THE STATE OF THE APPAREL SECTOR

2015 SPECIAL REPORT

WATER

THE GLOBAL LEADERSHIP AWARD
IN SUSTAINABLE APPAREL

THIS REPORT IS PRODUCED BY THE SUSTAINABLE BUSINESS GROUP FOR THE SUSTAINABLE FASHION ACADEMY (SFA) AND THE GLOBAL LEADERSHIP AWARD IN SUSTAINABLE APPAREL (GLASA).

CREATIVE DIRECTION AND GRAPHIC DESIGN *Maria Sånge*, SÅNGE DESIGN

REFERENCE FOR THIS REPORT

Maxwell, D. McAndrew, L. Ryan, J. 2015, The State of the Apparel Sector 2015 Special Report - Water
A REPORT FOR THE GLOBAL LEADERSHIP AWARD IN SUSTAINABLE APPAREL, THE SUSTAINABLE BUSINESS GROUP, SEPTEMBER 2015

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THE GLOBAL LEADERSHIP AWARD IN SUSTAINABLE APPAREL

THE SUSTAINABLE FASHION ACADEMY

GLASA AND SFA

The Global Leadership Award in Sustainable Apparel (GLASA) was launched in 2013 to inspire bold and courageous leadership in the apparel sector and to mobilise key stakeholders around promising ideas and practices that can significantly improve the apparel industry's sustainability performance. The GLASA process involves both analysis, recommendations and outreach. The analysis includes a mapping and assessment of key initiatives within the industry and the development of a State of the Apparel Sector report. The process then culminates with a global symposium and award ceremony. During 2015, GLASA focuses on water and the apparel sector. The aim is to identify leading practices and promising initiatives that can significantly contribute to the sustainable use of water as well as to identify where important gaps remain. This report provides analysis to support the GLASA process, GLASA is coordinated by The Sustainable Fashion Academy (SFA). For more information please visit glasaaward.org.

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THE SUSTAINABLE BUSINESS GROUP

The Sustainable Business Group provides expert sustainability consultancy and training to business, government and NGOs. For business clients we measure, manage and communicate the sustainability impacts of operations and supply chains. For government and NGOs we conduct studies to inform evidence based policy making, run multi stakeholder coalitions and projects to drive sustainable production, consumption and the transition to a green economy. Established in 2007 as Global View Sustainability Services (GVSS), we rebranded to The Sustainable Business Group in 2015.

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WATER – THE NEW ELEPHANT IN THE BOARDROOM

The Global Leadership Award in Sustainable Apparel (GLASA) was established to inspire bold and courageous leadership in the apparel sector. It recognizes and mobilizes key stakeholders around promising ideas or practices that have the potential to reshape the apparel industry in ways that are compatible with nature and human and animal welfare.

It is becoming increasingly clear that natural resource depletion, environmental degradation, and economic inequality pose threats to future economic development and human welfare. Citizens and decision-makers are demanding accountability from the business sector for their social and environmental impacts and their leadership in delivering solutions that significantly address these challenges.

The apparel sector can deliver this leadership. The global apparel retail market is worth trillions of dollars. While meeting a global demand, the manufacturing of apparel has supported national development and industrialization, employing millions of people. Apparel products are very influential because they reach and engage almost everyone.

But the apparel industry also contributes significantly to and is affected by the environmental degradation and social challenges we are now facing. Growing volumes contribute to water scarcity in production countries, increased use of harmful chemicals and greenhouse gas emissions. At the same time, increasing shortages of water and land pose great risks to the natural resource base the industry relies upon. Equally significant is the situation of workers in the supply chain, where in poorer countries working conditions often do not meet minimum human rights and fair labor standards.

The encouraging news is that more influential apparel, textile and footwear companies are listening and some are responding. In conjunction with government agencies and stakeholder and advocacy organizations, the industry has begun to offer constructive solutions. But given the scale, complexity and urgency of the challenges we face, bolder, more ambitious approaches are needed.

For 2015, GLASA identified water stress as an issue that can pose significant risk to society and industry in the coming years. The apparel industry uses and pollutes significant amounts of water across its supply chains. This poses both threats to people who need to access freshwater for consumption, to important ecosystems that sustain us, and to other industries, like food production, that compete for this natural resource. It may also threaten the apparel sector's current business model.

GLASA commissioned The Sustainable Business Group (SBG) to assess the human, environmental and business case for accelerating water management improvements in the apparel sector in light of an increasingly water constrained world. The analysis presented in this 2015 State of the Apparel Sector Water Report describes what these challenges mean for the apparel industry, and what practices - technological, financial, policy, advocacy and collaborative initiatives – are currently underway to reduce the water footprint of apparel and textiles. The good news is that strong innovators and promising initiatives have emerged over the last years.

However, the analysis also concludes that efficiency improvements alone will not be sufficient to solve the apparel sector's water challenges. This is because growing demand for water from both apparel and non-apparel users will likely erode any efficiency improvements that may be achieved with current approaches. A more ambitious approach is therefore needed that is commensurate with the true scale of the water challenge.

We hope the analysis presented in this report will advance our sector's understanding of these challenges and inspire the comprehensive concerted actions required to successfully address them. When this happens the growing water crisis will no longer be the elephant in the boardroom for the apparel industry.

Michael Schragger

Executive Director THE SUSTAINABLE FASHION ACADEMY
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EXECUTIVE SUMMARY

There is an urgent environmental, human and business case for accelerating water management improvements in the apparel sector in light of an increasingly water constrained world. This report provides a state of the sector overview of water risk and opportunity for apparel and textiles.

The water challenge for apparel sits within a wider context of water constraints and increasing competition for supply. At the big picture, water scarcity has been identified as the number one global risk to society over the next ten years by the World Economic Forum[1]. From a human rights perspective, access to safe, clean drinking water supplies, hygiene and sanitation are already risks in many world regions. Competing uses for water across the nexus of water, food, energy and climate change will constrain water availability for the textiles sector and become more severe in the future. By 2030, global population is expected to be 9 billion and economic growth in emerging markets will be 6 percent with over 2 percent in developed. By this time, 4 billion people are expected to live in high water stressed areas and global freshwater demand will exceed supply by over 40 percent under business as usual practices. This represents a major resource risk for apparel in terms of continued security of supply, competitiveness and resilience.

