patterns and increasing urbanization and industrialization, coupled with climate change implications, are increasing pressures on limited water resources. With a globally distributed supply chain, C&A's business touches many areas facing long-term water shortages or poor water quality due to unsustainable use.

In response to growing concern about the over-allocation and pollution of water resources and to better understand the sustainability of its cotton clothing supply chain and ultimately improve the sustainability of the industry as a whole, C&A engaged the Water Footprint Network (WFN) to conduct a Water Footprint Assessment of its supply chain using WFN's globally recognized standard. Water Footprint Assessment includes a comprehensive approach to the accounting of water consumption and pollution in the supply chain, the assessment of the sustainability, efficiency and equitability of that water consumption and pollution, and strategic response formulation to address the world's pressing water challenges. This first comprehensive Water Footprint Assessment provides clear guidance on where C&A's supply chain intersects with water scarcity and water pollution hotspots and can be used to prioritize strategic actions.

There is an urgent need for efficient, equitable and sustainable use of the world's limited water resources. This publication documents the Water Footprint Assessment results with the purpose of highlighting how a global company can begin the daunting task of assessing the sustainability of its supply chain and identifying priority areas for further effort. We share this report in order to facilitate the journey for others who wish to make their own contribution to improving the sustainability, efficiency and equitability of the use and management of our precious water resources.

The fashion company C&A is one of the leading fashion companies in Europe, with the aim of offering to its customers fashion at affordable prices for the whole family. Sustainability is not just a recent fashion phenomenon for C&A, since it has underpinned its business model in evolving ways in it's over 170 years of business. C&A Foundation is committed to improving the lives of the hundreds of thousands of people who make valuable contributions – as farmers, garment workers, store employees, local communities and more – to the cotton and apparel value chain. In collaboration with Water Footprint Network, a global multi-stakeholder initiative focused on sustainable, fair, and efficient use of freshwater resources through the use of Water Footprint Assessment, the joint partnership has provided valuable insights on actionable response strategies for corporate leadership in water management.

We hope you find this document of value.

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Executive Summary

Water scarcity and water pollution levels are increasing in river basins around the world due to growing populations, changing consumption patterns and poor water governance. The apparel sector increasingly faces water availability and quality issues in its widely distributed supply chain. Improving environmental performance in the apparel supply chain is critical for the long-term viability of the sector as well as the sustainability of ecosystems and communities.

For these reasons C&A has committed to achieving a more sustainable supply chain in the production of their textile products. They have engaged with the Water Footprint Network to conduct a Water Footprint Assessment of their cotton product supply chain to improve their understanding of their water footprint, the sustainability of it and their business relationship with the increasing stress on the world's freshwater resources.

To assess the water consumption and pollution of C&A´s supply chain, we applied the Global Water Footprint Standard as set out in The Water Footprint Assessment Manual (Hoekstra et al., 2011). The water footprint (WF) is a measure of the appropriation of freshwater for productive activities both in terms of the amount of water consumed (green and blue WF) or polluted (grey WF). The Water Footprint Assessment (WFA) is a structured process which quantifies and maps the green, blue and grey water footprint, assesses its sustainability and uses this information to identify strategic actions to reduce the WF and improve its sustainability. The WFA presented here is a first effort to build an understanding of C&A's cotton clothing supply chain. The study focuses on cotton agriculture and wet processing which are the steps with the highest WF in the cotton clothing supply chain.

The WFA used data from 1) C&A: quantities sourced and their country of origin; 2) the global water footprint database, WaterStat (WFN, Enschede, The Netherlands, Mekonnen and Hoekstra, 2011b): WF of cotton agriculture; and 3) the United States Environmental Protection Agency (US EPA): survey of effluent discharges from textile mills.

The results of the WF accounting show that there is a high variation in the cotton agriculture WF depending on the region and management practices used in cultivation and in the wet processing due to different processes and technologies used to manufacture the final textile products. Therefore the total WF of C&A´s supply chain can vary between 5,7 to 9,7 billion m3/year. This variation reflects the wide range of the WF in the wet processing steps which can vary between 2,1 – 6,1 m3/year.

The results obtained for the blue WF by country of origin and distinguishing between agriculture and industry showed that the blue WF in the agricultural sector is by far higher than the industrial blue WF, whereas the grey water footprint in industry is far higher than in agriculture. Around 60% of C&A´s blue WF lies within India (> 500 million m3/year), 13% in Turkey (> 115 million m3/year) and around 8% in Pakistan (> 67 million m3/year), whereas 30% of C&A´ grey WF lies within Bangladesh (> 1 billion m3/year), around 26% in China (> 960 million m3/year) and 18% in India (> 650 million m3/year).

Priority river basins were identified by overlaying C&A's blue WF with blue water scarcity maps (Hoekstra, et al. 2012). Priority basins are those which have a share of C&A's blue WF above 1% and a moderate, significant or severe blue water scarcity for more than one month of the year

The priority basins are:

1. Indus, 39% of C&A's supply chain blue WF, 12 months moderate to severe water scarcity.
2. Tigris/Euphrates, 5% of C&A's supply chain blue WF, 6 months moderate to severe water scarcity.
3. Murray, 4% of C&A's supply chain blue WF, 8 months moderate to severe water scarcity.
4. Krishna, 2% of C&A's supply chain blue WF, 9 months moderate to severe water scarcity.

These basins are where C&A should take action to reduce the blue WF and bring the basin into sustainability. Reduction of the WF can be achieved by replacing one technique or technology by another with the goal being a lower or even zero WF. Achieving improvements in the WF of C&A´s supply chain may be difficult since suppliers are not under C&A's direct control. However, engagement with cotton farmers and wet processing mills is a critical step for C&A to achieve a sustainable supply chain.

1. Introduction

The pressure on freshwater resources worldwide has rapidly increased since the beginning of industrialisation and especially since the globalization of trade. About 40 per cent of the water footprint of consumption in Europe is outside of Europe (Vanham and Bidoglio, 2013), with some countries having much higher external water footprints than this average (Mekonnen and Hoekstra, 2011). Many products sold in Europe are not produced locally, but in developing countries where the cost for production is relatively low. This economic benefit, however, goes along with some negative aspects: developing countries do not always use advanced technology in terms of resource use and pollution and sometimes lack knowledge on best management practices. In addition, these countries do often not have the same level of environmental regulation and/or enforcement as in developed countries. In various places, this has led to water scarcity and high water pollution levels, while water allocation is not equitable, efficient and sustainable.

For these reasons C&A has committed to work towards a more sustainable supply chain in the production of their textile products. They have engaged with the Water Footprint Network (WFN) to conduct a Water Footprint Assessment (WFA) of their cotton product supply chain in order to increase their understanding of their water footprint and their business relationship with the increasing stress on the world's freshwater resources.

A WFA accounts the volumes of water consumed and polluted throughout the production chain of a product, assesses its sustainability and formulates responses in order to reduce or avoid the water footprint (WF). The WF is an indicator of water consumption and pollution, specified geographically and temporally.

This study aims to measure the WF in C&A´s cotton supply chain, starting with the cultivation of cotton and going through the processing steps to the final product. This will allow identifying where in the supply chain the consumption and pollution of water is most significant and where it intersects with water scarcity and high water pollution levels.

The study will allow C&A to take a first step towards reducing their water footprint and improving its sustainability.

2. Water footprint assessment method and data

To assess the water consumption and pollution of C&A´s supply chain, we applied the Global Water Footprint Standard as set out in *The Water Footprint Assessment Manual* (Hoekstra et al., 2011).

The assessment started by accounting the water footprint followed by a sustainability assessment and ending with the formulation of response options.

The following sections describe the WF methodology and the data used, as well as the approach taken for the WF accounting and sustainability assessment.

2.1 Goal and Scope

The goal of this study is to support C&A in their sustainability commitment by conducting a WFA of their cotton textile supply chain.

The study will help C&A understand the water consumption and pollution associated with their cotton products, as well as the sustainability of that production and will form the basis for formulating measures on how to reduce their WF and improve the sustainability of their supply chain.

The WF accounting of C&A´s supply chain was subdivided into cotton growing and the industrial processes necessary to produce C&A´s cotton textile products for the fiscal year 2011 with a focus on washing, dyeing and finishing (WDF).

The sustainability, of both the agricultural and industrial WF, was assessed using the indicator of water scarcity at a river basin scale on an annual basis.

The response strategies were proposed based on the accounting and sustainability assessment steps as possible measures for C&A to reduce their WF and increase their sustainability.

2.2 Water Footprint Accounting

The WF is differentiated between blue, green and grey:

- The blue water footprint (blue WF) refers to consumption of surface and groundwater resources.
- The green water footprint (green WF) refers to consumption of rainwater stored in soil (insofar as it does not become run-off).
- The grey water footprint (grey WF) refers to the volume of freshwater polluted.

The green, blue and grey WF was calculated for the cotton as harvested in the countries of origin, as well as the blue and grey WF of the industrial textile processing in the countries where the final product is purchased.

Blue WF

The blue WF indicates the consumptive use of so-called blue water, in other words, fresh surface or groundwater. Blue water consumption refers to the water which evaporates during a process, is incorporated into a product, or does not return to the same catchment area in the same period of time (= "lostreturnflow").

The blue water footprint of a process step was calculated as follows:

$$WFproc,blue = BlueWaterEvaporation + BlueWaterIncorporation + LostReturnflow \quad [volume/time]$$

In this assessment the assumption has been made that the textile processing mills return their effluents into the same catchment in the same period of time. Therefore the "lostreturnflow" is assumed to be zero.

The amount of blue water evaporated and/or incorporated into the textile product can be calculated by the difference of the water intake and the water discharged of a processing step.

Green WF

The green WF is the volume of rainwater consumed during the production process. This is particularly relevant for the agricultural cotton cultivation, where it refers to the total rainwater evapotranspiration (from plantations) plus the water incorporated into the harvested crop. The green WF in a process step is equal to:

$$WFproc,green = GreenWaterEvaporation + GreenWaterIncorporation \quad [volume/time]$$

The distinction between the blue and green WF is important because the hydrological, environmental and social impacts, as well as the economic opportunity costs of surface and groundwater use for production, differ distinctively from the impacts and costs of rainwater use.

Grey WF

The grey WF indicates the amount of freshwater pollution that can be associated with a process step. It is defined as the volume of freshwater that is required to assimilate the load of pollutants based on natural background concentrations and existing ambient water quality standards. (Hoekstra et al., 2011)

To calculate the GWF the pollutant load (L) is divided by the difference between the ambient water quality standard (c_{max}) for the corresponding pollutant and its natural concentration (c_{nat})[1] in the receiving water body. The pollutant load entering a water body can be calculated as the effluent volume (*Effl*) multiplied by the concentration of the pollutant in the effluent (c_{effl}) minus the water volume of the abstraction (*Abstr*) multiplied by the actual concentration of the intake water (c_{act}).

The grey water footprint can then be calculated as follows:

$$WF_{proc,grey} = \frac{L}{c_{max} - c_{nat}} = \frac{Effl \times c_{effl} - Abstr \times c_{act}}{c_{max} - c_{nat}}$$

[volume/time]

Since the natural concentrations in the receiving water bodies are not known, a natural chemical background concentration of zero is assumed. This will result in an underestimated grey WF when natural concentration is actually not equal to zero. For the maximum allowable concentrations in ambient water the US EPA National Recommended Water Quality Criteria for fresh water aquatic life was used.

2.3 Water footprint sustainability assessment

The WFA Manual describes the possibility of assessing the sustainability of the blue, green and grey WF from three different perspectives: environmental, social and economic. This assessment will focus on the environmental sustainability of the blue WF.

The sustainability of a process within C&A's supply chain depends on whether the WF of a process is situated in a river basin in which the total WF is unsustainable at any period of the year. This criterion of sustainability simply implies that when the WF of a process contributes to a region, where the overall WF is unsustainable, the WF of this particular process is unsustainable as well. A region in which the WF is unsustainable is called a "hotspot". In a hotspot, problems of blue water scarcity occur.

Blue water scarcity occurs when the blue WF exceeds blue water availability. In this study the blue water scarcity levels, as suggested by Hoekstra et al. (2012), were used. They have classified the values into four levels of water scarcity:

- **Low blue water scarcity** (< 100%): the blue WF is lower than 20% of natural runoff and does not exceed blue water availability; river runoff is unmodified or slightly modified; presumed environmental flow requirements are not violated.

[1] Natural background concentrations are concentrations which would be without human impact.

- **Moderate blue water scarcity** (100–150%): the blue WF is between 20 and 30% of natural runoff; runoff is moderately modified; environmental flow requirements are not met.
- **Significant blue water scarcity** (150–200%): the blue WF is between 30 and 40% of natural runoff; runoff is significantly modified; environmental flow requirements are not met.
- **Severe water scarcity** (> 200%). The monthly blue WF exceeds 40% of natural runoff; runoff is seriously modified; environmental flow requirements are not met.

2.4 Water footprint response formulation

With the accounting and sustainability assessment completed, response strategies were formulated and prioritized to address the WF components in the entire production chain that need to be reduced to improve their sustainability. In order to prioritize which WF deserves action, a minimum share of 1% of the total WF was set.

2.5 Data used

The WF was assessed by using the data provided by C&A, data on water footprints of cotton from the global database WaterStat (Mekonnen and Hoekstra , 2011b) and through literature review.

C&A provided information on the quantities (in number of pieces) of finished products bought in the fiscal year 2011, the percentage of cotton products and the countries from which the finished products were bought. There is though a lack of transparency in the supply chain of C&A, which could have supported an assessment at a more detailed scale, e.g., where the process steps from field to the finished product exactly take place. For this reason it was assumed that the cotton is cultivated in the river basins of the corresponding country of origin, where FAO (Food and Agriculture Organization of the United Nations) has registered cotton cultivation. This information was obtained out of the global WF study by Mekonnen and Hoekstra (2011b).

For the industrial processing, the data out of the global water footprint study by Hoekstra and Mekonnen (2012) were used, which assumes that the WF of industry is located in population dense regions.

To assess the WF of the textile processing operations, the data of the US EPA (United States Environmental Protection Agency) survey on developing effluent limitation guidelines and standards for textile mills from 1982 has been used.[2] This data was used, since to date no representative similar survey in the textile industry sector has been completed.

[2] EPA: Development document for effluent limitations guidelines and standards for the textile mills, United States Environmental Protection Agency, Washington DC, 1982.

Three textile mill categories have been selected to represent the wet processing segment:

- 336 Woven Fabric Finishing Mills;
- 442 Knit Fabric Finishing Mills; and
- 217 Stock & Yarn Finishing Mills.

A typical process flow diagram of these finishing mills is presented in Annex I-a to I-c and a description of the processes in Annex II. The textile mills where further subdivided and Table 1 shows an overview of the processes involved in each subcategory (the orange coloured fields mean that the process is present and yellow coloured fields mean that the process can be present but not necessarily).

Table 1: Processes included in each textile mill subcategory.

	Woven fabric			**Knit fabric**			**Stock & yarn**
Process	Simple	Complex	Desize	Simple	Complex	Hosiery	Normal
Desize	√	√	√				
Scour		√	√	√	√	√	√
Mercerize		√	√				√
Bleach		√	√	√	√	√	√
Dye	√	√	√	√	√	√	√
Print	√	√	√		√	√	
Final Finish		√	√		√	√	

To calculate the blue WF of the textile mills, the data out of “The Water Encyclopedia” by Van der Leeden et al, 1990 was used. The percentage of water consumed by the textile mill sector was calculated and then used to obtain the water consumption of the textile mills in the US EPA survey.

For the sustainability assessment the data out of the study by Hoekstra et al. (2012) was used.

3. Water footprint of C&A's supply-chain

Based on the methodology and data described in the preceding chapter, the water footprint of C&A´s globally sourced cotton and its WDF industrial processing for the fiscal year 2011 was identified and quantified. Subsequently, the water footprints' sustainability was assessed, followed by the formulation of possible responses. The results are presented in the following sections.

3.1 Water footprint of cotton cultivation

The results for the WF of the production for one ton of seed cotton in C&A´s sourcing countries is presented in Figure 1 and Table 2. The figure clearly shows which countries are below or above the global average WF. Comparing the WF of C&A's top 5 sourcing countries, we see that India is more than 5000 m^3/t above the global average, while China, Turkey, USA and Pakistan remain below.

India with over 9000 m^3/t has the highest WF in C&A´s sourcing countries followed by Tanzania, Vietnam and Sudan. The possible reasons for such a high WF could be due to climatic conditions, which result in a high evapotranspiration and therefore high green WF or bad management practices such as over irrigation or high fertilizer application rates resutling in a high blue or grey WF.

The subdivision into blue, green and grey WF highlights these issues. Whereas India, Tanzania, and Vietnam have high green WFs, Sudan has a higher blue WF. Countries also such as Syria, Egypt, Australia, Pakistan and Turkey have compared to others a much higher ratio of blue WF, which shows the high irrigation of cotton growing.

These characteristics in the WF can therefore be targeted in response strategies for reducing the WF. It must be noticed though that for Vietnam, Thailand, Indonesia, Ivory Coast and Mali no data for the blue WF were available, and for Spain, Mali and Greece no data for grey WF were available.