Investors have identified textiles as having a high exposure to business disruptions from water related issues especially for cotton growing and production. Already, the textile supply chain incorporates many countries and regions with high water risks including China, India, USA, Pakistan, Bangladesh, Turkey and Brazil. Based on the existing water challenges for apparel and wider competing demands, the key improvement opportunities need to focus on the priority water impacts and dependencies in the supply chain – cotton growing, production (dye and finishing) and consumer laundering. It is clear that due to competing demands, as well as a projected 5 percent growth in the apparel sector by 2025, that efficiency improvements alone will be insufficient to solve this challenge.

The growing water crisis is becoming the elephant in the board room for apparel and textile companies that needs to be acknowledged. This report highlights examples of innovators from industry, technology, finance, government and collaborations that are starting to understand these risks and develop actions to reduce their water impacts. Beyond these early adopters, an industry strategy and roadmap is needed for mainstreaming action towards a common water stewardship vision that is commensurate with the true scale of the water challenge. An illustration of levers and change agents that form such a roadmap are below. This incorporates not just maximising the wealth of improvement potential still available from efficiency but also a shift in the long term goal of what responsible water management in apparel and textiles needs to look like by 2030.

EXECUTIVE SUMMARY

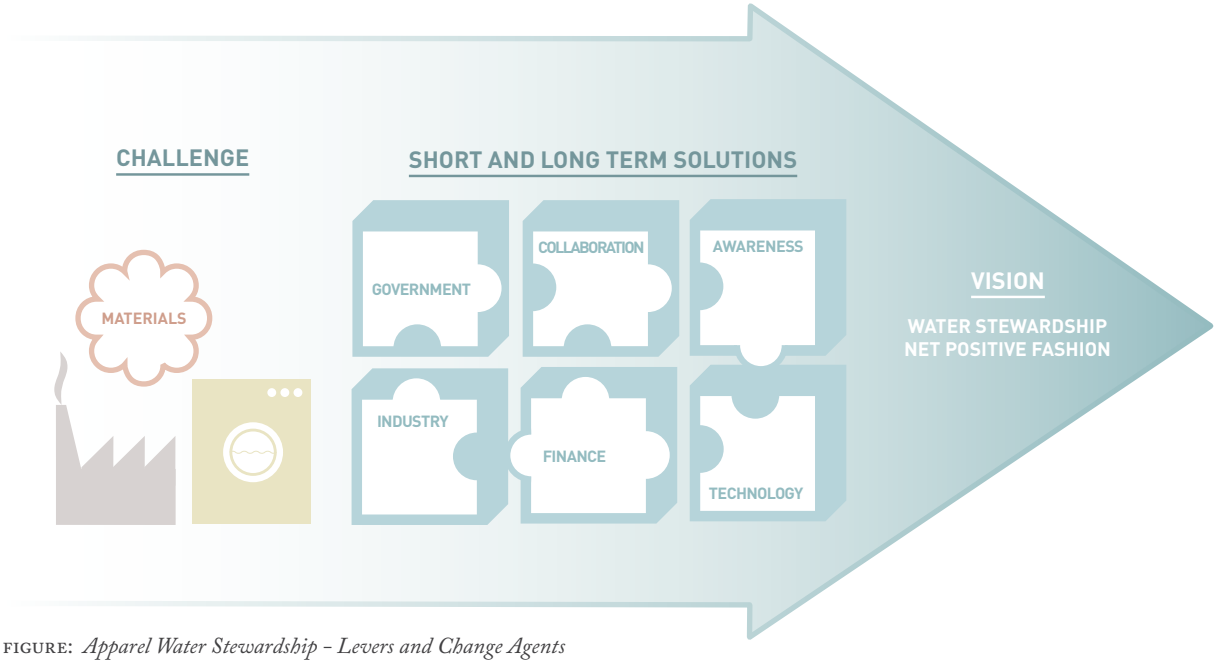

FIGURE: *Apparel Water Stewardship – Levers and Change Agents*

Tackling this challenge requires a business model shift from being "users of water that treat pollution" to being "water stewards" managing the real risks and opportunities this presents across the supply chain and at the local river basin level. As illustrated, wider systemic changes focusing on integrated water management, leap frog improvements in technology, government regulation/enforcement, financial incentives and multi-stakeholder collaboration platforms are key elements of the solution. The apparel and textile sectors will also need to engage with other land dependent, high water using sectors including food, beverage and agriculture to collaborate on water management solutions in a more systemic way than we see now.

"Zero" is replacing "reduction" for textile sector chemical and pollution impacts in initiatives such as the Zero Discharge of Hazardous Chemicals (ZDHC) Roadmap. This trend in apparel is also seen in other sectors where there is a shift away from the "doing less bad" approach of impact reduction to "enhancing" the environment and society with which a business interacts. **For apparel, perhaps a future vision is "low or zero water fashion"? Where local conditions allow, could it even be "net positive fashion" where more accessible, better quality water is created than is consumed?**

ACKNOWLEDGEMENTS

Thank you to the GLASA Advisory Group and all those who gave their time and expertise to inform this report.[a]

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[a] *Inclusion only means views were provided and anonymized in the report.*

GLOSSARY AND DEFINITIONS

GLOSSARY

BCI	Better Cotton Initiative
CmiA	Cotton made in Africa
ESG	Environmental, Social and Governance
FSC	Forest Stewardship Council
GOTS	Global Organic Textile Standard
GM	Genetically Modified or Transgenic
HRWS	Human Rights to Water and Sanitation
LCA	Life Cycle Assessment
REEL	Responsible Environment Enhanced Livelihoods
SAC	Sustainable Apparel Coalition
SDG	Sustainable Development Goals
TE	Textile Exchange
UNDP	United Nations Development Program
WEF	World Economic Forum
WFN	Water Footprint Network

DEFINITIONS

LIFE CYCLE ASSESSMENT – one of the most commonly used tools for measuring environmental impacts of products across their life cycle. Water impacts are measured by the water used or consumed and the pollution of waste water generated.

TEXTILES – include consumer apparel, commercial uniforms (public sector or corporate clothing) and soft furnishings e.g. curtains, bed linen (of particular focus)/fibres, yarn and fabrics.

WATER FOOTPRINT – provides a detailed understanding of how much water is embedded in a product across its supply chain. It consists of the following components:

- **Blue water –** Fresh surface and groundwater – the water in freshwater lakes, rivers and aquifers.
- **Green water –** Rainwater falling on land that does not run off or recharge the groundwater but is stored in the soil or temporarily stays on top of the soil or vegetation.
- **Grey –** polluted water
- **Dilution factor –** The number of times that a polluted effluent volume has to be diluted with ambient water in order to arrive at the maximum acceptable concentration level.

WATER SCARCITY – the lack of volumetric availability from a water supply.

- **Physical scarcity** exists when the demand exceeds the supply that can be provided. Based on UNEP, UNDP, World Resource Institute and World Bank definitions[2], when internal renewable water resources in a country drop below 1000 cubic metres/person/year this is defined as water scarce. When they are below 500 cubic metres/person/year, this is defined as critical levels of water scarcity.
- **Economic scarcity** exists when there are limitations to retrieving abundant water, these could be political or economic.

WATER STRESS – the point at which local demand, from both humans and nature, for water exceeds what freshwater is available in that area. This considers several aspects including scarcity, water quality, environmental flows and the accessibility of water.

WATER RISK – the probability of an entity experiencing a deleterious water related event.

WATER STEWARDSHIP – improvement of water use and a reduction in impacts across the value chain. This includes a commitment to sustainable management of shared water resources through collective action with other businesses, governments, NGOs and communities.

1.0 INTRODUCTION

AIMS AND SCOPE

To support GLASA Water 2015, this state of the apparel sector water report provides an overview of the priority water challenges for the sector, business case for solving them and practices that can significantly contribute to this. Leading practices and promising initiatives that can significantly contribute to apparel water stewardship are outlined. These cover categories including (1) industry practices (2) policy and regulation (3) technology and innovation (4) collaborative initiatives (5) financial incentives and (6) awareness raising (business and consumers). Case examples of a selection of these innovators are included to inspire others to action. Based on the scale of the water challenges and current state of play, recommendations for next steps to improve water stewardship are proposed.

The scope covered is the water impacts and dependencies of the apparel and textile[b] sector supply chain (cradle to grave) and associated geographies, in particular focusing on water stressed regions. As water stress varies with geographies, a local as well as sector focus was taken. The framing also takes into account the wider sustainability impacts of the sector interlinked with water such as energy and chemicals use. It considers the systemic implications for the apparel sector of competing uses for water such as for drinking water, food and energy.

The industry scope of GLASA is apparel, but wider textiles (also including soft furnishing, bed linen, yarns and fabric) are included in this report as this more accurately illustrates the scale of water challenges and potential solutions. The fast/value, mid range and luxury segments of the apparel market is included.

METHOD

To gather the data for the report, a comprehensive desk top assessment of the evidence supplemented by interviews with over 30 experts and the GLASA Advisory Group were conducted. The evidence base for apparel and textiles was drawn from with a key focus on available credible sources such as industry reports (e.g. Life Cycle Assessments (LCA)), articles from academic journals and government sources. Evidence used is listed in **7.0 References.**

OPEN CONSULTATION

An open consultation process during summer 2015 was used to engage stakeholders beyond GLASA. Contributions from this and the GLASA symposium on 27 August 2015 were incorporated into this final report.

[b] *Footwear is not included in the scope*

PHOTO *Carlos Castilla, Shutterstock*

2.0 WATER CHALLENGE BIG PICTURE

Water is a resource under increasing constraints, with its management now cited as one of the greatest risks to business continuity and growth[c]. This challenge impacts people, the planet and industry with critical relevance for apparel. **Figure 1** illustrates in red the countries and regions around the globe that already suffer from high water risk. The apparel sector supply chain incorporates several of these in particular for cotton growing and garment production. These include China, India, USA, Pakistan, Bangladesh, Turkey and Brazil.

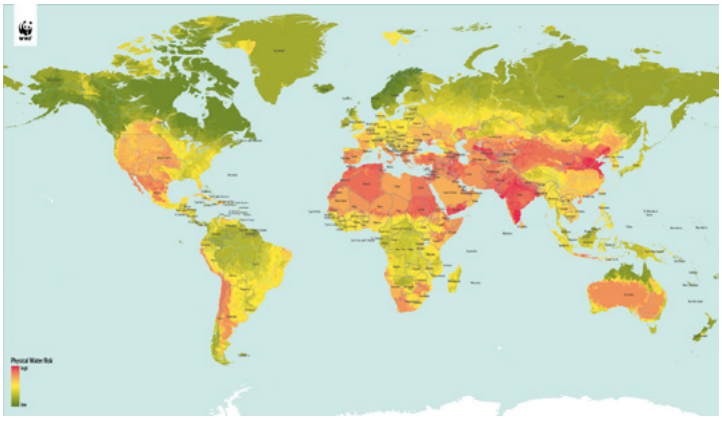

FIGURE 1: *Map of Water Risk (Source: WWF Water Risk Map, 2014)*[4]

The same amount of water is on the planet now as when it was formed. What is changing is our increased use and pollution of water. Increasing population and urbanisation are key features in growing global demand for water for drinking, sanitation, food and energy. Rising competition for water is already impacting the textile sector which is a high water user and polluter. Water constraints will increasingly challenge "business as usual".

So, what does success look like? The UN Sustainable Development Goals for water[3] see success as a world where there is availability and sustainable management of water and sanitation as a human right for all. The UN Global Compact CEO Water Mandate guidance to companies – especially high water users - is to incorporate their responsibility to respect Human Rights to Water and Sanitation (HRWS) in water management policies and practices. The Alliance for Water Stewardship sees success for industry as shifting from being "water users and polluters" to "responsible water stewards" focusing on protecting and enhancing freshwater resources for all the stakeholders that use them. This respects human needs and ensures long-term benefits (environmental, social and economic) are maintained for people and nature.