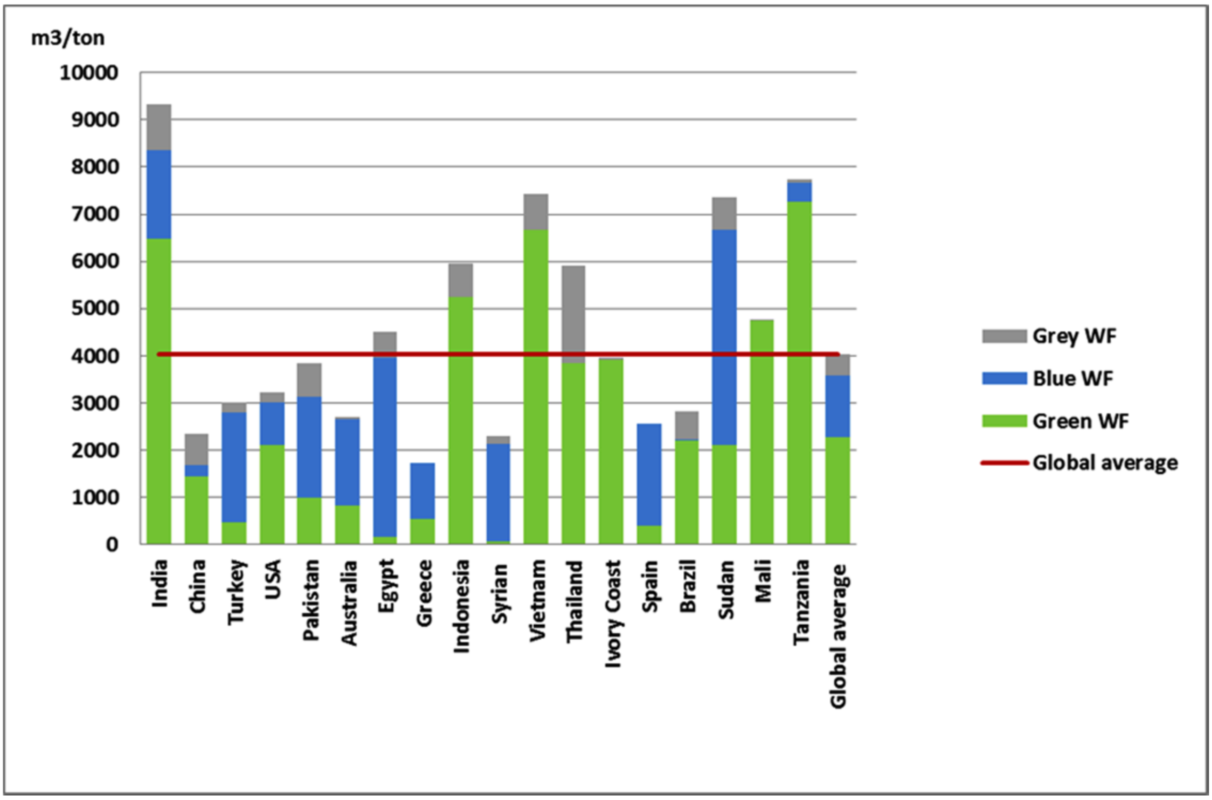


Figure 1: Average water footprint per tonne of seed cotton in C&A's sourcing countries (m^3/t).

Table 2: Average water footprint of seed cotton in C&A's sourcing countries (m^3/t).

Country	Green	Blue	Grey	Total
Australia	837	1827	32	2696
Brazil	2208	18	603	2829
China	1440	247	653	2340
Egypt	154	3805	547	4506
Greece	534	1186	NI	1719
India	6490	1866	965	9321
Indonesia	5237	NI	714	5951
Ivory Coast	3918	NI	44	3961
Mali	4740	NI	0	4740
Pakistan	982	2156	711	3849
Spain	399	2156	NI	2555
Sudan	2103	4564	686	7353
Syrian	67	2064	175	2307
Tanzania	7266	398	66	7729
Thailand	3843	NI	2068	5911
Turkey	476	2330	216	3022
USA	2114	903	213	3230
Vietnam	6676	NI	748	7424
Global average	2282	1306	440	4029

In order to have a better understanding of the WF issues within each sourcing country, the blue, green and grey WF are analysed separately.

3.1.1 Blue water footprint

Figure 2 shows the blue WF for C&A´s sourcing countries. It can be clearly seen that the blue WF of Sudan and Egypt are over 3000 m^3/t higher than the global average and should be targeted when aiming to reduce the WF of cotton. Also for the other countries above the global average a closer look should be taken into the irrigation practices carried out.

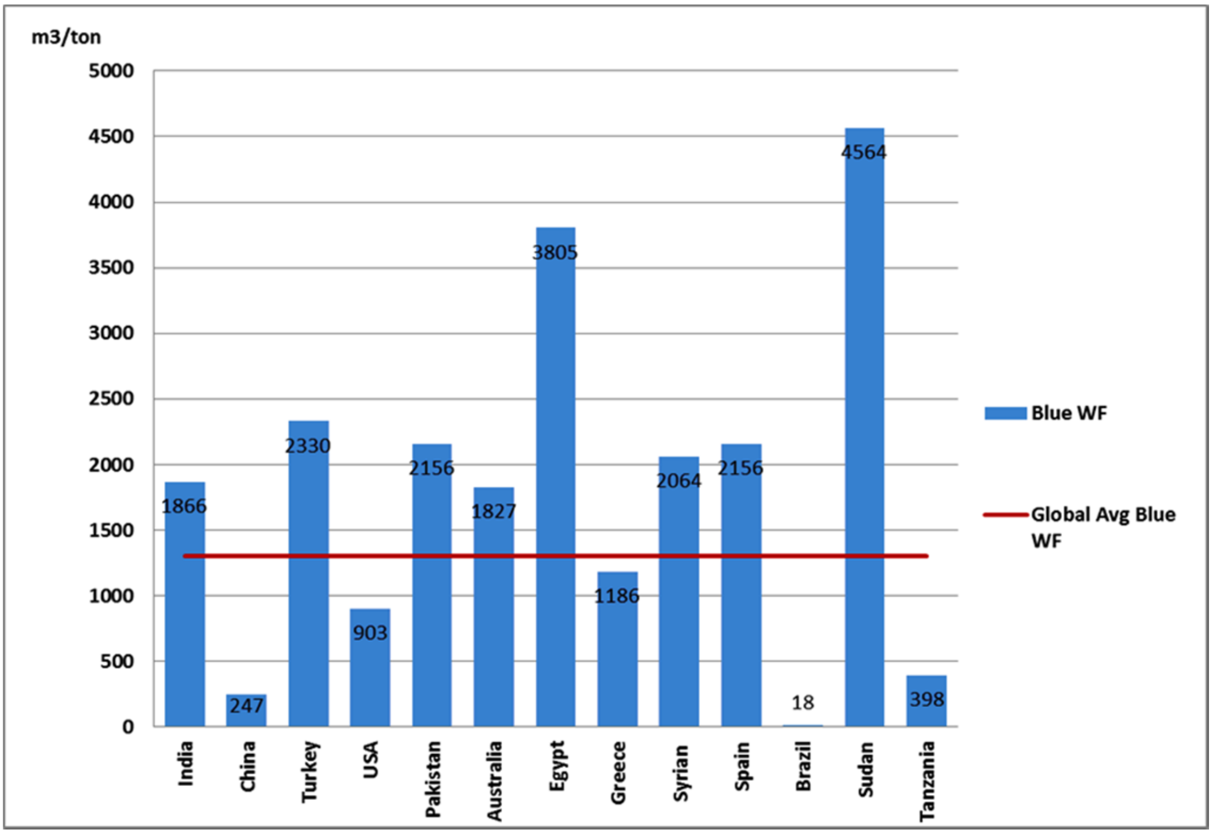


Figure 2: Blue WF in C&A´s sourcing countries.

3.1.2 Green water footprint

The green WF gives information on the environmental conditions, such as climate and soil, of the cultivating region. High green WF means high evapotranspiration rates due to high temperatures and high water holding capacities due to soil texture. The goal should be to maximize the efficiency of the green WF thereby reducing dependency on irrigation to meet cotton's water needs. Figure 3 shows the green WF for C&A´s sourcing countries.

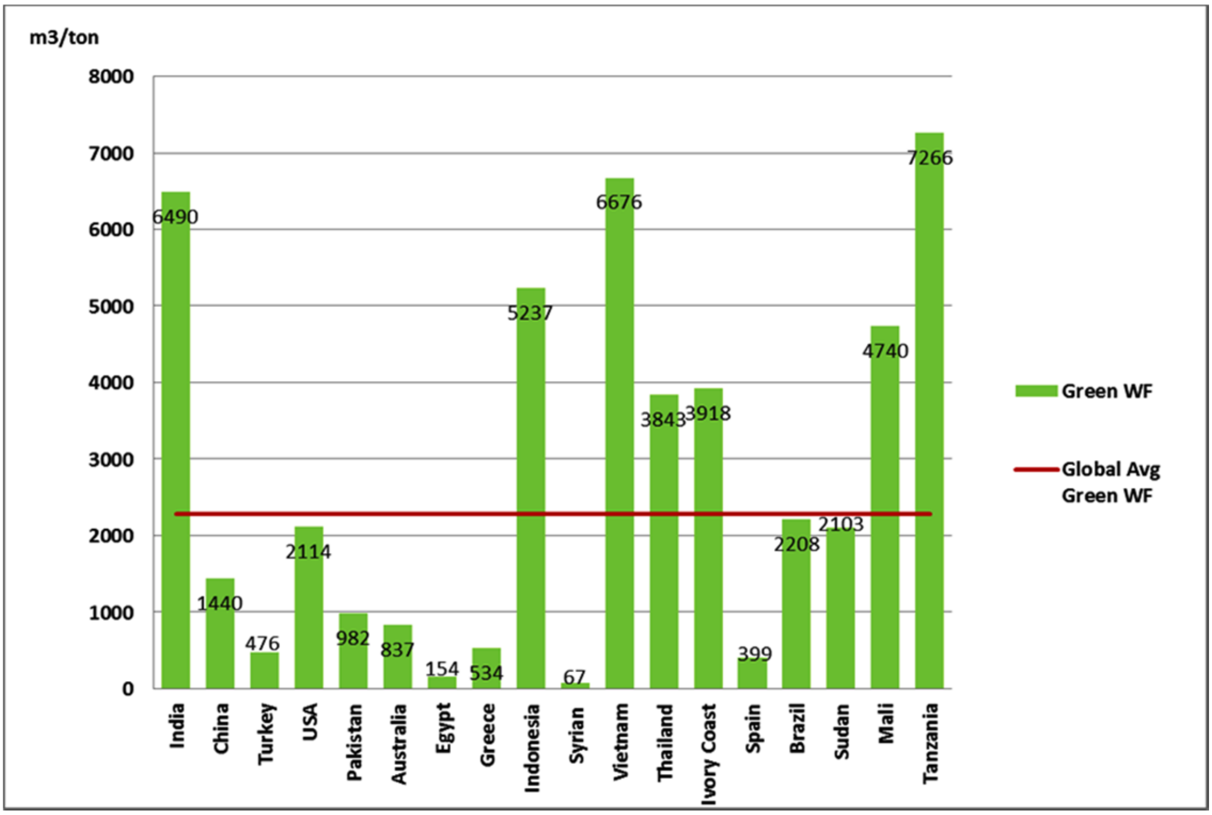


Figure 3: Green WF in C&A´s sourcing countries.

3.1.3 Grey water footprint

The grey WF gives the information on the contamination of water resources through the chemicals applied in cotton cultivation. Figure 4 shows the grey WF within C&A´s sourcing countries. Countries with WF over the global average show either higher application rates of chemicals or negative influencing environmental conditions.

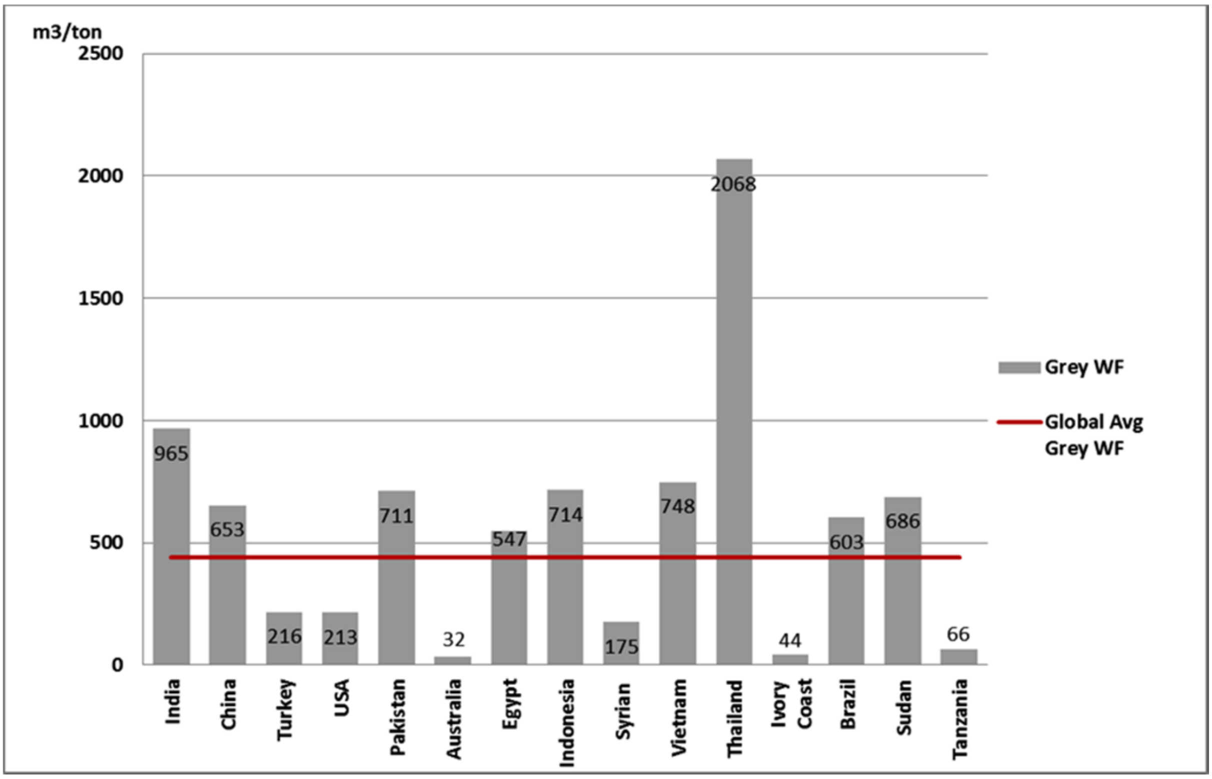


Figure 4: Grey WF in C&A´s sourcing countries.

The following Figure 5 shows maps of the global water footprints of seed cotton according to the study made by the researchers Mekonnen and Hoekstra (2011b).

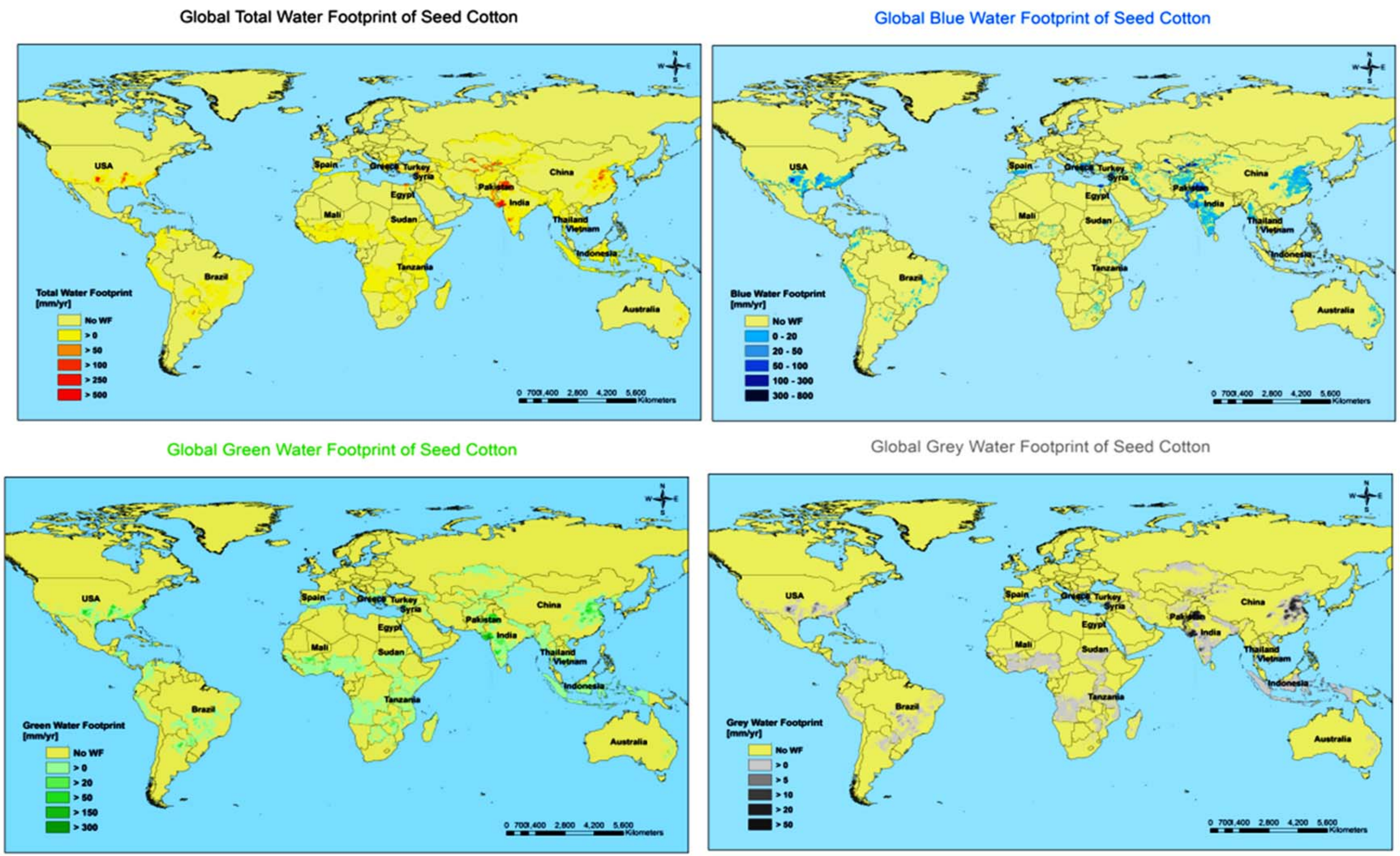


Figure 5 Maps showing the global water footprints of seed cotton in C&A’s sourcing countries.