[c] *Currently in development with completion expected by Sept. 2015*

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3.0 WATER CHALLENGE FOR APPAREL

- Textile and apparel production uses and pollutes significant amounts of water across the supply chain. The priority water impacts and dependencies are cotton growing, textile production (dyeing/finishing/treating) and consumer laundering.
- The global average water footprint for 1 kilogram of cotton is 10,000–20,000 liters depending on where it's grown.
- On average, an estimated 100–150 liters of water is needed to process 1 kilogram of textile material. Approximately 28 billion kilograms of textiles are dyed per annum in the apparel industry using over 5 trillion liters of water (2 million Olympic sized swimming pools!).
- Consumer laundering uses on average 1650 liters of water per 1 kilogram washed, but this varies across the world based on laundering practices.
- China, India, USA, Pakistan, Bangladesh, Turkey and Brazil are textile supply chains countries with regions of high water stress already. Yet water stress existing in regions is still not a mainstream factor driving cotton sourcing or manufacturing shifts in this market. With at least 3 percent market growth per annum anticipated for apparel to 2025, demand is expected to outstrip supply.

3.1 PRIORITY WATER IMPACTS AND DEPENDENCIES

Textile and apparel production uses and pollutes significant amounts of water across the supply chain. Water used is withdrawn from groundwater and/or surface waters. This contributes to freshwater depletion, in particular in water stressed regions. Water pollution causes eutrophication impacting drinking water sources for people and aquatic life. The most significant water impacts and dependencies across the textile supply chain are illustrated in figure 2. These occur at cotton growing, textile production (dyeing/finishing/treating) and consumer laundering stages. The wider environmental impacts are also illustrated as there are links with water.

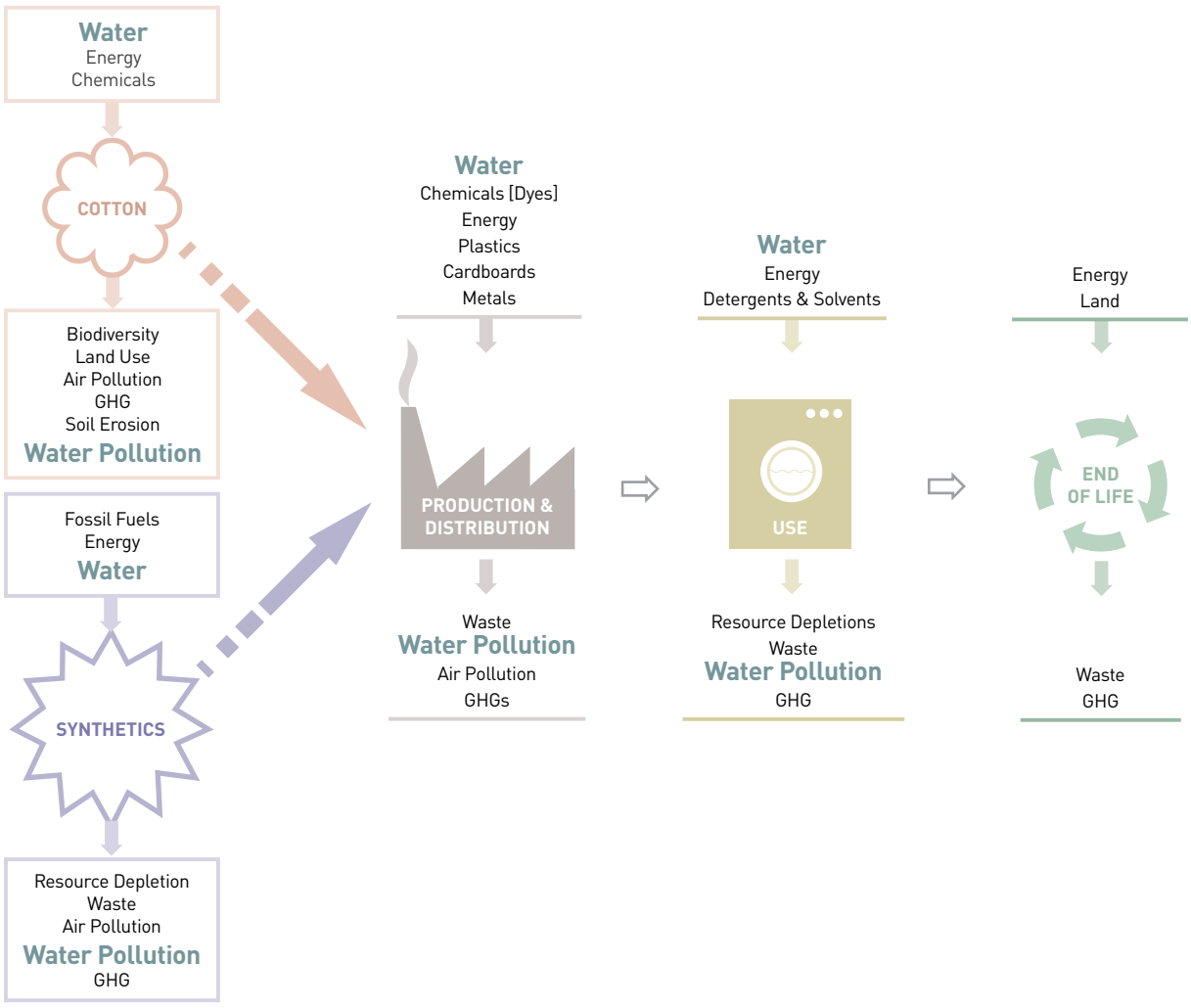

FIGURE 2: *Water Impacts & Dependencies - Textile Supply Chain*

Cotton and polyester are the dominant fibres used in apparel and textiles by market volume. As illustrated, the water impacts and dependencies for these fibre types are different and this needs to be considered when assessing water impact and improvement opportunities. **On average for 2013/2014, cotton made up 35-40% of textile production, while approximately 50% was from synthetics, with the rest accounted for by other fibres[5].** Polyester is the dominant synthetic fibre used by volume. However there are variations per market and garment such as sportswear which uses high volumes of synthetics. Figure 3 provides the average water use per kilogram of textile for each of the priority water supply chain stages. This provides a high level indication of the volumes at each stage only, and is not intended for comparison between stages.