3.1.4 C&A´s Cotton Cultivation Water Footprint

We received from C&A the production quantities of their main supplying markets for fiscal year 2011 as shown in Table 3.

Table 3: C&A's obtained production quantities.

Production quantities	
Office	**Quantity (number of pieces)**
Bangladesh	223,277,000
Cambodia	40,506,000
CN-DL (North China)	26,145,000
CN-SH (Central China)	84,884,000
HK (South China)	55,413,000
India	77,494,000
Indonesia	43,794,000
Laos	2,570,000
N. Korea	1,173,000
Madagascar	245,000
Malaysia	1,203,000
Pakistan	15,066,000
S. Korea	228,000
Sri Lanka	10,605,000
Taiwan	300,000
Thailand	5,575,000
Vietnam	11,368,000
Turkey	53,088,000
Grand total:	**652,934,000**

C&A knows that 50% of these units are cotton products, which results in a total of 326,467,000 cotton units.

It is not known what type of clothing units these are, which would influence the amount of cotton in each product. We have used an average amount of cotton necessary to produce these products of 625 grams per unit. This represents the average of a pair of jeans (about 1000g) and a T-shirt (about 250g). Multiplying the 326,467,000 cotton units by 625g results in a total final textile weight of C&A's cotton products of 204,042 tonnes (i.e. metric tons) for the fiscal year 2011. To produce this total amount of final textile 645,958 tonnes of seed cotton has to be cultivated. This has been calculated using the product fractions along the production chain (see Annex I – product tree for cotton)

Further only the total amounts of cotton products are known and the origin of the seed cotton necessary to produce the final product (see Table 4).

The total amount (in tonnes) of seed cotton needing to be cultivated to produce C&A's cotton products was divided by the percentage of sourced seed cotton in the country of origin (see Table 4). The countries where no global data was available (Malaysia and Taiwan) were added to the "Unknown".

Table 4: C&A's sourced seed cotton per country.

Country of origin	Volume of seed cotton sourced in the country (%)	Total seed cotton cultivated to produce C&A's cotton products (tonnes/year)
India	42.1	272,142
China	30.4	196,371
Turkey	7.7	49,545
USA	5.3	34,171
Pakistan	4.9	31,523
Australia	3.3	21,446
Unknown	2.0	13,048
Egypt	1.2	7,751
Greece	1.1	7,299
Indonesia	0.77	4,974
Syria	0.49	3,165
Vietnam	0.27	1,744
Thailand	0.20	1,292
Ivory Coast	0.11	711
Spain	0.05	323
Brazil	0.03	194
Sudan	0.02	129
Mali	0.01	65
Tanzania	0.01	65
TOTAL	**100**	**645,958**

Multiplying the tonnes of seed cotton cultivated in each country for C&A's products, by the corresponding WF associated in each country (see Table 2), C&A's seed cotton WF could be assessed. The "Unknown" were calculated with global averages.

The total WF of the cotton sourced to produce C&A´s textile products (for the fiscal year 2011) is 3,6 billion cubic meters (see Figure 6).

63% of the total WF refers to the volume of rainwater stored in the soil, which is consumed by the cotton plant (green WF).

24% of the total WF refers to the volume of surface and ground water used through irrigation for the cultivation of cotton (blue WF).

13% of the total WF is addressed to the pollution of water sources by the use of nitrogen as fertilizer in cotton cultivation (grey WF).

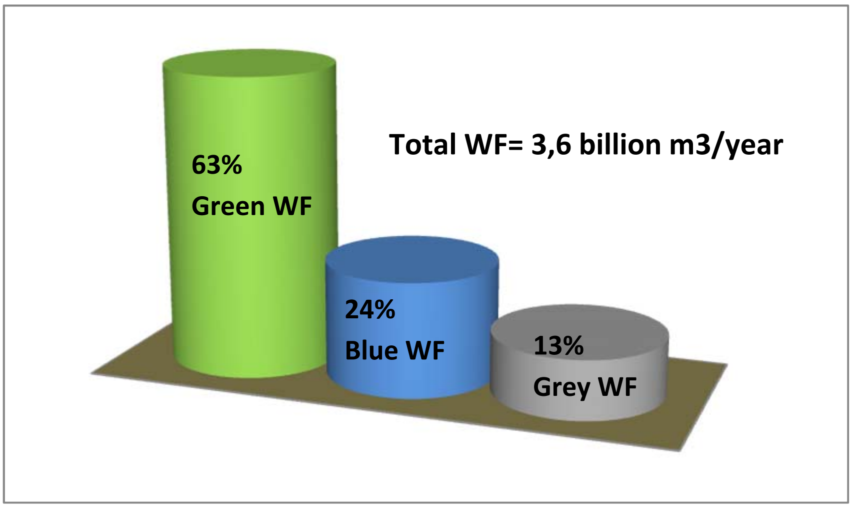


Figure 6: C&A's supply-chain water footprint related to the stage of cotton cultivation (m3/year).

The distribution of C&A´s cotton WF throughout the sourcing countries and distinguished by the green, blue and grey WF for the fiscal year 2011 is presented in Table 5. The results are in order of the country where C&A has the highest water footprint to the lowest. India from where most of the cotton is sourced (over 40%) has respectively the highest water footprint (≈2,5 billion m^3/year) followed by China (≈ 460 million m^3/year) and Turkey (≈ 150 million m^3/year). The water footprint of the other countries where C&A sources its cotton is comparatively much smaller.

Table 5: Water footprint related to cotton cultivation for C&A's cotton (m3/year).

Country of origin	Green WF	Blue WF	Grey WF	Total WF
India	1,766,133,338	507,922,519	262,674,512	2,536,730,369
China	282,859,187	48,463,502	128,246,244	459,568,933
Turkey	23,562,615	115,452,885	10,723,160	149,738,661
Pakistan	30,955,828	67,956,378	22,403,383	121,315,589
USA	72,230,745	30,861,834	7,294,834	110,387,412
Australia	17,958,145	39,172,792	682,934	57,813,871
Unknown	29,781,320	17,043,539	5,743,150	52,568,008
Egypt	1,191,830	29,498,265	4,240,068	34,930,163
Indonesia	26,046,510	4,974	3,553,341	29,604,825
Vietnam	11,643,112	1,744	1,305,050	12,949,906
Greece	3,896,524	8,654,040	7,299	12,557,863
Thailand	4,964,820	1,292	2,672,192	7,638,304
Syria	213,347	6,532,856	554,961	7,301,164
Ivory Coast	2,783,721	711	31,128	2,815,560
Sudan	271,680	589,637	88,641	949,959
Spain	128,824	696,243	323	825,390
Brazil	427,894	3,448	116,921	548,263
Tanzania	469,353	25,684	4,244	499,282
Mali	306,159	65	1	306,225
TOTAL WF	**2,275,824,951**	**872,882,408**	**450,342,387**	**3,599,049,746**

The differences in the WF is based not only on the quantities of cotton sourced, as over 40% is sourced in India followed by over 30% in China and over 7% in Turkey, but also climatic conditions in the growing area and farming management practices.

The following pie charts show the relation of blue, green and grey WF in C&A´s highest WF sourcing countries. While India has the highest green WF, Turkey's WF is dominated by the blue WF and China has a relative high grey WF. Through these findings, the more targeted response strategies can be developed by C&A.

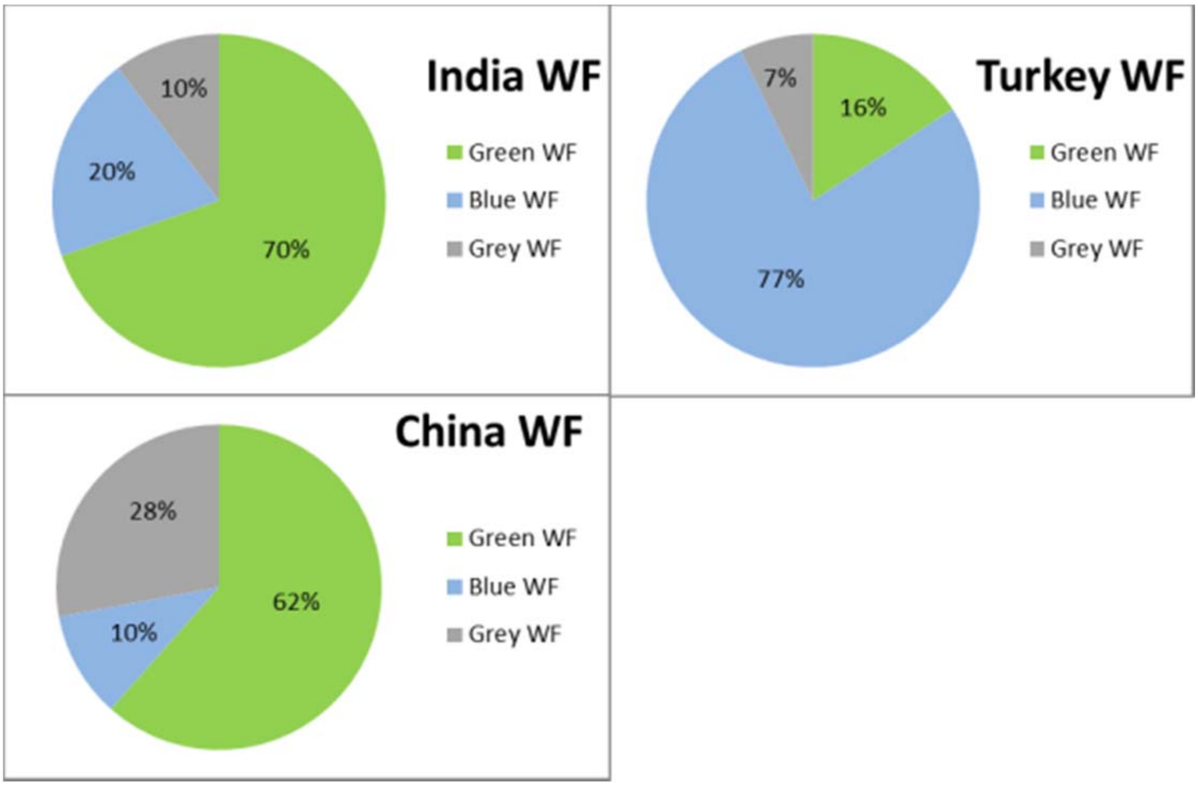


Figure 7: Color composition of the WF of cotton cultivation in India, China and Turkey, C&A´s most important sourcing countries.

Figure 8 shows maps with an overview of the WF of C&A´s globally sourced seed cotton.

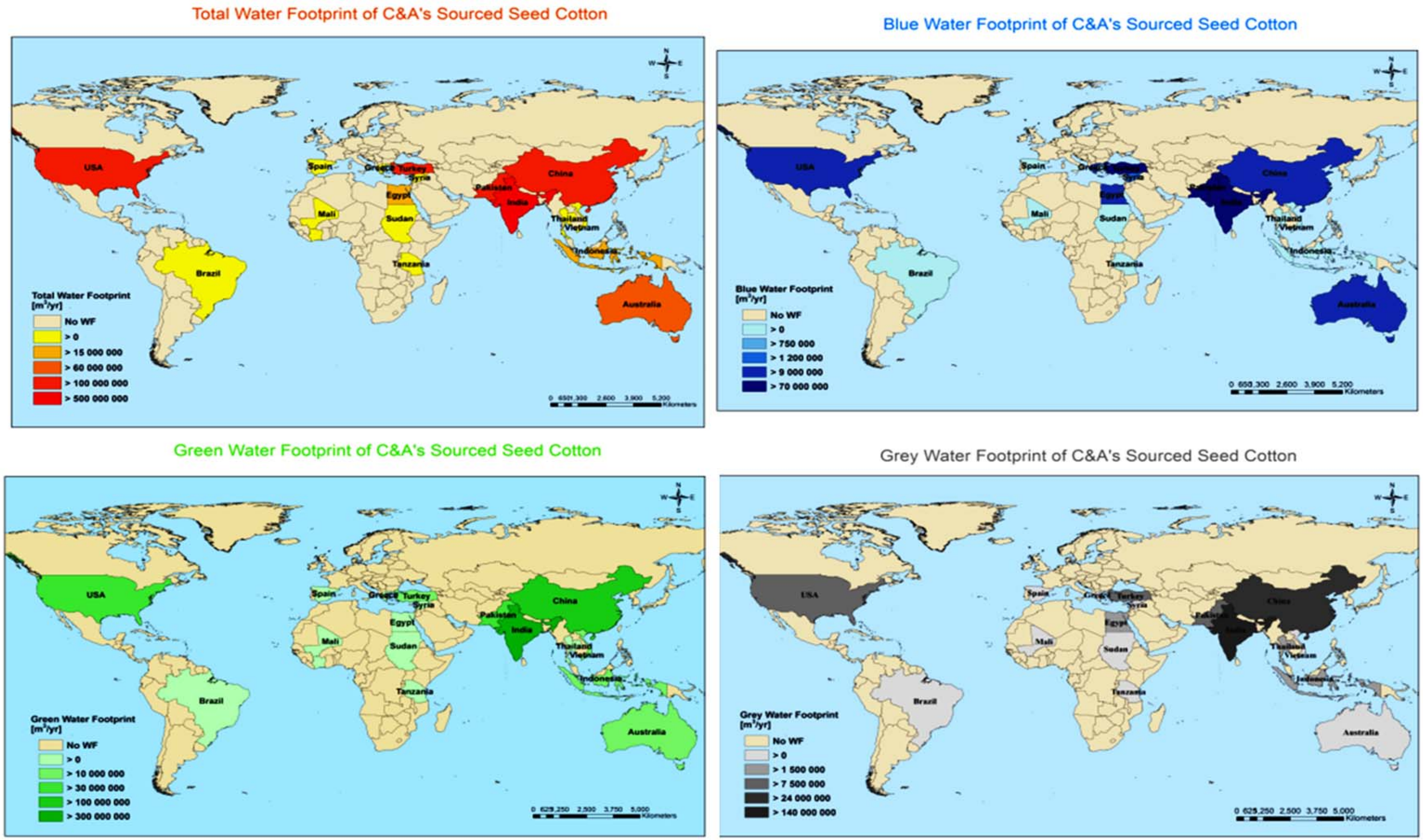


Figure 8: Overview of the WF of C&A´s globally sourced seed cotton.

3.2 Water footprint of industrial textile processing

In the following sections the results for the industrial (WDF) Water Footprint Assessment are presented.

3.2.1 Blue water footprint

Based on data from Van der Leeden et al. (1990) (see Table 7), the blue WF of the textile mills in the US EPA survey were calculated (see Figure 9).

Table 6: Water consumption in the US by textile mill sector in 1983.

	Establishments reporting	Water intake (Mm^3/yr)	Water discharged (Mm^3/yr)	Water consumed (Mm^3/yr)	Water consumed (% of intake)
Weaving mills cotton	69	172,6	149,2	23,4	**14**
Knitting mills	191	226,8	210,9	15,9	**7**
Yarn & thread mills	77	67,5	61,7	5,8	**9**

Figure 9 presents the results of the blue WF for each textile mill category and its subcategories. The blue WF differs depending on the processes used and the fabric processed. Woven fabric processing generally consumes more water than knit fabric processing due mostly to the fact that woven fabric needs additional processing such as desizing and mercerizing. Stock & yarn processing water consumption can be similar to woven or knit fabric processing, depending on the processes used.

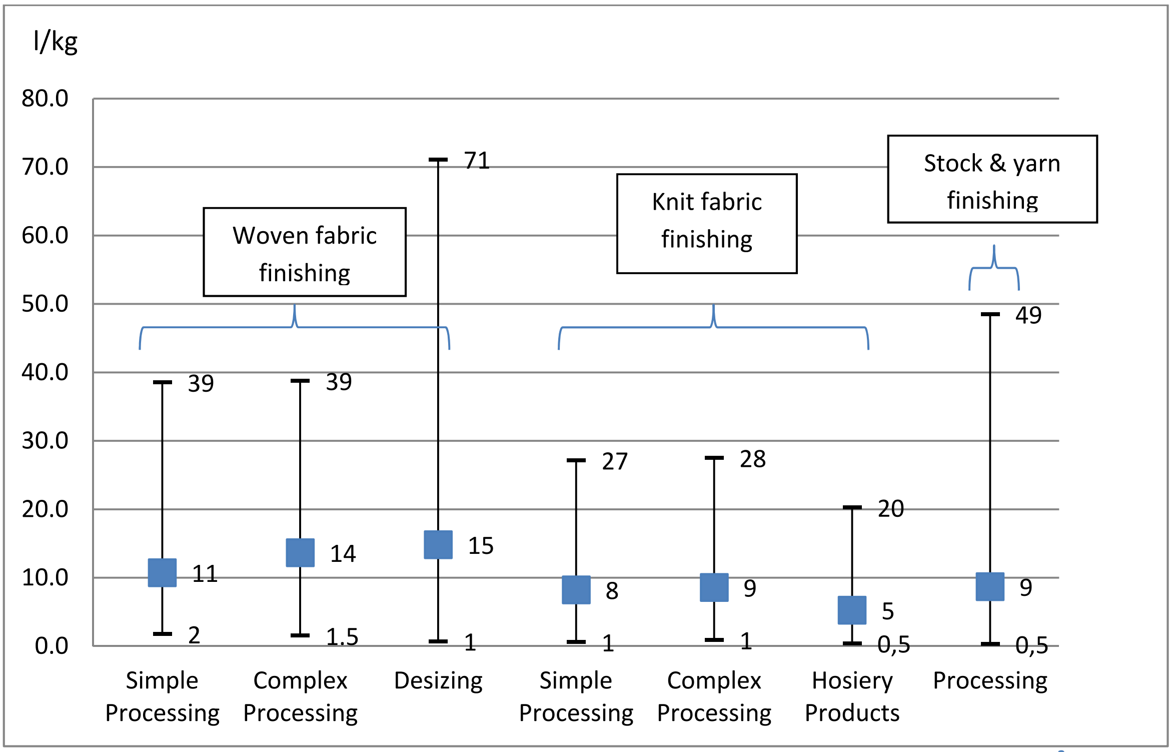


Figure 9: Minimum, median and maximum blue water footprint of textile production processes (m^3/t).

Comparing the different subcategories one can see that the more complex the process the higher the blue WF. Simple processing mills (to which also hosiery processing can be associated) mainly use dyeing processes, whereas complex processing mills include additional processes such as printing and finishing. The desizing mills can include even more processing steps and therefore can consume the most water. Also within a processing subcategory the water footprint can differ ranging from below 1 litre per kilogram of processed product to up to over 70 litres per kilogram. Possible reasons for such ranges could be the number of processes applied to the fabric, process technologies, and process management.

3.2.2 Grey water footprint

Figure 10 shows the results for the grey WF of the different textile processing categories and subcategories. As one can see here the same pattern cannot be seen as in the blue water footprint results. Simple processing appears to have higher grey water footprint than complex processing. This could be due to the fact that the concentrations of the chemicals in the effluent are higher which could be due to lower effluent discharges. Desizing mills and stock & yarn processing mills mostly have higher grey water footprints which could be attributed to more processes applied containing hazardous substances.

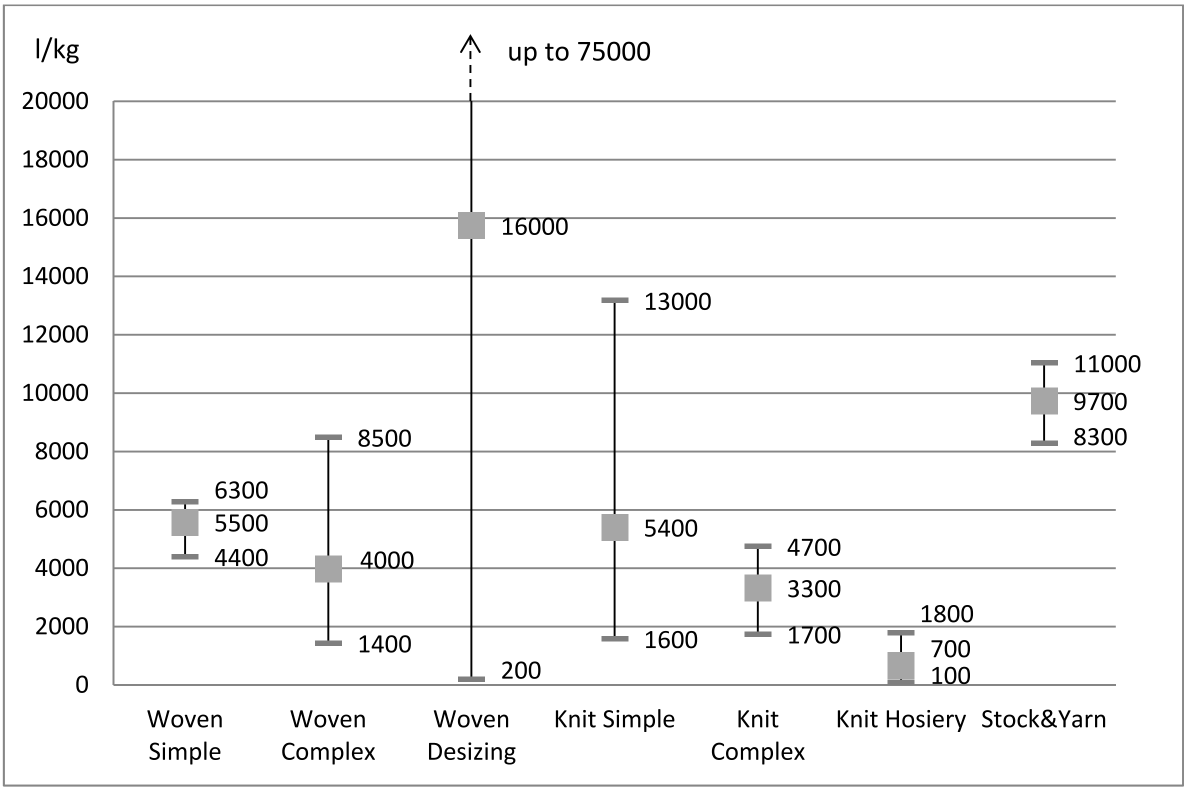


Figure 10: Minimum, average and maximum grey water footprint of textile production processes (m^3/t).

To analyse the variation in the grey water footprints of the processes applied in each category and subcategory the grey water footprint of the different chemicals used was studied. The US EPA (1982) had analysed a total of 129 pollutants in a field sampling program of textile mill untreated wastewaters, for which for 64 pollutants concentrations were detected over the detection limit. Table 7 lists the calculated grey WF per pollutant associated for each textile mill subcategory. In total for 39 of the 64 detected pollutants (see Annex III) the grey WF could be calculated. For the remaining 25 pollutants no maximum allowable environmental concentrations were found.

As defined in the Water Footprint Assessment Manual, the highest grey WF represents the grey WF of the process step, since it is assumed that with the assimilation of the most toxic pollutant all other pollutants are also assimilated. Copper and silver are the pollutants which determine the grey WF of the different process steps. This is due to the high concentrations in the effluents (Copper up to 3120 µg/l – see Annex III) or high toxicity (Silver c_{max} of 0,71 µg/l – see Annex III). Although these two contaminates represent the grey WF of the process steps, the other contaminants of course cannot be neglected.

In Table 7 one can see that the woven fabric desizing processing has the greatest variety in high grey WF pollutants, followed by stock & yarn processing and simple knit fabric processing. Besides copper and silver, the **heavy metals** zinc, cadmium, chromium, lead, mercury, nickel, arsenic and antimony show high grey WFs although they differ for every process step. It can be highlighted that the heavy metals beside silver are all included in

C&A’s priority substance list.

In addition to heavy metals, **organic substances** such as pentachlorophenol, selenium, chlorobenzene parameters, acenaphthylene, etc. show high grey WFs, many of which are also included in the C&A priority list. Nevertheless, there are some organic contaminants which are not included in C&A´s priority list, which also have high grey WFs such as acrolein, thallium, n-nitrosodiphenylamine, trichlorofluoromethane and 1,2-dicloropropane. Beside heavy metals and organic compounds, **cyanide** resulted in a relatively high grey water footprint.

All contaminants related grey WFs are represented differently in each category and subcategory of WDF processing, which reflects the wide variety of manufacturing methods, process machinery and design requirements in the textile industry, and therefore the variation in effluent discharges.

Table 7: Pollutant-specific grey WF per process (l/kg). Zero values mean the pollutant was either not detected or in concentrations below a water footprint of 1 m^3/t.

Category			Woven Fabric Processing									Knit Fabric Processing									Stock & Yarn Processing		
Subcategory			Simple			Complex			Desizing			Simple			Complex			Hosiery			Normal		
Nr	C&A Relevance	Toxic Pollutant (µg/l)	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
1	ZDHC / C&A RSL	copper (total)	5600	6300	4400	4000	8500	1400	16000	75000	200	2600	9700	280	830	870	790	40	40	40	1800	6100	730
2		silver	920	920	920	2900	2900	2900	6400	25000	1200	5400	13000	1600	3300	4700	1700	680	680	680	9700	11000	8300
3	ZDHC	zinc	500	900	100	940	1900	420	2500	20000	140	280	590	60	280	420	160	550	1300	40	890	2100	280
4	ZDHC / C&A RSL	pentachlorophenol	760	860	660	360	360	360	1900	8000	50	40	40	40	0	0	0	0	0	0	0	0	0
5		cyanide	30	30	30	0	0	0	440	1500	30	40	45	35	360	970	40	20	20	20	90	90	90
6	ZDHC / C&A RSL	cadmium (total)	340	340	340	120	120	120	430	510	260	350	580	230	0	0	0	0	0	0	290	430	70
7	ZDHC / C&A RSL	chromium (total)	3	5	2	15	25	5	410	2600	2	20	80	2	0	2	1	40	120	1	60	290	1
8	ZDHC / C&A RSL	lead (total)	65	70	60	150	190	100	330	690	50	240	390	130	180	290	60	0	0	0	410	770	170
9	C&A RSL	selenium	0	0	0	0	0	0	120	550	10	40	70	10	0	0	0	670	1800	90	100	180	20
10	ZDHC / C&A RSL	mercury (total)	80	80	80	70	70	70	100	100	100	0	0	0	0	0	0	0	0	0	80	80	80
11	C&A RSL	ethylbenzene	10	20	0	30	80	1	70	810	0	20	80	0	35	40	30	0	0	0	0	0	0
12	ZDHC / C&A RSL	1,2,4-trichlorobenzene	10	10	10	0	0	0	60	90	30	390	1000	50	90	90	90	0	0	0	120	120	120
13	ZDHC / C&A RSL	nickel	30	30	30	30	33	20	40	170	5	40	60	20	60	70	50	0	0	0	50	100	10
14	C&A RSL	toluene	10	40	0	10	20	2	40	250	0	2	10	0	2	4	0	0	0	0	0	1	0
15	C&A RSL	naphthalene	10	20	4	0	0	0	30	120	0	1	2	0	6	10	0	0	0	0	1	2	0
16	ZDHC	1,2-trans-dichloroethylene	0	0	0	0	0	0	20	40	0	0	0	0	0	0	0	0	0	0	0	0	0
17		N-nitrosodiphenylamine	0	0	0	2	2	2	20	20	20	0	0	0	0	0	0	2	2	2	0	0	0
18	C&A RSL	benzene	10	10	10	10	10	10	10	50	0	4	4	4	0	0	0	0	0	0	0	0	0
19	C&A RSL	acenaphthene	10	10	10	0	0	0	10	20	2	20	30	7	0	0	0	0	0	0	15	20	10
20	ZDHC / C&A RSL	arsenic (total)	0	0	0	30	30	30	10	30	0	10	30	0	2	2	1	0	0	0	3	10	1
21	ZDHC	1,1-dichloroethylene	0	0	0	0	0	0	10	10	5	2	2	2	0	0	0	0	0	0	0	0	0
22	ZDHC	1,1,1-trichloroethane	1	1	1	0	0	0	10	20	1	20	60	0	0	0	0	0	0	0	0	0	0
23	ZDHC / C&A RSL	chlorobenzene	0	0	0	640	1100	160	5	5	5	0	0	0	90	110	60	0	0	0	10	10	5
24	C&A RSL	anthracene	0	0	0	0	0	0	5	5	5	0	0	0	0	0	0	0	0	0	4	4	4
25		trichlorofluoromethane	0	0	0	0	0	0	3	3	3	4	4	4	0	0	0	0	0	0	0	0	0
26	ZDHC / C&A RSL	1,2-dichlorobenzene	0	0	0	0	0	0	2	10	0	2	3	0	0	0	0	0	0	0	3	10	0
27		1,2-dichloropropane	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
28	ZDHC / C&A RSL	tetrachloroethylene	0	0	0	0	0	0	0	1	0	10	20	0	10	20	1	0	0	0	3	10	0
29	ZDHC / C&A RSL	antimony (total)	0	0	0	0	0	0	0	3	0	1	2	0	4	10	1	0	0	0	1	3	0
30	ZDHC / C&A RSL	1,4-dichlorobenzene	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
31		thallium	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	ZDHC	chloroform	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	1	1	0	0	2	0
33	ZDHC / C&A RSL	1,2-dichloroethane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34		acrolein	0	0	0	0	0	0	0	0	0	6200	6200	6200	0	0	0	0	0	0	0	0	0
35		1,1,2,2-tetrachloroethane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	C&A RSL	acenaphthylene	0	0	0	0	0	0	0	0	0	0	0	0	2900	2900	2900	0	0	0	0	0	0
37	C&A RSL	fluorene	0	0	0	0	0	0	0	0	0	50	50	50	0	0	0	0	0	0	4	4	4
38	C&A RSL	phenanthrene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4
39	C&A RSL	pyrene	0	0	0	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3.2.3 Total Water Footprint

To obtain the total WF of the industrial processing the blue and grey WFs were added (Table 9). The total WF is fully dominated by the grey WF component.

Table 8: Total water footprint of textile industrial processing (m^3/t).

Subcategory	Max. WF	Min. WF	Avg. WF
Woven simple	6.318	4.392	5.584
Woven complex	8.521	1.432	3.989
Woven desizing	74.951	193	15.759
Knit simple	13.196	1.581	5.408
Knit complex	4.773	1.741	3.330
Knit hosiery	1.801	92	671
Average finishing	18.260	1.572	5.790
Stock & yarn	11.082	8.275	9.744

Since the subsequent necessary processes can vary in their complexity depending on the textile produced, average values were used to calculate the WF related to C&A's textile products. The WF for C&A's textile products for the fiscal year 2011 were therefore calculated by combining the average values of the finishing WF and the stock & yarn WF.

3.2.4 C&A´s Industrial Processing Water Footprint

The total textile weight produced for C&A in the fiscal year 2011 was 204.042 tonnes. To obtain 204.042 tonnes of cotton textile products, 214.781 tonnes of yarn are necessary (derived out of the product fraction of the product tree for cotton products see Annex I – Product tree for cotton).

The WF of the industrial processing steps necessary to produce C&A's cotton textile for fiscal year 2011 was then calculated by adding the WF of the yarn processing and the WF of the subsequent necessary processes to obtain the final product.

$$WF_{C\&A} = (214.781 \text{ tonnes} \times \text{WF Yarn}) + (204.042 \text{ tonnes} \times \text{WF finished textile product})$$

The total weight of C&A's finished cotton textile products was calculated as 204.042 metric tonnes for the fiscal year 2011. To process this amount of cotton products the total volume of water consumed and polluted (total water footprint = blue + grey water footprint) can vary between 2 and 6 billion m^3 (see Figure 11).

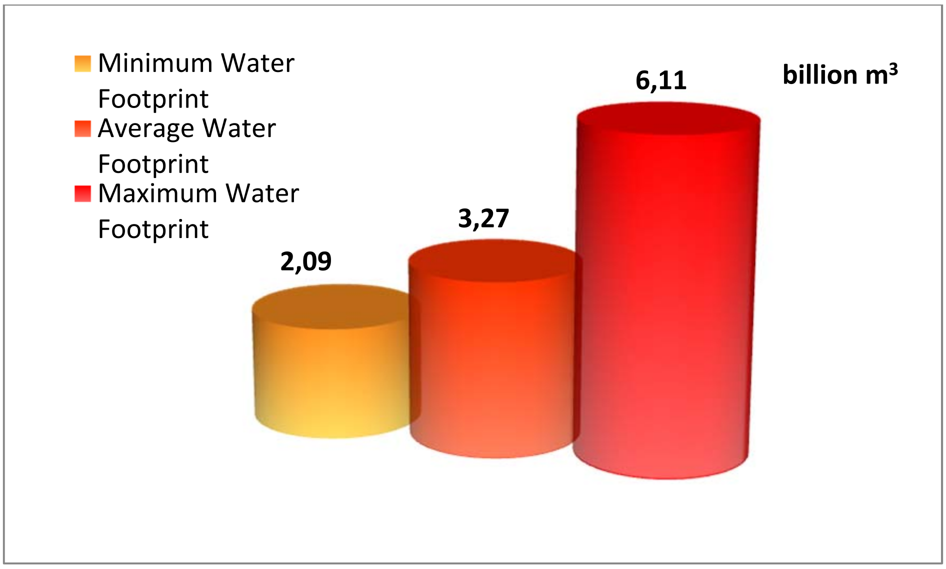


Figure 11: Total water footprint of C&A´s cotton products processing for the fiscal year 2011 (billion m^3).

These ranges are due to the possible different processes applied in the production, their varying water consumption, the diverse chemicals used and their environmental toxicity.

Table 9 shows more in detail the results of C&A's total industrial process water footprint.

Table 9: C&A's total industrial process water footprint (m^3/year).

	Total cotton weight (t)	Max. WF	Min. WF	Avg. WF
Stock & yarn	214.781	2.380.143	1.777.361	2.092.808
Finishing	204.042	3.725.823	320.700	1.181.410
Total process		6.105.966	2.098.062	3.274.218

Figure 12 shows the total WF for the different process subcategories in cubic meters per tonne. Also here it can be seen that the ranges within process steps can vary significantly. This could be due to the technology used and their efficiency or the design requirements for the different products.