SUPPLY CHAIN STAGE	IMPACT & DEPENDENCY	AVERAGE WATER USE [per 1 kilogram of textiles]
Growing cotton fibre	Water use and pollution	20,000 litres [irrigated conventional cotton crop]
Treating/dyeing/finishing fibres and fabrics [all fibres]	Water use and pollution	100–150 litres[d]
Consumer laundering [all fibres]	Water use and pollution	1650 litres

FIGURE 3: *Priority water supply chain stages*

To put water use and pollution at the dyeing and finishing stage in context, per annum over 5 trillion liters of water is used by the apparel industry to dye fabric (equivalent to 2 million Olympic sized swimming pools!) Process chemicals are typically added to dissolve the dyes in water generating waste water.[6]

The implications of the volumes of water used and pollution caused vary dependent on a range of factors. For example: (1) the region and how water stressed it is, (2) whether the water source is groundwater or surface water (3) for cotton, whether the crop is rain fed or irrigated. There is also a strong relationship between water, energy and chemicals used in determining water volumes and pollution levels generated. This is an important trade-off to consider in determining water improvement solutions.

The impact of water across the apparel supply chain is measured using Life Cycle Assessment (LCA) and /or water footprint techniques. LCA measures a range of environmental impacts. To determine water impacts it measures the water used or consumed and the pollution of waste water generated. The water footprint breaks down the water into the following components:

- **Blue water - withdrawal of ground or surface water (naturally/artificially) for use e.g. in irrigation**
- **Green water - water from rainfall**
- **Grey/dilution water - water pollution during growth or processing. This impact is quantified in terms of the dilution volume necessary to assimilate the pollution**

Further detail on the water impacts for these priority supply chain stages incorporating the key factors that influence this is outlined in 3.2–3.4 below. Data from evidence sources using both LCA and water footprint have been used in this report. References to the specific sources are included. As the scope of LCAs and other sources will vary, comparison is not intended.

[d] *This is to process 1 kilogram of textile, but the actual volume per production site will depend on its capacity.*

3.2 COTTON

Global consumption of cotton textile and apparel products requires 256 Giga cubic meters/annum, out of which approximately 42% is blue water, 39% green water and 19% grey water.[7] Much of this water is to irrigate cotton crops as well as for dyeing and finishing production processes.

For cotton, the volume of water used or pollution generated and wider environmental implications varies on factors including whether the cotton is rain fed or irrigated, chemicals and pesticide used and soil quality. **Globally, an estimated 73% of cotton is produced in irrigated fields and only 27% under rain-fed conditions[8]. The average yield of cotton is 850 kilograms per hectare for irrigated cotton and 390 kilograms per hectare for rain fed cotton.** However in addition to water, many factors such as soil fertility, seed quality and agricultural practices also affect yield. New data is emerging that rainfed yields can be just as high with the right factors in place[8a]. This yield difference is important to consider in trade-offs between increased yield and sustainability impacts[8]. **The global average water footprint for 1 kilogram of cotton is 10,000–20,000 liters depending on where it's grown[11].** Even with irrigation, US cotton uses just 8,000 liters per kilogram. However, producing 1 kilogram of cotton in India consumes 22,500 liters of water due to inefficient water use and high rates of water pollution[9]. Approximately 50 percent of all pesticides used in India are in cotton production. By exporting more than 7.5m bales of cotton in 2013, India also exported approximately 38bn cubic metres of virtual water. Hence, country and region specific considerations are key in understanding the problem and solutions at both local and regional levels. The Environmental Justice Foundation estimates 15 to 35 percent of irrigated water withdrawals are considered unsustainable given the level of water stress existing in irrigated cotton growing regions.[10]

Figure 4 Illustrates the virtual water embedded in the water footprint of a range of cotton textile products.

		VIRTUAL WATER CONTENT (liters)			
	STANDARD WEIGHT (g)	BLUE WATER	GREEN WATER	DILUTION WATER	TOTAL VOLUME OF WATER
1 PAIR OF JEANS	1000	4900	4500	1500	10,850
1 SINGLE BED SHEETS	900	4400	4000	1350	9750
1 T-SHIRT	250	1230	1110	380	2720
1 DIAPER	75	370	330	110	810
1 JOHNSON'S COTTON BUD	0.333	1.6	1.5	0.5	3.6

As one example, a conventionally produced pair of cotton jeans has a significant water footprint, typically over 10,000 liters per pair of jeans. However innovations in denim production are lowering this. One example is Levis Strauss's cotton jeans where the water footprint has been reduced to 3,800 liters of water per pair of jeans. For this, fibre production, predominantly cotton (68 percent), consumes the most water, followed by consumer care (23 percent)[12].

Approximately 26 million tonnes of cotton (2013/2014 figures) are produced each year in around 80–90

countries on an estimated 30 million hectares (equivalent to the size of the UK and Switzerland together)[13]. Conventionally grown cotton is a highly chemical intensive crop which impacts the water pollution it generates. It uses:

- **3% of the world's arable land.**
- **10% of all agricultural chemicals.**
- **15–25% of all insecticides.[14]**

The majority of the global cotton grown is still conventional. Sustainable cotton is still under 10 percent of the market. For the 2013/2014 harvest 5 percent was sustainable with Certified Organic at just under 1 percent[14a]. In 2015 Better Cotton Initiative was moving towards 8 percent. An estimated 70 percent of the global cotton market is from genetically-modified (GM) or Transgenic cotton, with Bt cotton the main GM variety. While GM does focus on drought resistance, these GM varieties have mainly targeted insect pests and/or tolerance of certain herbicides.[15]

While the area of cotton plantations has remained more or less constant since 1930, cotton production has tripled in the last 70 years. China, United States, India, Pakistan, Uzbekistan and West Africa account for over 75% of global cotton production. Cotton production for the top 10 producing countries is illustrated in figure 5.[16]