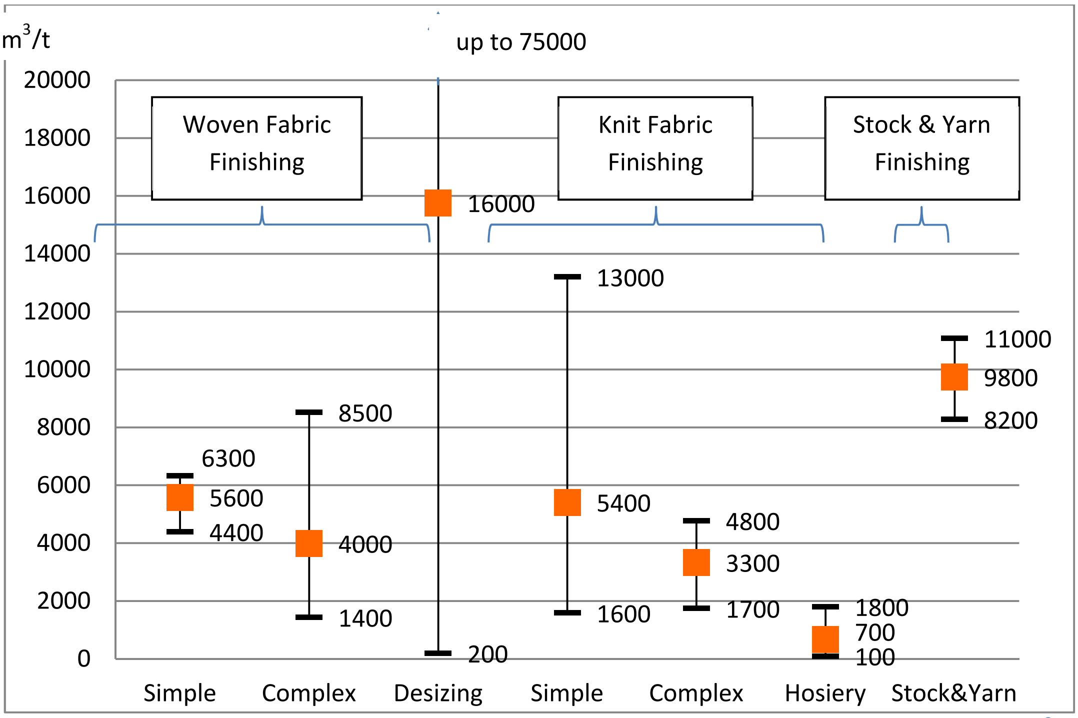


Figure 12: Minimum, average and maximum total water footprints for the different mill subcategories (m^3/t).

These ranges are also seen within the blue WF, from about 0,0003 Gm^3 to 0,02 Gm^3 (see Figure 13) and the grey WF, from 2,09 Gm^3 to 6,09 Gm^3 (see Figure 14).

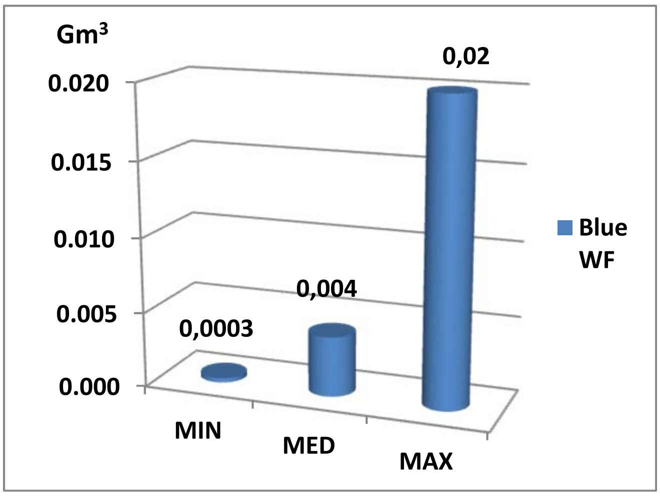


Figure 13: Blue water footprint of C&A´s cotton products processing for the fiscal year 2011 (Gm^3).

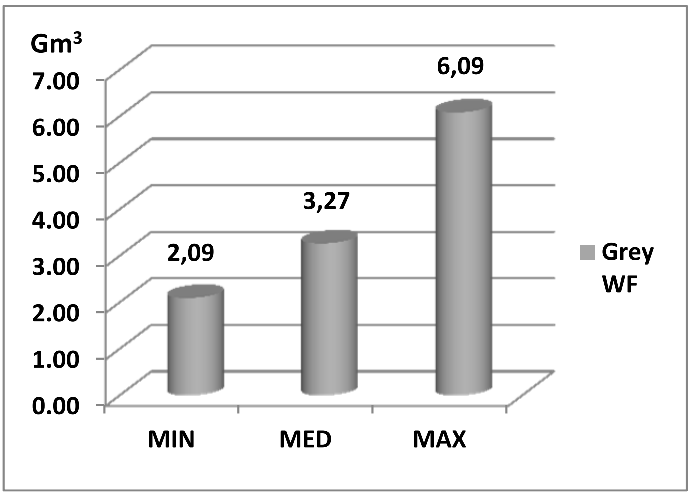


Figure 14: Grey water footprint of C&A´s cotton products processing for the fiscal year 2011 (Gm^3).

Comparing the values of the blue and grey WF with each other one can see that there are large differences with the grey WF being higher than the blue WF by a factor of between 100 and 10.000. This shows the high volumes of water polluted by the industrial sector in comparison to the volumes of water consumed.

Table 11 and 12 show more detailed the blue and grey WF results.

Table 10: C&A's industrial process blue water footprint (m^3/t).

	Total cotton weight (t)	BWF Max.	BWF Min.	BWF Med.
Stock & yarn	214.781	10.413	64	1.869
Finishing	204.042	7.594	198	2.085
Total process		18.007	262	3.954

Table 11: C&A's industrial process grey water footprint (m^3/t).

	Total cotton weight (t)	GWF Max.	GWF Min.	GWF Avg.
Stock & yarn	214.781	2.369.730	1.777.298	2.090.938
Finishing	204.042	3.718.229	320.502	1.179.326
Total process		6.087.959	2.097.800	3.270.264

Figure 15 shows the per cent of share of the blue and grey WF to the total water footprint. Notice that the scale at the y-axis starts at 98,8%. This means less than 1% of the industrial WF is related to blue water consumption and more than 98% is related to the grey water footprint (to pollution).

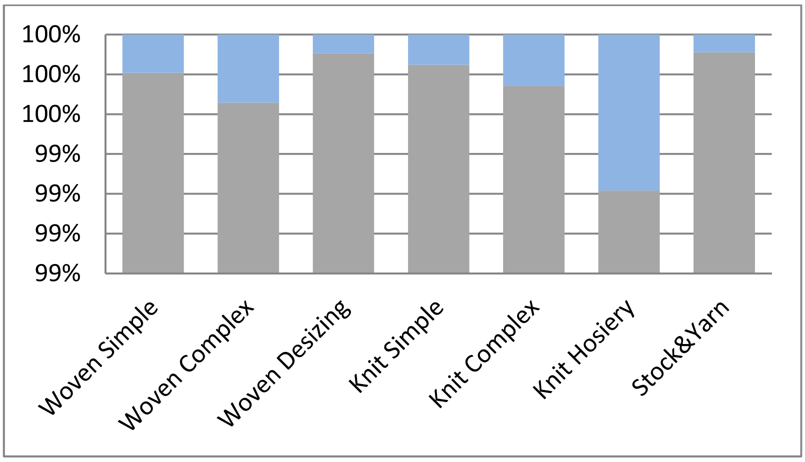


Figure 15: Percentage of blue and grey water footprint in the total water footprint.

The volume of water consumed (blue WF) compared to the volume of water polluted is extremely small, not to say insignificant. Nevertheless one can see a pattern in the fluctuation of the blue and grey water footprint share between categories and subcategories. Woven fabric processing mills seem to have a higher share in water consumption in comparison to knit fabric processing mills (with the exception of desizing mills and hosiery processing) and similar to stock and yarn processing. Simple processing mills seem to have a higher share of pollution than complex processing, whereas complex processing seem to have a higher share of water consumption than simple processing mills. Although the share of blue WF is extremely small, it should not be neglected, since it may have local impacts.

3.3 Total supply-chain water footprint

As the results in the preceding sections show, there is a high variation in the WF depending on the region and management practices of cotton cultivation and the processes and technologies used to manufacture the final textile products. Therefore the total WF of C&A´s supply chain can vary between 5,7 to 9,7 billion m^3/year (see Table 12). This variation depends mainly on the process steps used in industry, where the WF can vary between 2,1 – 6,1 (see Table 12).

Therefore also the total industrial WF can be higher or lower than the agricultural WF. Nevertheless it has to be noticed that for the agricultural WF no data was available to calculate the grey WF due to the use of pesticide, which as shown in previous studies has a large contribution to the grey WF in agriculture.

Table 12: Agricultural and industrial total water footprint.

	Total supply chain	Agriculture	Industry
Total WF in billion m^3/year	5,7 - 9,7	3,6	2,1 - 6,1

Table 13 gives a detailed overview of the results obtained for the blue WF by country of origin and distinguishing between agriculture and industry. As one can see the blue WF in the agricultural sector is by far higher than the industrial blue WF. C&A has the highest blue WF in India (> 500 million m3/year), followed by Turkey (> 115 million m^3/year) and Pakistan (> 67 million m^3/year). Although C&A sources only 4,88% of its seed cotton in Pakistan, it has its third highest blue water footprint in this country, which clearly reflects the non-efficient use of blue water resources. In comparison China, where C&A sources over 30% of its seed cotton, the blue WF is over 48 billion m^3/year.

Table 13: Distribution of C&A's supply chain blue water footprint.

Country of origin	Volume of seed cotton sourced from the country (%)	Weight of seed cotton (tonnes/year)	Agricultural BWF (m^3/year)	Volume of finished textile sourced from the country (%)	Weight of finished products (tonnes/year)	Industrial BWF (m^3/year)	Total BWF (m^3/year)
Australia	3.32%	21,446	39,172,792				39,172,792
Bangladesh				34.20%	69,774	1,395	1,395
Brazil	0.03%	194	3,448				3,448
Cambodia				6.20%	12,658	253	253
China	30.40%	196,371	48,463,502	25.49%	52,010	1,040	48,464,542
Egypt	1.20%	7,751	29,498,265				29,498,265
Greece	1.13%	7,299	8,654,040				8,654,040
India	42.13%	272,142	507,922,519	11.87%	24,217	484	507,923,003

Country of origin	Volume of seed cotton sourced from the country (%)	Weight of seed cotton (tonnes/year)	Agricultural BWF (m^3/year)	Volume of finished textile sourced from the country (%)	Weight of finished products (tonnes/year)	Industrial BWF (m^3/year)	Total BWF (m^3/year)
Indonesia	0.77%	4,974	4,974	6.71%	13,686	274	5,248
Ivory Coast	0.11%	711	711				711
Laos				0.39%	803	16	16
Madagascar				0.04%	77	2	2
Malaysia				0.18%	376	8	8
Mali	0.01%	65	65				65
N. Korea				0.18%	367	7	7
Pakistan	4.88%	31,523	67,956,378	2.31%	4,708	94	67,956,472
S. Korea				0.03%	71	1	1
Spain	0.05%	323	696,243				696,243
Sri Lanka				1.62%	3,314	66	66
Sudan	0.02%	129	589,637				589,637
Syria	0.49%	3,165	6,532,856				6,532,856
Taiwan				0.05%	94	2	2
Tanzania	0.01%	65	25,684				25,684
Thailand	0.20%	1,292	1,292	0.85%	1,742	35	1,327
Turkey	7.67%	49,545	115,452,885	8.13%	16,590	332	115,453,217
Unknown	2.02%	13,048	17,043,539				17,043,539
USA	5.29%	34,171	30,861,834				30,861,834
Vietnam	0.27%	1,744	1,744	1.74%	3,553	71	1,815
TOTAL:	100%	645,958	872,882,408	100%	204,039	4,081	872,886,489

Table 14 compares the grey water footprint between the agricultural and industrial processes for each sourcing country. The grey water footprint in industry is far higher than in agriculture. C&A has the highest grey water footprint in Bangladesh (> 1 billion m^3/year), followed by China (> 960 million m^3/year) and India (> 650 million m^3/year). It must be noted again that pesticides were not taken in consideration at the agricultural level.

Table 14: Distribution of C&A's supply chain grey water footprint.

Country Sourced	Volume of seed cotton sourced from the country (%)	Weight of seed cotton (tonnes/year)	Agricultural GWF (m^3/year)	Volume of finished textile sourced from the country (%)	Weight of finished products (tonnes/year)	Industrial GWF (m^3/year)	Total GWF (m^3/year)
Australia	3,32%	21.446	682.934				682.934
Bangladesh				34,20%	69.774	1.118.297.916	1.118.297.916
Brazil	0,03%	194	116.921				116.921
Cambodia				6,20%	12.658	202.877.033	202.877.033
China	30,40%	196.371	128.246.244	25,49%	52.010	833.590.289	961.836.533
Egypt	1,20%	7.751	4.240.068				4.240.068
Greece	1,13%	7.299	7.299				7.299
India	42,13%	272.142	262.674.512	11,87%	24.217	388.133.926	650.808.438
Indonesia	0,77%	4.974	3.553.341	6,71%	13.686	219.345.203	222.898.544
Ivory Coast	0,11%	711	31.128				31.128
Laos				0,39%	803	12.872.018	12.872.018
Madagascar				0,04%	77	1.227.099	1.227.099
Malaysia				0,18%	376	6.025.307	6.025.307
Mali	0,01%	65	1				1
N. Korea				0,18%	367	5.875.050	5.875.050
Pakistan	4,88%	31.523	22.403.383	2,31%	4.708	75.459.077	97.862.460
S. Korea				0,03%	71	1.141.953	1.141.953
Spain	0,05%	323	323				323
Sri Lanka				1,62%	3.314	53.115.858	53.115.858
Sudan	0,02%	129	88.641				88.641
Syria	0,49%	3.165	554.961				554.961
Taiwan				0,05%	94	1.502.570	1.502.570
Tanzania	0,01%	65	4.244				4.244
Thailand	0,20%	1.292	2.672.192	0,85%	1.742	27.922.764	30.594.956
Turkey	7,67%	49.545	10.723.160	8,13%	16.590	265.894.829	276.617.989
Unknown	2,02%	13.048	5.743.150				5.743.150
USA	5,29%	34.171	7.294.834				7.294.834
Vietnam	0,27%	1.744	1.305.050	1,74%	3.553	56.937.395	58.242.445
TOTAL:	100%	645.958	450.342.386	100%	204.039	3.270.218.289	3.720.560.675

Table 15 shows the distribution of the blue and grey WF between the sourcing countries. Around 60% of C&A´s blue WF lies within India, 13% in Turkey and around 8% in Pakistan. 30% of C&A´

grey WF lies within Bangladesh, around 26% in China and 18% in India.

Table 15: Distribution of C&A´s blue and grey water footprint.

Source country	Share in total BWF (%)	Share in total GWF (%)	Source country	Share in total BWF (%)	Share in total GWF (%)
Australia	4.5	< 0,1	N. Korea	<0.1	0,2
Bangladesh	<0.1	30,1	Pakistan	7.8	2,6
Brazil	<0.1	< 0,1	S. Korea	<0.1	< 0,1
Cambodia	<0.1	5,5	Spain	0.1	< 0,1
China	5.6	25,9	Sri Lanka	<0.1	1,4
Egypt	3.4	0,1	Sudan	0.1	< 0,1
Greece	1.0	< 0,1	Syria	0.7	< 0,1
India	58.2	17,5	Taiwan	<0.1	< 0,1
Indonesia	<0.1	6,0	Tanzania	<0.1	< 0,1
Ivory Coast	<0.1	< 0,1	Thailand	<0.1	0,8
Laos	<0.1	0,3	Turkey	13.2	7,4
Madagascar	<0.1	< 0,1	Unknown	2.0	0,2
Malaysia	<0.1	0,2	USA	3.5	0,2
Mali	<0.1	< 0,1	Vietnam	<0.1	1,6

4. Sustainability of C&A´s blue water footprint

In the C&A's supply-chain WF sustainability assessment, the data and information such as the blue WF for each C&A sourcing country at a river basin scale, the number of months per year that a basin in a C&A sourcing country experiences low, moderate, significant or severe blue water scarcity (see Section 2.3 for the classification of the blue water scarcity level) are used. In order to assess the sustainability at a river basin scale, only the blue WF within the basins were data on water scarcity was available could be considered. Therefore the assessment could only be done for 66% of C&A´s blue WF. The proportion of the total blue WF within the basin refers though to 100% of C&A´s blue WF. If a production step or process of the C&A supply chain is located in a hotspot (i.e. the basin is experiencing at least one month a year with moderate, significant or severe scarcity) this process is unsustainable. The results are shown in Table 16.

In many of the listed hotspot basins (see table Annex IV), C&A's supply-chain blue WF is relatively small compared to C&A's global supply-chain blue WF. Therefore in order to identify basins for which C&A can prioritise in its response strategy, the share of C&A's supply-chain blue WF within a basin to the total C&A's global supply-chain blue WF is calculated. Also a threshold value, 1%, is set to identify C&A's priority basins. The outcome of the blue WF sustainability assessment is presented in Table 17 and detailed assessment results are presented in Annex IV.

Table 16: C&A´s blue water footprint in a number of river basins from which C&A sources and the number of months per year that the basin faces low, moderate, significant or severe blue water scarcity.

						Number of months per year that a basin faces low, moderate, significant or severe water scarcity			
Country	River Basin	Agricultural BWF	Industrial BWF	Total	% of Total BWF[3]	Low	Moderate	Significant	Severe
Australia	Murray	38.521.400	7,76	38.521.408	4,4	4	2	0	6
China	Yongding He	11.992.100	79,06	11.992.179	1,4	0	0	0	12
	Huang He (Yellow River)	10.260.600	139,38	10.260.739	1,2	5	1	2	4
	Huai He	3.134.750	84,77	3.134.835	0,4	5	1	5	1
	Yangtze River (Chang Jiang)	700.764	333,56	701.098	0,1	12	0	0	0
China; India; Bangladesh	Ganges	6.819.270	376,06	6.819.646	0,8	5	0	2	5
China; Pakistan	Tarim	11.196.800	7,97	11.196.808	1,3	1	1	1	9
China; Pakistan; India	Indus	344.162.000	197,67	344.162.198	39,4	0	1	3	8
Egypt; Sudan; Tanzania	Nile	15.453.100	14,43	15.453.114	1,8	10	0	0	2
India	Krishna	20.704.800	77,30	20.704.877	2,4	3	1	1	7
	Narmada	14.679.500	17,10	14.679.517	1,7	5	2	0	5
	Godavari	12.593.100	62,64	12.593.163	1,4	5	2	0	5
	Tapti River	7.824.980	17,01	7.824.997	0,9	4	2	1	5
	Mahi River	4.055.700	11,10	4.055.711	0,5	5	2	0	5
	Cauvery River	2.130.940	35,23	2.130.975	0,2	0	3	1	8
	Penner River	868.453	10,98	868.464	0,1	0	1	2	9
Spain	Guadalquivir	533.019	0,09	533.019	0,1	5	1	0	6
Turkey; Syria	Tigris & Euphrates	46.399.600	52,69	46.399.653	5,3	6	0	1	5
USA	Mississippi River	9.792.310	26,41	9.792.336	1,1	8	2	0	2
	Brazos River	7.117.170	1,00	7.117.171	0,8	5	0	1	6
	Colorado River (Carribbean Sea)	4.219.020	0,59	4.219.021	0,5	5	1	0	6
	Colorado River (Pacific Ocean)	2.314.920	2,61	2.314.923	0,3	4	0	3	5
	San Joachin River	2.298.080	0,59	2.298.081	0,3	4	1	0	7

[3] The proportion of the total blue WF within the basin refers though to 100% of C&A´s blue WF, although the assessment could be done only for 66%.

Table 17: Priority basins within C&A´s supply chain.

Data derived from the product WF account				Check the sustainability of the total WF in the catchment in which the process is located		Check the sustainability of the WF of the process itself	Conclusion		Check relevance from product perspective	Check whether response is required
Process Step	Country	River Basin	Blue WF	Number of months per year that a basin faces moderate, significant or severe water scarcity	Does the country have hotspots?	Can the WF be reduced or avoided altogether?	Is this a sustainable component in the product WF?	Percentage of the blue water footprint of C&A related to cotton products located in this basin	Share above threshold of one per cent	Is this a priority component?
Agricultural	Australia	Murray	38.521.400	8	yes	yes	no	4,4	yes	yes
Agricultural	China	Yongding He	11.992.100	12	yes	yes	no	1,4	yes	yes
Agricultural	China	Huang He (Yellow River)	10.260.600	7	yes	yes	no	1,2	yes	yes
Agricultural	China; Pakistan	Tarim	11.196.800	11	yes	yes	no	1,3	yes	yes
Agricultural	China; Pakistan; India	Indus	344.162.000	12	yes	yes	no	39,4	yes	yes
Agricultural	Egypt; Sudan; Tanzania	Nile	15.453.100	2	yes	yes	no	1,8	yes	yes
Agricultural	India	Krishna	20.704.800	9	yes	yes	no	2,4	yes	yes
Agricultural	India	Narmada	14.679.500	7	yes	yes	no	1,7	yes	yes
Agricultural	India	Godavari	12.593.100	7	yes	yes	no	1,4	yes	yes
Agricultural	Turkey; Syria	Tigris & Euphrates	46.399.600	6	yes	yes	no	5,3	yes	yes
Agricultural	USA	Mississippi River	9.792.310	4	yes	yes	no	1,1	yes	yes

Based on the above assessment, the most important priority basins for C&A are: Indus, Tigris/Euphrates, Murray and Krishna (see Table 18)

Table 18: C&A´s priority basins.

Basin	Share of C&A Supply-chain Blue WF located in the basin	Nr. of months of the basin under moderate to severe scarcity
Indus	39,4 %	12
Tigris/Euphrates	5,3 %	6
Murray	4,4 %	8
Krishna	2,4 %	9

The following Figures 16 to 18 show how we overlaid C&A's supply-chain blue WF map and the global blue water scarcity map to identify hotspots in C&A's supply chain. The arrows visualize how the blue WF (in Figure 16) and the water scarcity river basins (in Figure 17) lead to the priority basins (encircled in Figure 18).

Figure 16: Blue water footprint of C&A's supply chain.

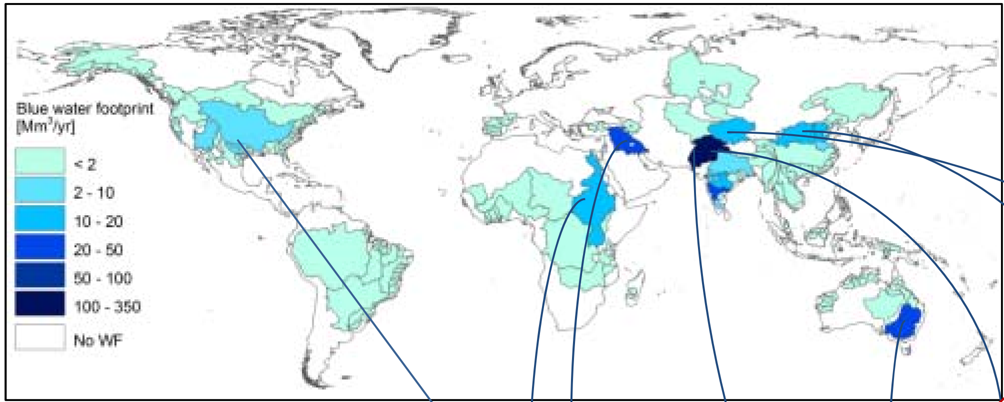
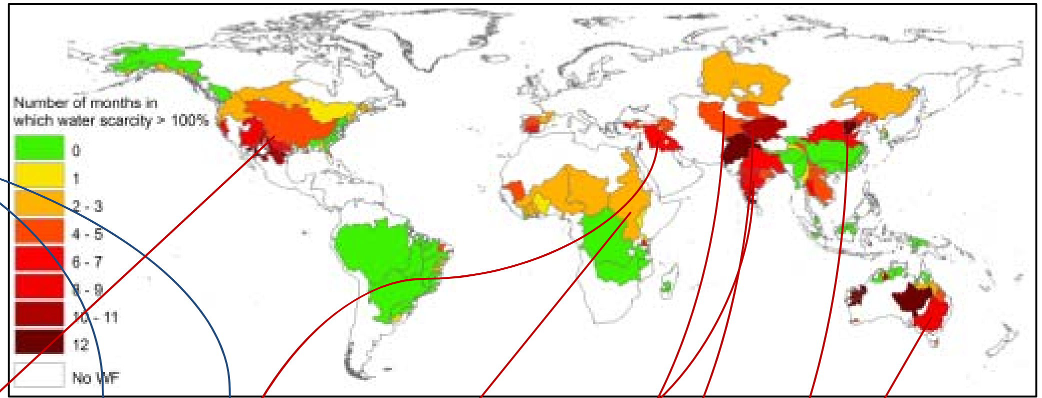


Figure 17: River basins with water scarcity > 100% in C&A' supplying countries.



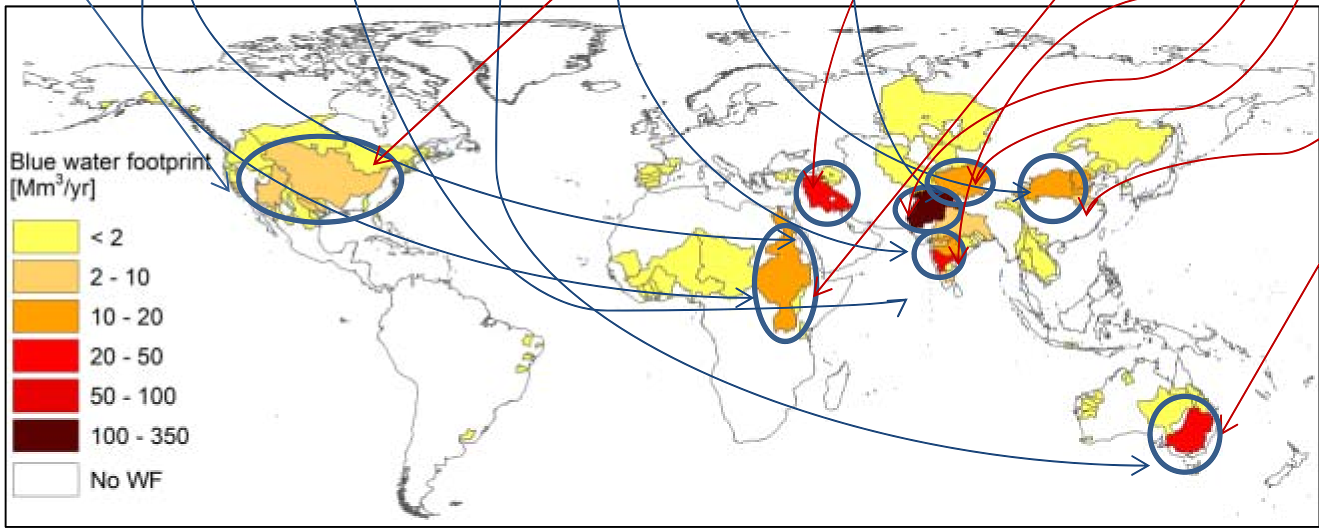


Figure 18: C&A's blue water footprint hotspots.

5. Identification of possible response strategies

What can be done to reduce the WF of C&A´s supply chain in order to become more sustainable?

The general guideline for WF reduction according to the Water Footprint Assessment Manual (Hoekstra et al., 2011) is: avoid, reduce and compensate (in order of priority). In all cases, priority for taking action should also be given to WF components of C&A´s supply chain that are located in "hotspots". The WF of a specific process is unsustainable and therefore needs to be reduced if (i) the WF of the process contributes to a hotspot, or (ii) the WF can be relatively easily be reduced or avoided altogether, independent of the geographic context. The second criterion implies that WFs need to be reduced also in water-abundant areas, whenever reasonably possible, not to solve local water problems in these areas, but to contribute to a more efficient water use globally. Reducing WFs (m^3/t) in water abundant areas by increasing water productivity (t/m^3) is key in reducing the pressure on water resources in water-poor areas, since increased production of water-intensive goods in areas where water is sufficiently available is necessary when the limits to production are already exceeded in water-poor areas.

'Reduction' of WFs can be achieved in two different ways. In a certain production chain, one can replace one technique by another technique that results in a lower or even zero WF or one can avoid the use of a specific ingredient or final product altogether. Examples of improved production technology are: replace sprinkler irrigation by drip irrigation; replace conventional by organic farming. Examples of avoidance are: avoid the application of toxic chemicals that end up in the surface or groundwater. When exploring options to reduce WFs it is always essential to explore both avenues.

Table 18 summarizes the possible WF reduction options per WF component per sector. Technically, both blue and grey WF in industrial processes can be reduced to zero by full water recycling, although this goal may be limited due to costs associated with its implementation. In a closed cycle there will be neither evaporation losses nor polluted effluents. In industries, only when freshwater needs to be incorporated into a product, the associated blue WF cannot be avoided, but blue WFs that refer to water evaporation in industrial processes can generally be avoided by recapturing the water. C&A can principally strive to zero blue and grey water footprint in the cotton processing industries in its supply chain, although cost considerations may lead to the necessity to accept levels slightly above zero. Further study on the costs of recycling and wastewater treatment technologies necessary to reduce blue and grey WFs to zero would be needed to get more precise guidance in this matter.

In agriculture, the grey WF can be reduced substantially by lowering the application of chemicals to the field and employing better techniques and timing of application (so that less chemicals reach the water system by run-off from the field or by leaching). Green and blue WF in agriculture can generally be reduced substantially by increasing green and blue water productivity (t/m^3). In the case of blue water, this implies applying less irrigation water in a smarter way, in order to give a higher yield per cubic metre of water evaporated. By increasing blue water productivities in irrigated agriculture (through the application of water-saving irrigation techniques and by 'deficit' instead of 'full' irrigation) and by increasing the fraction of production that is based on green instead of blue water, the blue WF can be reduced. As shown in the *Grey Water Footprint Phase II Final Report 2012*, the grey WF can be lowered through organic farming. If organic farming is not feasible in some cases, improvements can be made by shifting from conventional application of chemicals to precision application of artificial fertilizers and pesticides.

Table 19: Possible WF reduction options per WF component per sector.

	Agriculture	Industry
Green WF	Decrease green WF (m^3/t) by increasing green water productivity (t/m^3) in both rain-fed and irrigated agriculture. Increase total production from rain-fed agriculture.	Not relevant.
Blue WF	Decrease blue WF (m^3/t) by increasing blue water productivity (t/m^3) in irrigated agriculture. Decrease ratio blue/green WF.	Zero blue WF: no losses through evaporation – full recycling – only blue WF related to the incorporation of water into a product cannot be avoided.
Grey WF	Reduced use of artificial fertilizers and pesticides; more effective application. Grey WF can be reduced through organic farming.	Zero grey water footprint: no pollution – full recycling and treatment of remaining return flows.

Achieving improvements in the WF of C&A´s supply chain may be difficult since they are not under C&A's direct control. However, engagement with the farmers, cotton processing industries and their associations in the cotton supply chain is a critical step along the water stewardship journey.

Measures to improve supply-chain sustainability include some of the following elements:

- Agree on WF reduction targets with suppliers;
- Change the business model in order to achieve more control over the supply chain;
- Invest in improved cotton farming and cotton-processing practices;
- Possibly move away from sourcing cotton from hotspot-areas where making steps towards improvements are very difficult; and
- Invest in improved catchment management and sustainable water use in the catchment where the company's residual WF is located.

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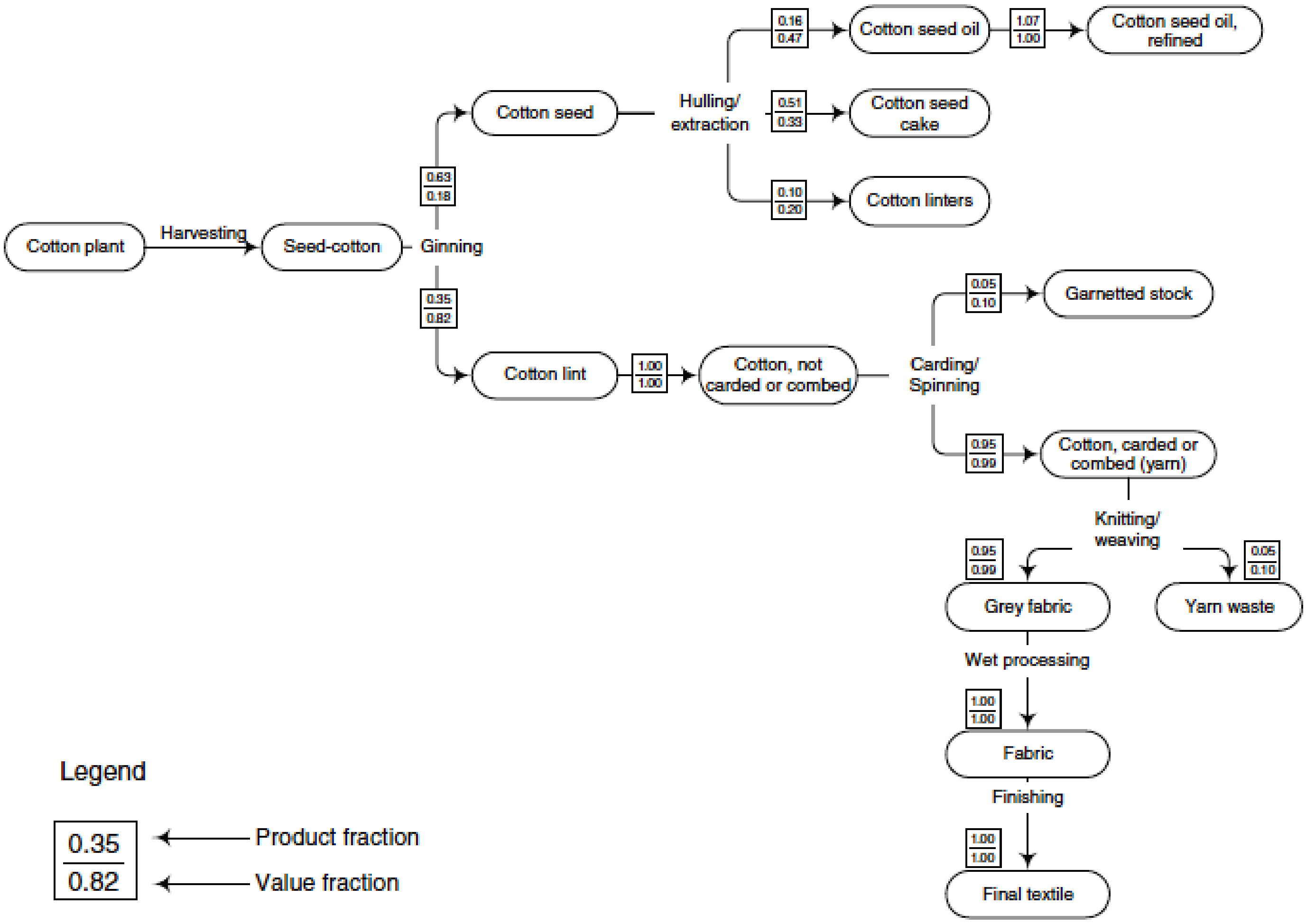
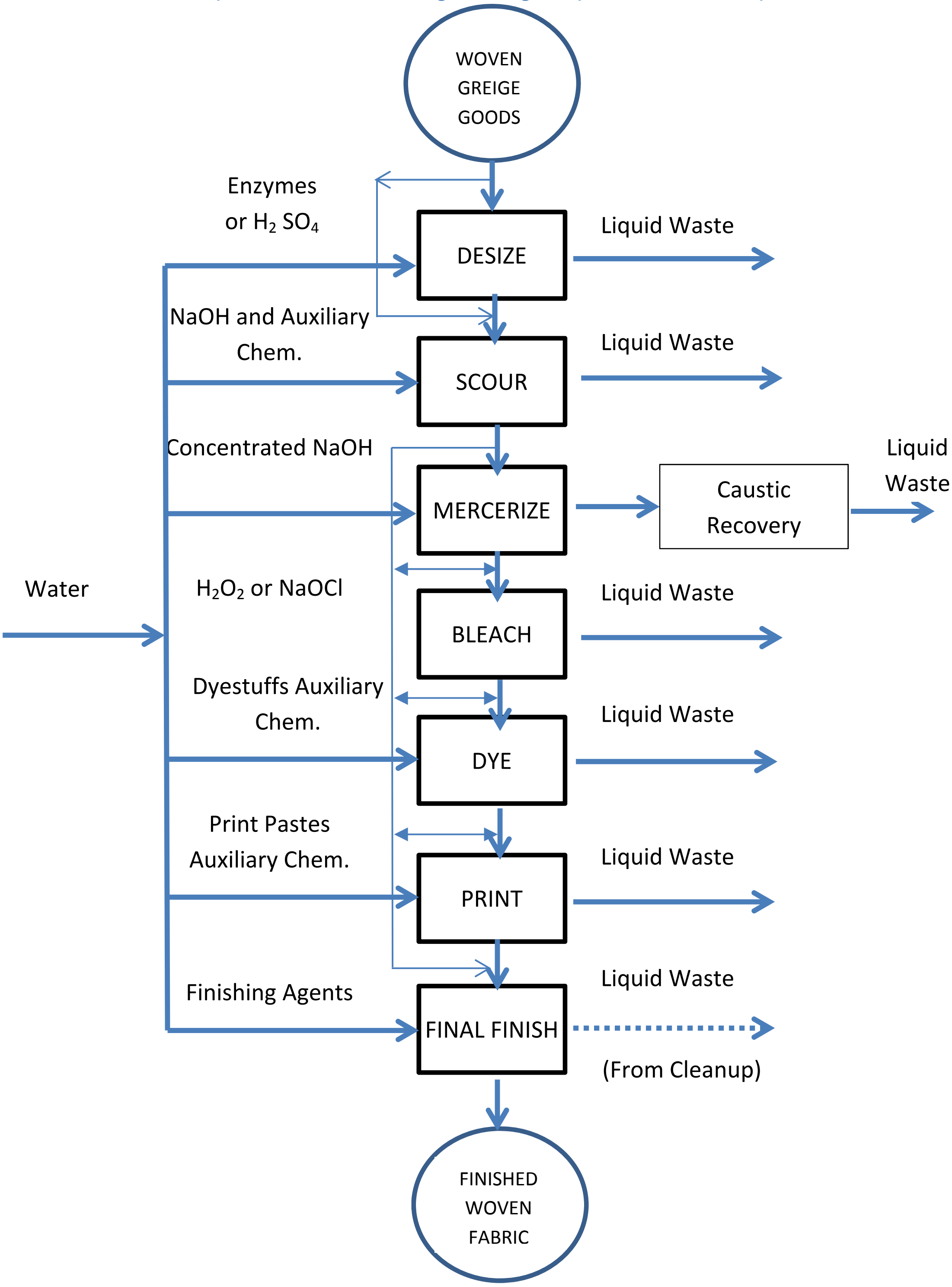
Annex I – Product tree and process flow charts for cotton production