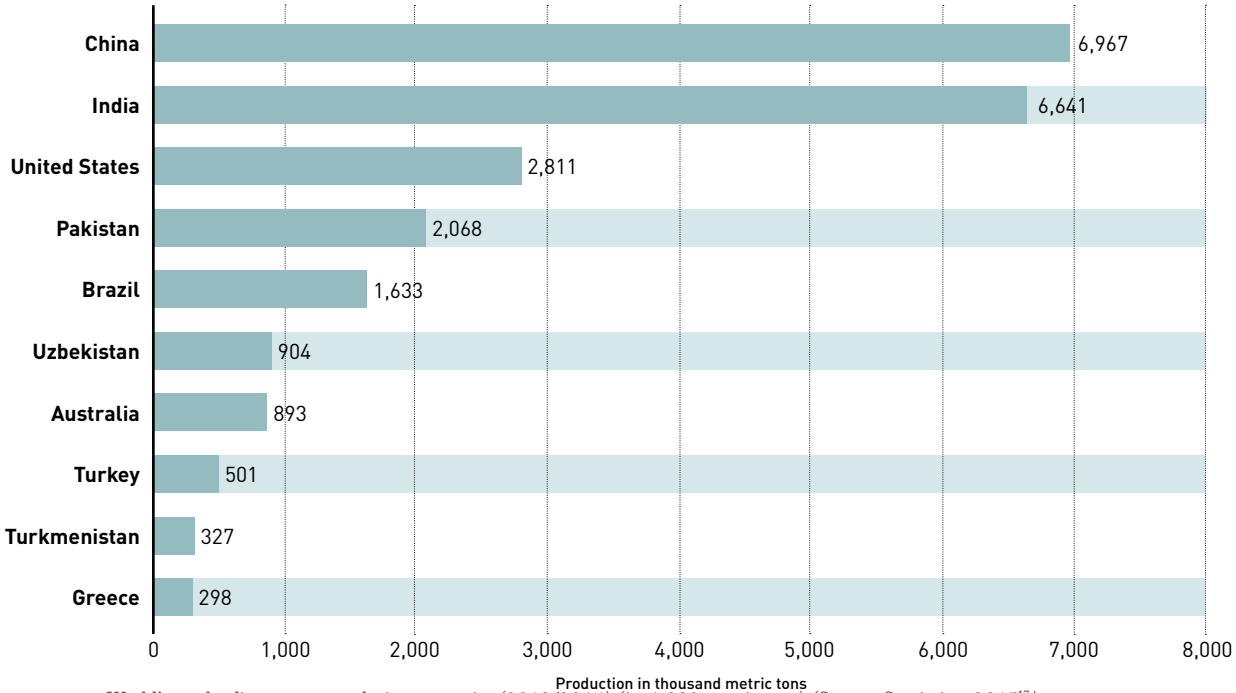

FIGURE 5: *World's ten leading cotton producing countries (2013/2014) (in 1,000 metric tons) (Source: Statistica, 2015[17])*

Key water risk factors for these cotton growing regions are water stress, drought, insufficient rainfall, flooding and pollution. Water stress is where local demand for water exceeds what freshwater is available in that area. Factors such as water scarcity, water quality, environmental flows and the accessibility of water all impact water stress. **Cotton growing countries impacted by water stress now include China, India, USA, Pakistan and Brazil.** Critical cotton growing drought regions include:

- **Australia's Murray-Darling basin;**
- **Colorado River basin in the U.S. Southwest;**
- **Orange-Senqu basin, covering parts of South Africa, Botswana and Namibia and all of Lesotho;**
- **Yangtze and Yellow river basins in China.**[18]

Droughts in China, India and Texas have already impacted cotton commodity prices, in particular yield reducing droughts in Xinjiang, Yangtze River Basin, Huanghua Region, Gujarat, Maharashtra and Andhra Pradesh. Cotton can be relatively drought tolerant which makes growing it in semi-arid zones with irrigation feasible. However, overuse from ground and surface water supplies is a significant problem demonstrated in these regions. One of the most striking is the pollution and depletion of the Aral Sea in central Asia – once the fourth largest lake in the world – driven by cotton production in Uzbekistan.

Many cotton regions are located in important river catchments. Figure 6 lists these. River basin stress from cotton is particularly impacting basins including the Indus River in Pakistan, the Murray-Darling Basin in Australia, and the Colorado River basin. The Indus River valley in Pakistan, for example, incorporates one of the most extensive irrigation systems in the world.

COUNTRY	RIVER CATCHMENT
Brazil	e.g. Parana
China	Yellow River Valley (30.6%), Yangtse River (61.3%)
Egypt	Nile Valley
India	e.g. Narmada
Mali	Niger
Pakistan	Indus Valley (largest irrigation system world-wide; continues to India)
Turkey	Menderez, Gediz GAP Scheme A (Euphrat and Tigris)
Uzbekistan	Amu-Dar, Syr-Dar

FIGURE 6: *River catchments in cotton producing areas (Source: WWF, The impact of cotton on freshwater resources and ecosystems*[19]*)*

Water impacts are typically cross-border. Competition for water in other countries is a key risk factor to cotton growing countries and river basin regions. For example, as China is the world's largest cotton producer and many rivers for other cotton growing countries start there, several countries have already been identified as water risk regions due to lack of future availability. Examples are in figure 7 showing their external reliance on remaining resources.

COUNTRY	IRWR [billion m^3/yr]	TRWR [actual] [billion m^3/yr]	External Reliance [billion m^3/yr]	External Reliance %
Bangladesh	105	1,227	1,122	91%
Cambodia	121	476	356	75%
India	1,446	1,911	465	24%
Laos	190	334	143	43%
Myanmar	1,003	1,168	165	14%
Pakistan	55	247	192	78%
Thailand	225	439	214	49%
Vietnamn	359	884	525	59%
IRWR – Internal Renewable Water Resource TRWR – Total Renewable Water Resource				

FIGURE 7: *Countries with rivers which start in China (Source: China Water Risk[20])*

3.3 DYEING, FINISHING AND PROCESSING

Conventional textile dyeing and wet processing requires large amounts of fresh water withdrawal and disposal of wastewater. Dye houses in India, Bangladesh and China have a well documented history of exhausting local water supplies, and causing pollution from wastewater into local streams and rivers.The volume of water used varies depending on the fibre – cotton or polyester being the dominant. **On average, an estimated 100–150 liters of water is needed to process 1 kilogram of textile material. Approximately 28 billion kilograms of textiles are dyed per annum in the apparel industry using over 5 trillion liters of water. In 2015, it is predicted that over 39 million tons of polyester will be dyed.** Approximately 6 kilograms of process chemicals are typically needed to dissolve the dyes in water per 100 kilogram of textiles resulting in waste water.[21] Overall, **20% of freshwater pollution comes from textile treatment and dyeing[22].**