The product tree shows the product fraction and value fraction per processing step from the cotton plant to the finished textile product. (Chapagain, et al 2006)

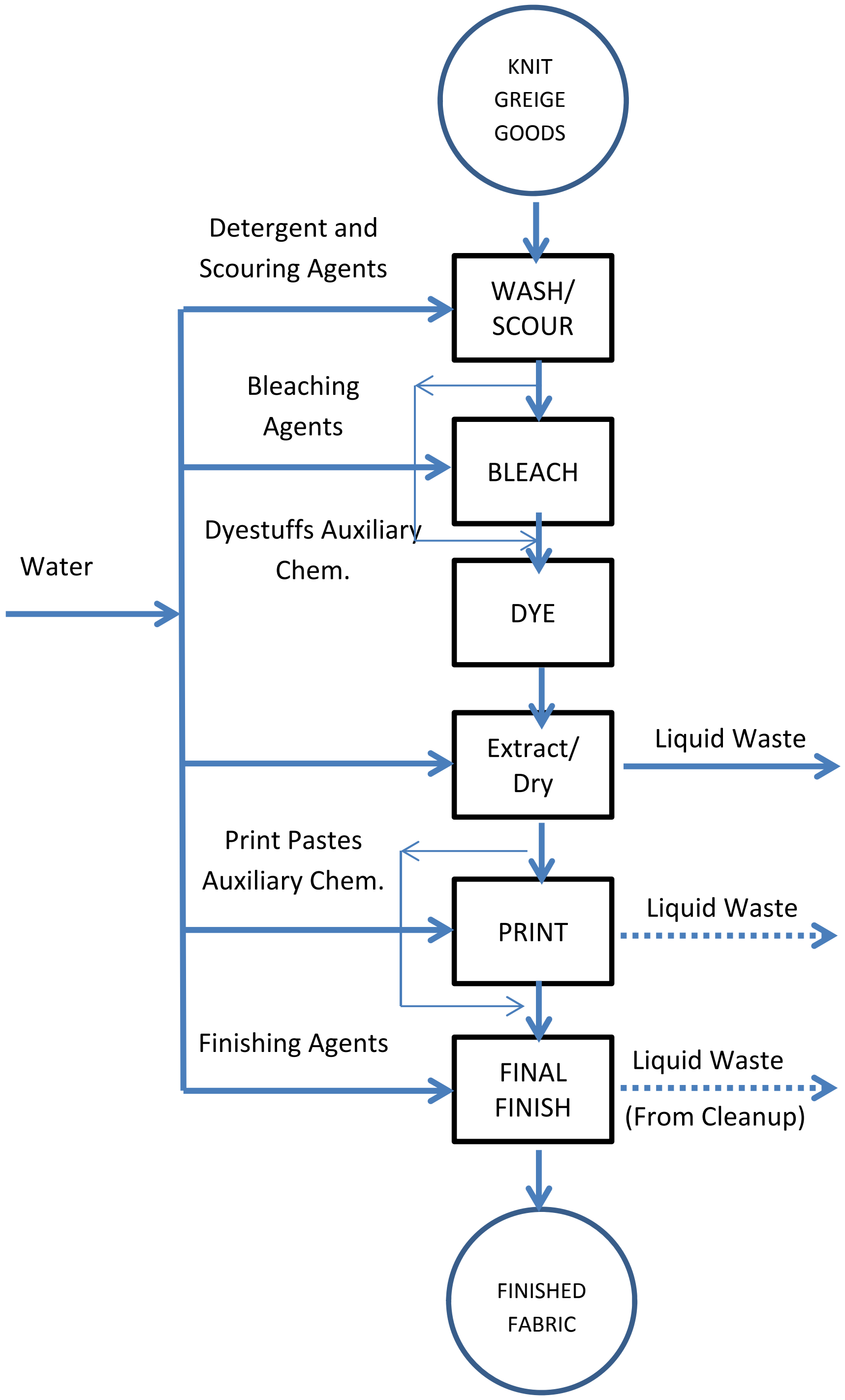


The following textile flow charts were taken from US EPA (1982, pp. 58-61).

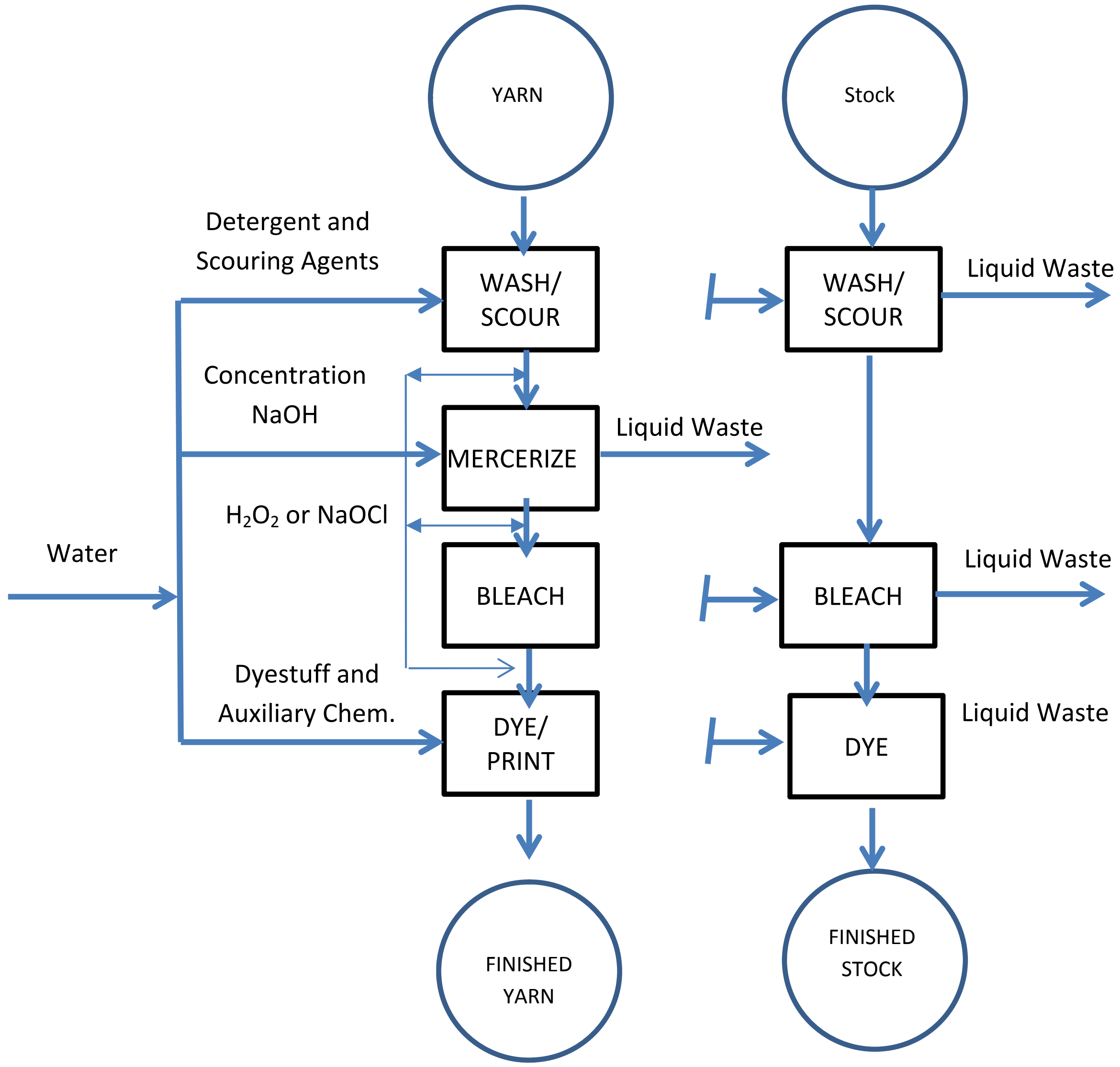
a) Woven Fabric Finishing flow diagram. (Source US EPA, 1982)



b) Knit Fabric Finishing flow diagram. (Source US EPA, 1982)



c) Yarn and stock finishing operations (Source US EPA, 1982)



Annex II – Major Wet Processes

The following information on textile processes was taken from US EPA (1982, pp. 37-50).

Most high water use textile manufacturing processes involve the conventional finishing of fibre and fabric products. The most significant processes are desizing, scouring, mercerizing, bleaching, dyeing and printing. It is not uncommon for two or more wet process operations to occur sequentially in a single batch unit or on a continuous range. For example, it is common for desizing, scouring and mercerizing operations to be placed in tandem with the continuous bleaching range to finish cotton more efficiently. A variety of wet finishing situations of this type may occur, depending upon factors such as processes used, type and quality of materials and product and original mill and equipment design.

a) Desizing

Desizing removes the sizing compounds applied to yarn in the slashing operation and is usually the first wet finishing operation performed on woven fabric. It consists of solubilizing the size with mineral acid or enzymes (starch size only) and thoroughly washing the fabric. Acid desizing uses a solution of dilute sulphuric acid to hydrolyse the starch and render it water soluble. Enzyme desizing uses vegetable or animal enzymes to decompose starches to a water soluble form. In either case, the desizing agent normally is applied to the fabric by roller pad. After the desizing solution has been applied, the goods are soaked or steeped in storage bins, steamers or J-boxes. After the size has been solubilized, the solution is discarded and the fabric is washed and rinsed. For desizing of PVA and CMC, sizing materials that are directly soluble in water, no decomposition is required and the goods are washed only with water.

b) Scouring

*Scouring is employed **to remove natural and acquired impurities from fibres and fabric**. The nature of the scouring operation depends on the fibre type.*

Cotton fabric contains natural impurities such as wax, pectin's and alcohols, as well as processing impurities such as size, dirt and oil. These substances are removed from the fabric by hot alkaline detergents or soap solutions. Also, cotton scouring makes the fibres whiter and more absorbent for subsequent bleaching and dyeing. Scouring of cotton often is done in conjunction with desizing rather than operation and usually is accomplished by width boiling.

c) Mercerizing

*Mercerization **increases the tensile strength, lustre, sheen, dye affinity and abrasion resistance of cotton goods.** It may be performed on yarn or greige goods, but usually is conducted after fabric scouring. It is accomplished by impregnating the fabric with cold* *sodium hydroxide solution (15 to 30 percent by volume). The solution causes swelling of the cotton (cellulose) fibres as the alkali is absorbed. Higher concentrations, longer residence times and lower temperatures favour greater swelling. When increased tensile strength is a primary consideration, the fabric is mercerized on a tender frame. After the desired period of contact, the caustic is washed off thoroughly, sometimes with the aid of an intermediate acid wash. In many mills, the sodium hydroxide is reclaimed in caustic recovery units and concentrated for reuse in scouring or mercerization. It is estimated that less than half of all cotton fabrics are mercerized and, with the increasing use of cotton polyester blends, less mercerization is likely in the future.*

d) Bleaching

Most cotton fabrics are bleached on continuous bleaching ranges directly after scouring.

Bleaching is a common finishing process ***used to whiten cotton****. In addition to removing colour, bleaching can dissolve sizing, natural pectins, waxes and small particles of foreign matter. It usually is performed immediately after scouring or mercerizing and prior to dyeing or printing. Bins, jigs or continuous equipment may be employed.*

Cotton bleaching is accomplished with hypochlorite, hydrogen peroxide, chlorine dioxide, sodium perborate, peracidic acid or other oxidizing agents. Reducing agents also may be used, although the oxidizing agents usually give a more permanent white color. Today, most cotton bleaching uses hydrogen peroxide or hypochlorite, either in kiers or on a continuous range; hydrogen peroxide is the preferred oxidizing agent and the continuous range the most efficient bleaching method.

e) Dyeing

The dyeing operation is a major source of wastewater in fabric finishing. Dyeing is without question the most complex of all the wet finishing operations in the textile industry. There are 9 basic classifications of dyes according to application and approximately 17 types according to use by the textile industry. There are thousands of individual dyes. In addition to the dyestuff itself, various other chemicals are added to help deposit the dye or to develop the color. Chemicals that are used include acids, bases, salts, wetting agents, retardants, accelerators, detergents, oxidizing agents, reducing agents, developers and stripping agents.

Depending on the type of fabric, dye, equipment used and the efficiency of the processes, the wastewater from the dyeing of woven fabric may contain many combinations of the dyes and auxiliary chemicals. The process contributes substantially to the total pollutant mass discharge rate and is responsible for most of the wastewater flow. The wastewater from the process may contain organic and metallic toxic pollutants and is high in dissolved solids relative to other processes. It is, however, low in suspended solids relative to other processes. The wastewater typically is colored and, if the color is not reduced, can be aesthetically undersireable for discharge into receiving waters.

f) Printing

Printing, like dyeing, is a process for applying color to fabric. However, the color application techniques are quite different. Instead of coloring the whole cloth as in dyeing, print color is applied only to specific areas of the cloth to achieve a planned design. Consequently, printing often is referred to as localized dyeing.

Final washing of the fabric removes excess print paste and leaves a uniformly smooth effect. This process, along with the cleanup of print paste mixing tanks, applicator equipment (troughs and rollers) and belts, contributes the pollutant loading associated with the printing process.

Printing wastes are comparable in constituents to dye wastes, although the volumes are much lower and the concentrations greater. The thickeners contribute to the biochemical oxygen demand and solvents used to prepare pigments and clean pigment application equipment often are present. Printing pigments will contribute suspended solids when the fabric is rinsed, although much of the wastewater from printing comes from the cleaning of make-up tanks and process equipment.