In addition to dyeing, water is used as a solvent in many pre-treatment and finishing processes, such as washing, scouring and bleaching. At the end of the dyeing process, an estimated 10–20 percent of the dye typically remains contributing to wastewater. Wet processing waste water contains dyes, bleach, detergent and other processing chemicals generating waste water requiring treatment before disposal. If untreated, or insufficiently treated water (a common problem in developing countries) is released into water courses and water pollution occurs. As such, the elimination or reduction of process water and chemicals is a key water management solution for textile dyeing and finishing.

3.4 CONSUMER LAUNDERING

The volume of water used in consumer laundering depends on the washing machine efficiency, detergents and laundering behaviours used, which vary around the world. On average, 1650 liters of water is used in consumer laundering per kilogram of clothing. A conventional washing machine uses over 950 liters per weekly wash. An efficient one uses approximately 650 liters.[23] Eutrophication (from detergents) causes water pollution. Decreasing toxicity of detergents and use of tertiary waste water treatment plants for public water supplies manages these pollution issues in developed countries. This is not the case in developing countries where effluent treatment and best practice is still not the norm. Wider significant impacts of laundering are energy use and associated Greenhouse Gas (GHG) emissions from tumble drying. The frequency of garment washing and water temperature used are factors influencing water and climate change impacts[24]. As illustrated in figure 8, cold water wash is more common in the USA than China. In Europe 40 degrees is the average washing temperature. "Wash at 30 degrees" or more recently "I Prefer 30" campaigns running for over ten years have resulted in a slow shift to 30 degree washing as consumer behavior is difficult to change[25]. For example in the UK only approximately 35 percent of consumers wash at 30 degrees[26].

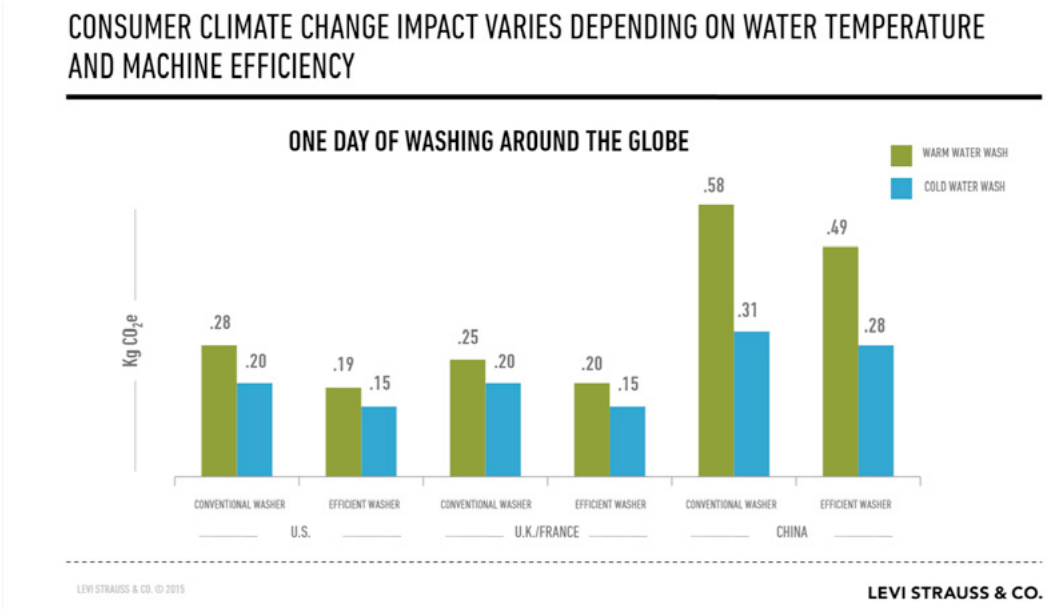

FIGURE 8: *One Day of Washing Around the Globe (Source: Levi Strauss & Co, 2015, Understanding the environmental impact of a pair of Levi's® 501® jeans)*[27]

3.5 RELATIONSHIP AND TRADE-OFFS BETWEEN WATER AND OTHER IMPACTS

In determining water improvement solutions for textiles, the relationships and trade-offs between water and other environmental impacts, in particular energy and chemicals, need to be considered. This is relevant to raw material production, dyeing and finishing as well as consumer laundering life cycle stages. Variations across different fibres also need to be considered. For example cotton is the highest water user in general compared to the other textile dominant fibres polyester and viscose. In terms of energy, polyester uses the most energy at raw material production with viscose (regenerated) being the most energy intensive in dyeing and finishing[28].

Environmental improvements can require several impacts to be considered together to work. For effective dyeing and finishing low temperature dyes can enable less energy, chemical and water use. At the laundering stage, low temperature detergents enable cleaning at lower temperatures and less water use in washing machines. Hence solutions to date have involved other sectors including chemical and electronics. These relationships need to be considered in water improvements at a systemic level to ensure chemical, energy or other impacts are not increased.