Annex III – Pollutants in textile mill effluents and ambient water quality standards

			Woven Fabric Conentrations															Knit Fabric Concentrations															Stock & Yarn Concentrations					EPA	
		Subcategory	Simple			#	*	Complex			#	*	Desizing			#	*	Simple			#	*	Complex			#	*	Hosiery			#	*	Normal			#	*	Cmax (ug/l)	Derivation of Cmax
		Average Wastewater Discharge Rate (l/kg)	108,8			2		94,8			3		136,8			12		93,5			5		112,3			3		48,4			3		115,2			6			
		Average Water Intake (l/kg)	124,0			2		108,0			3		155,9			12		100,1			5		120,1			3		51,4			3		123,3			6			
ID	C&A Relevace	Toxic Pollutant (ug/l)	Avg	Max	Min			Avg	Max	Min			Avg	Max	Min			Avg	Max	Min			Avg	Max	Min			Avg	Max	Min			Avg	Max	Min				
1	C&A RSL	acenaphthene	9	9	9	3	1	0	0	0	0	0	15	27	2	21	2	33	53	12	6	2	0	0	0	0	0	0	0	0	0	0	22	30	13	7	2	170	acute tox
2		acrolein	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	199	199	199	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1-hour avg
3		acrylonitrile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	90	90	6	1	0	0	0	0	0	1600	1600	1600	4	1	0	0	0	0	0	-	
4	C&A RSL	benzene	32	32	32	3	1	31	31	31	3	1	49	170	1	28	6	20	20	20	6	1	1	1	1	3	1	2	3	1	4	2	1	1	1	7	1	510	acute tox
5	DHC / C&A RS	chlorobenzene	0	0	0	0	0	169	296	42	3	2	1	1	1	23	2	0	0	0	0	0	20	25	14	3	2	0	0	0	0	0	2	2	1	7	2	25	acute tox
6	DHC / C&A RS	1,2,4-trichlorobenzene	28	28	28	3	1	0	0	0	0	0	101	156	45	26	2	1045	2700	120	6	3	190	190	190	3	1	0	0	0	0	0	270	270	270	7	1	250	acute tox
7	DHC / C&A RS	hexachlorobenzene	2	2	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	
8	DHC / C&A RS	1,2-dichloroethane	6	6	6	3	1	0	0	0	0	0	4	4	4	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	118000	acute tox
9	ZDHC	1,1,1-trichloroethane	17	17	17	3	1	0	0	0	0	0	79	306	16	23	5	406	1200	8	6	3	3	3	3	3	1	0	0	0	0	0	0	0	0	0	0	1800	acute tox
10		1,1-dichloroethane	0	0	0	0	0	0	0	0	0	0	4	4	4	20	1	4	6	1	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	
11		1,1,2,2-tetrachloroethane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	21	21	3	1	0	0	0	0	0	1	1	1	7	1	9320	acute tox
12		bis-(chloromethyl) ether	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	6	7	1	-	
13		2,4,6-trichlorophenol	0	0	0	0	0	20	20	20	3	1	44	94	1	26	3	0	0	0	0	0	0	0	0	0	0	27	27	27	4	1	13	16	9	7	2	-	
14		parachlorometa cresol	0	0	0	0	0	0	0	0	0	0	7	9	5	26	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	29	29	7	2	-	
15	ZDHC	chloroform	11	11	11	3	1	33	33	33	3	1	18	32	3	28	9	260	498	22	6	2	44	71	17	3	2	391	642	140	4	2	86	410	1	7	5	28900	acute tox
16		2-chlorophenol	0	0	0	0	0	131	131	131	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	10	7	1	-	
17	DHC / C&A RS	1,2-dichlorobenzene	0	0	0	0	0	0	0	0	0	0	17	62	1	26	4	18	35	1	6	2	0	0	0	0	0	0	0	0	0	0	29	56	1	7	2	1120	acute tox
18	DHC / C&A RS	1,4-dichlorobenzene	0	0	0	0	0	0	0	0	0	0	2	2	2	21	1	7	7	7	6	1	0	0	0	0	0	0	0	0	0	0	1	1	1	7	1	1120	acute tox
19	ZDHC	1,1-dichloroethylene	0	0	0	0	0	0	0	0	0	0	62	84	39	22	2	29	29	29	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1160	acute tox
20	ZDHC	1,2-trans-dichloroethylene	0	0	0	0	0	0	0	0	0	0	181	360	2	20	2	0	0	0	0	0	5	5	5	3	1	0	0	0	0	0	0	0	0	0	0	1160	acute tox
21		2,4-dichlorophenol	0	0	0	0	0	0	0	0	0	0	41	41	41	21	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	20	20	7	1	-	
22		1,2-dichloropropane	0	0	0	0	0	0	0	0	0	0	68	100	36	20	2	2	2	2	6	1	0	0	0	0	0	0	0	0	0	0	56	56	56	7	1	23000	acute tox
23		1,3-dichloropropylene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	
24		2,4-dimethylphenol	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	3	1	0	0	0	0	0	96	190	2	7	2	-	
25		2,6-dinitrotoluene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	54	54	7	1	-	
26	C&A RSL	ethylbenzene	233	460	5	3	2	960	2835	18	3	3	1692	19000	1	28	19	711	2600	2	6	5	1031	1209	852	3	2	0	0	0	0	0	3	6	1	7	5	3200	acute tox
27	ZDHC	methylene chloride	47	47	47	3	1	0	0	0	0	0	53	120	3	25	8	1315	2600	30	6	2	8	8	8	3	1	0	0	0	0	0	7	9	4	7	2	-	
28		trichlorofluoromethane	0	0	0	0	0	0	0	0	0	0	27	27	27	26	1	45	45	45	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1100	acute tox
29	C&A RSL	naphthalene	249	410	87	3	2	0	0	0	0	0	468	2079	1	26	17	32	51	1	6	3	118	210	2	3	3	8	9	7	4	2	14	41	1	7	5	2300	acute tox
30		2-nitrophenol	0	0	0	0	0	0	0	0	0	0	60	60	60	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	
31		4-nitrophenol	0	0	0	0	0	0	0	0	0	0	88	110	65	18	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	240	240	240	7	1	-	
32		N-nitrosodiphenylamine	0	0	0	0	0	11	11	11	3	1	72	72	72	21	1	0	0	0	0	0	0	0	0	0	0	20	20	20	4	1	0	0	0	0	0	585	acute tox
33	DHC / C&A RS	pentachlorophenol	37	42	32	3	2	20	20	20	3	1	75	310	2	26	12	2	2	2	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,3	1-hour avg
34		phenol (GC/HS)	94	147	40	3	2	0	0	0	0	0	58	295	1	26	21	17	55	1	6	5	5	7	2	3	2	39	59	3	4	3	10	19	2	7	3	-	
35	DHC / C&A RS	bis (2-ethylhexyl)phthalate	382	860	5	3	3	90	138	9	3	3	210	1449	5	26	22	157	430	1	6	3	83	135	30	3	2	22	22	22	4	1	90	490	3	7	7	-	
36	DHC / C&A RS	butyl benzyl phthalate	0	0	0	0	0	0	0	0	0	0	24	66	1	21	3	0	0	0	0	0	160	160	160	3	1	0	0	0	0	0	0	0	0	0	0	-	
37	DHC / C&A RS	di-n-butyl phthalate	13	13	13	3	2	7	7	7	3	1	13	28	1	21	9	0	0	0	0	0	7	10	3	3	2	0	0	0	0	0	14	24	3	7	2	-	
38	DHC / C&A RS	di-n-octyl phthalate	0	0	0	0	0	0	0	0	0	0	1	1	1	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	
39	ZDHC	diethyl phthalate	0	0	0	0	0	3	3	3	3	1	15	69	1	21	7	34	34	34	6	1	76	150	2	3	2	0	0	0	0	0	8	15	3	7	3	-	
40	ZDHC	dimethyl phthalate	13	13	13	3	1	12	12	12	3	1	0	0	0	0	0	0	0	0	0	0	12	12	12	3	1	0	0	0	0	0	48	111	14	7	3	-	
41	C&A RSL	acenaphthylene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4400	4400	4400	3	1	0	0	0	0	0	0	0	0	0	0	170	cute tox O&
42	C&A RSL	anthracene	0	0	0	0	0	0	0	0	0	0	1	1	1	21	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	7	1	30	cute tox O&
43	C&A RSL	fluorene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	15	15	6	1	0	0	0	0	0	0	0	0	0	0	1	1	1	7	1	30	cute tox O&
44	C&A RSL	phenanthrene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	7	1	30	cute tox O&
45	C&A RSL	indeno(l,2,3-cd)pyrene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	7	1	-	
46	C&A RSL	pyrene	0	0	0	0	0	1	1	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	cute tox O&
47	DHC / C&A RS	tetrachloroethylene	0	0	0	0	0	11	15	6	3	2	15	26	1	28	18	438	1108	9	6	4	465	890	39	3	2	9	16	2	4	2	156	310	1	7	2	5280	acute tox
48	C&A RSL	toluene	216	620	8	3	3	204	303	28	3	3	490	3200	2	28	18	45	140	4	6	5	33	61	3	3	3	2	3	1	4	3	5	12	2	7	6	1750	acute tox
49	DHC / C&A RS	trichloroethylene	0	0	0	0	0	52	52	52	3	1	812	5600	1	28	7	322	840	5	6	3	3	3	3	3	1	0	0	0	0	0	80	229	1	7	3	-	
50		beta-BHC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	-	
51	DHC / C&A RS	antimony (total)	0	0	0	0	0	0	0	0	0	0	17	180	1	25	23	59	186	1	5	5	286	515	57	3	2	8	10	6	4	2	94	200	5	7	4	9000	acute tox
52	DHC / C&A RS	arsenic (total)	0	0	0	0	0	120	120	120	3	1	22	77	1	24	16	35	100	1	6	3	5	5	4	3	2	2	2	2	4	1	9	19	3	7	3	340	1-hour avg
53		asbestos	0	0	0	0	0	197	197	197	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	6	2	1	0	0	0	0	0	-	
54	DHC / C&A RS	cadmium (total)	5	5	5	3	1	2	2	2	3	1	5	6	3	26	4	6	10	4	6	4	0	0	0	0	0	0	0	0	0	0	4	6	1	7	3	1,6	1-hour avg
55	&A RSL (Chro	chromium (total)	8	12	4	3	2	42	67	16	3	2	787	4930	4	26	19	53	210	6	6	5	1	4	3	3	3	226	656	8	4	3	125	650	3	7	6	260	1-hour avg
56	DHC / C&A RS	copper (total)	292	329	230	3	3	239	510	86	3	3	656	3120	8	26	24	156	590	17	6	6	42	44	40	3	2	5	5	5	4	1	91	300	36	7	7	5,7	1-hour avg
57		cyanide	6	6	6	2	1	0	0	0	0	0	71	242	4	22	7	9	10	8	6	3	70	190	7	3	3	10	10	10	4	1	17	17	17	7	1	22	1-hour avg
58	DHC / C&A RS	lead (total)	14	15	13	3	2	37	49	25	3	2	57	120	8	26	12	61	99	32	6	5	38	62	13	3	2	0	0	0	0	0	86	160	36	7	3	24	1-hour avg
59	DHC / C&A RS	mercury (total)	1	1	1	2	1	1	1	1	2	1	1	1	1	22	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	6	1	1,4	1-hour avg
60	DHC / C&A RS	nickel	54	54	54	2	1	64	77	50	3	2	70	280	6	26	17	89	130	36	6	5	113	126	100	3	2	0	0	0	0	0	103	200	12	7	4	220	1-hour avg
61	C&A RSL	selenium	0	0	0	0	0	0	0	0	0	0	17	80	1	20	5	9	15	3	5	2	0	0	0	0	0	275	736	38	4	3	18	32	3	6	2	20	1-hour avg
62		silver	6	6	6	2	1	22	22	22	3	1	33	130	6	26	10	41	100	12	6	5	21	30	11	3	2	10	10	10	4	1	60	68	51	7	2	0,71	1-hour avg
63		thallium	9	9	9	2	1	0	0	0	0	0	2	2	2	22	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1400	acute tox
64	ZDHC	zinc	254	460	48	2	2	537	1080	240	3	3	999	7900	56	26	24	163	343	34	6	6	132	200	75	3	3	611	1420	40	4	4	418	1000	130	7	7	54	1-hour avg

(# - number of times chemical was analysed; * - number of times chemical was detected)

Annex IV – Blue water footprint sustainability assessment

Data derived from the product WF account				Check the sustainability of the total WF in the catchment in which the process is located		Check the sustainability of the WF of the process itself	Conclusion		Check relevance from product perspective	Check whether response is required
Process Step	Country	River Basin	Blue WF	Number of months per year that a basin faces moderate, significant or severe water scarcity	Does the country have hotspots?	Can the WF be reduced or avoided altogether?	Is this a sustainable component in the product WF?	Percentage of the blue water footprint of C&A related to cotton products located in this basin	Share above threshold of one per cent	Is this a priority component?
Agricultural	Australia	Murray	38.521.400	8	yes	yes	no	4,4	yes	yes
Agricultural	China	Yongding He	11.992.100	12	yes	yes	no	1,4	yes	yes
Agricultural	China	Huang He (Yellow River)	10.260.600	7	yes	yes	no	1,2	yes	yes
Agricultural	China	Huai He	3.134.750	7	yes	yes	no	0,4	no	no
Agricultural	China	Yangtze River (Chang Jiang)	700.764	0	no	yes	no	0,1	no	no
Agricultural	China; India; Bangladesh	Ganges	6.819.270	7	yes	yes	no	0,8	no	no
Agricultural	China; Pakistan	Tarim	11.196.800	11	yes	yes	no	1,3	yes	yes
Agricultural	China; Pakistan; India	Indus	344.162.000	12	yes	yes	no	39,4	yes	yes
Agricultural	Egypt; Sudan; Tanzania	Nile	15.453.100	2	yes	yes	no	1,8	yes	yes

Data derived from the product WF account				Check the sustainability of the total WF in the catchment in which the process is located		Check the sustainability of the WF of the process itself	Conclusion		Check relevance from product perspective	Check whether response is required
Process Step	**Country**	**River Basin**	**Blue WF**	**Number of months per year that a basin faces moderate, significant or severe water scarcity**	**Does the country have hotspots?**	**Can the WF be reduced or avoided altogether?**	**Is this a sustainable component in the product WF?**	**Percentage of the blue water footprint of C&A related to cotton products located in this basin**	**Share above threshold of one per cent**	**Is this a priority component?**
Agricultural	India	Krishna	20.704.800	9	yes	yes	no	2,4	yes	yes
Agricultural	India	Narmada	14.679.500	7	yes	yes	no	1,7	yes	yes
Agricultural	India	Godavari	12.593.100	7	yes	yes	no	1,4	yes	yes
Agricultural	India	Tapti River	7.824.980	8	yes	yes	no	0,9	no	no
Agricultural	India	Mahi River	4.055.700	7	yes	yes	no	0,5	no	no
Agricultural	India	Cauvery River	2.130.940	12	yes	yes	no	0,2	no	no
Agricultural	India	Penner River	868.453	12	yes	yes	no	0,1	no	no
Agricultural	Spain	Guadalquivir	533.019	7	yes	yes	no	0,1	no	no
Agricultural	Turkey; Syria	Tigris & Euphrates	46.399.600	6	yes	yes	no	5,3	yes	yes
Agricultural	USA	Mississippi River	9.792.310	4	yes	yes	no	1,1	yes	yes
Agricultural	USA	Brazos River	7.117.170	7	yes	yes	no	0,8	no	no
Agricultural	USA	Colorado River (Carribbean Sea)	4.219.020	7	yes	yes	no	0,5	no	no
Agricultural	USA	Colorado River (Pacific Ocean)	2.314.920	8	yes	yes	no	0,3	no	no

Data derived from the product WF account				Check the sustainability of the total WF in the catchment in which the process is located		Check the sustainability of the WF of the process itself	Conclusion		Check relevance from product perspective	Check whether response is required
Process Step	Country	River Basin	Blue WF	Number of months per year that a basin faces moderate, significant or severe water scarcity	Does the country have hotspots?	Can the WF be reduced or avoided altogether?	Is this a sustainable component in the product WF?	Percentage of the blue water footprint of C&A related to cotton products located in this basin	Share above threshold of one per cent	Is this a priority component?
Agricultural	USA	San Joachin River	2.298.080	8	yes	yes	no	0,3	no	no
Industrial	Australia	Murray	8	8	yes	yes	no	< 0,1	no	no
Industrial	China	Yongding He	79	12	yes	yes	no	< 0,1	no	no
Industrial	China	Huang He (Yellow River)	139	7	yes	yes	no	< 0,1	no	no
Industrial	China	Huai He	85	7	yes	yes	no	< 0,1	no	no
Industrial	China	Yangtze River (Chang Jiang)	334	0	no	yes	no	< 0,1	no	no
Industrial	China; India; Bangladesh	Ganges	376	7	yes	yes	no	< 0,1	no	no
Industrial	China; Pakistan	Tarim	8	11	yes	yes	no	< 0,1	no	no
Industrial	China; Pakistan; India	Indus	198	12	yes	yes	no	< 0,1	no	no
Industrial	Egypt; Sudan; Tanzania	Nile	14	2	yes	yes	no	< 0,1	no	no
Industrial	India	Krishna	77	9	yes	yes	no	< 0,1	no	no

Data derived from the product WF account				Check the sustainability of the total WF in the catchment in which the process is located		Check the sustainability of the WF of the process itself	Conclusion		Check relevance from product perspective	Check whether response is required
Process Step	Country	River Basin	Blue WF	Number of months per year that a basin faces moderate, significant or severe water scarcity	Does the country have hotspots?	Can the WF be reduced or avoided altogether?	Is this a sustainable component in the product WF?	Percentage of the blue water footprint of C&A related to cotton products located in this basin	Share above threshold of one per cent	Is this a priority component?
Industrial	India	Narmada	17	7	yes	yes	no	< 0,1	no	no
Industrial	India	Godavari	63	7	yes	yes	no	< 0,1	no	no
Industrial	India	Tapti River	17	8	yes	yes	no	< 0,1	no	no
Industrial	India	Mahi River	11	7	yes	yes	no	< 0,1	no	no
Industrial	India	Cauvery River	35	12	yes	yes	no	< 0,1	no	no
Industrial	India	Penner River	11	12	yes	yes	no	< 0,1	no	no
Industrial	Spain	Guadalquivir	0,1	7	yes	yes	no	< 0,1	no	no
Industrial	Turkey; Syria	Tigris & Euphrates	53	6	yes	yes	no	< 0,1	no	no
Industrial	USA	Mississippi River	26	4	yes	yes	no	< 0,1	no	no
Industrial	USA	Brazos River	1	7	yes	yes	no	< 0,1	no	no
Industrial	USA	Colorado River (Carribbean Sea)	1	7	yes	yes	no	< 0,1	no	no
Industrial	USA	Colorado River (Pacific Ocean)	3	8	yes	yes	no	< 0,1	no	no