3.6 MARKET AND FINANCIAL TRENDS

In 2014, the **global textile market was valued at over $US400 billion.** For the apparel segment of this, the US market is still the largest at just over **$US250 billion,** but other markets are growing rapidly.[30] **Historically the market has grown at just over 3 percent/annum. By 2025 the growth rate is expected to approach 5 percent/annum.** For apparel, women's wear mid market apparel is the largest segment valued at US$ 70 billion in 2013 and accounting for 48 percent of total global apparel sales. As illustrated in figure 9 women's mid market apparel is expected to account for 55 percent of apparel sales and 60 percent of growth in emerging markets by 2025. It has a Compound Annual Growth Rate (CAGR) of 45 percent by 2025. Half of the 20 largest women's apparel markets will also remain in mature markets such as the US. Emerging markets account for 37 percent of women's mid market apparel today, but by 2025 their share is expected to rise to over 50 percent. While the luxury apparel market is smaller, it is also growing in emerging markets from 14 percent now to an estimated 25 percent by 2025. During this time these markets will have grown three times faster than mature markets. Growing cities in emerging markets and the number of people in the "global consumer class" (with expendable income) are key features in growing apparel demand. By 2025, the top 600 growth cities (including Beijing, Hong Kong, Tianjin, and Rio de Janeiro) will account for 62 percent of women's apparel market growth.[31]

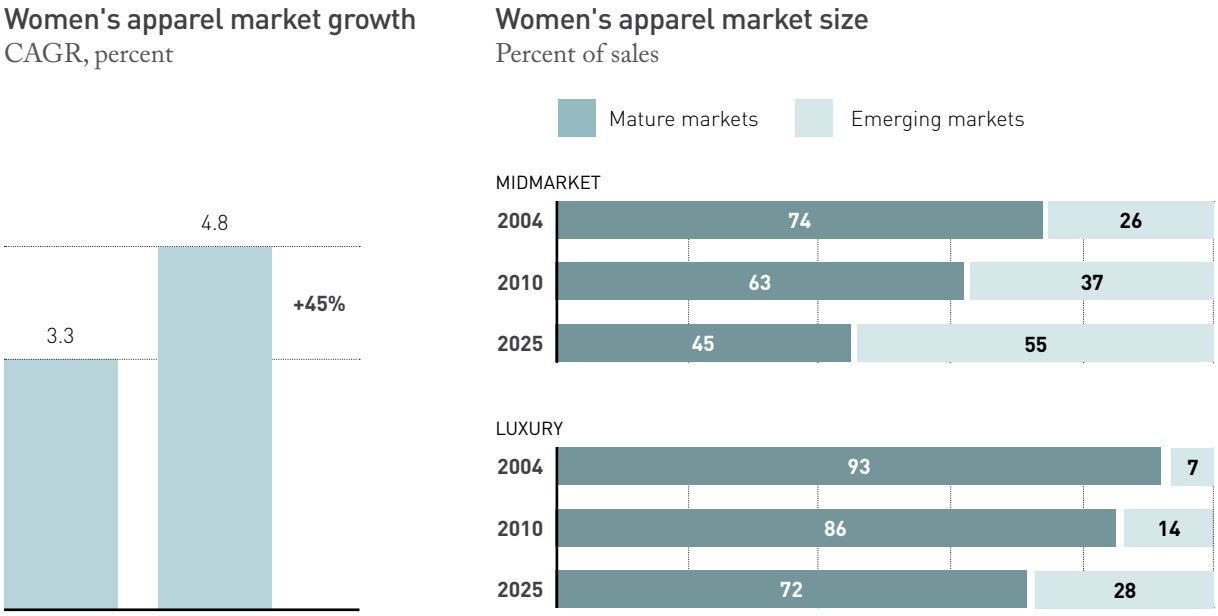

FIGURE 9: *Growth projections: women's apparel mid market and luxury (Source: McKinsey, Fashion scope [32])*

Market characteristics of the textile and apparel sector that impact water and wider sustainability impacts include the following:

- Globally, textiles represent 7 percent of world exports and support a significant number of economies and incomes around the world e.g. Bangladesh, Vietnam, Sri Lanka and Cambodia. The interconnectedness of the industry means that changes in trade and production can have significant positive and negative impacts on national economies, and/or the growth or subsistence of the industry[33]. In recent years, wage rises in China have meant a shift to countries with lower costs of production such as Bangladesh, Vietnam and Cambodia who are now gaining textile manufacturing market share[34]. **Whether water stress exists in regions is still not a mainstream factor driving cotton sourcing or manufacturing shifts in this market.** China and India are the countries producing most of the world's textiles, yet they contain many of the most water stressed regions. For China, it still produces around half of the world's textiles. While cutting and sewing production activities have moved out of China for cost reasons, the more water using and polluting production stages are still there. The textile sector is still one of the top five most intensive water using industries in China and ranks third in the most polluting. Recent strengthening of regulation and enforcement is expected to have business disruptions and cost implications as China gets serious on protecting its water resources and pollution. In the words of the China Water Risk awareness campaign:

> "Fashion is not only dirty, it is thirsty and since China has declared "war on pollution" to protect its limited water resources, fashion faces unprecedented pressures", from Dirty Thirsty Fashion: Blindsided by China's Water Wars, China Water Risk for CLSAU®35"

- The clothing supply chain is complex, global and characterised by a diverse range of SME sub contractors mainly in the developing world. Determining origin and sustainability credentials of raw materials and suppliers are a well recognised challenge for supply chain traceability. Embedded water is a key element of this.

- Cotton makes up around 40 percent of the world's fiber needs and is among the most powerful cash crops in the world. Up to 100 million farmers grow cotton (ranging from large scale commercial to small holder), and there are 250 million more workers in the wider cotton processing industry. In terms of the total number of people that derive their livelihoods from the fibre, it is estimated to be just under one billion.

- The cotton price in the first quarter of 2015 is at an extreme low at $1.476/ tonne. Cotton supply is exceeding demand in the global cotton market for the fifth season. As a result cotton stockpiles are expected to continue in 2015 to an all time high of 107.4m bales. The supply glut is exacerbated by increased cotton output in China and a decline in demand in China. Quotas and subsidies designed to protect domestic agriculture and industry from the free market have economic, social and environmental implications such as artificially reducing the price of cotton or growing cotton in climates where the water impacts are increased. This is a significant market barrier to incentivising cotton growing in regions where water impacts would be reduced.

- High consumption is a key factor driving demand in apparel. Fast or value fashion is the largest market by volume. It is characterised by "fast" supply chains driven by the demand and capacity to change collections every 2-3 weeks which is a key factor in driving clothing consumption. Localisation and speed to market are trends enabling proximity of manufacturers to the market to facilitate fast fashion.

PHOTO *Bepsy, Shutterstock*

4.0 WATER RISK TRENDS

- Water is a key enabler for food, energy and climate security. This presents serious implications for apparel due to the food/fibre, water, energy nexus.
- Competing demands for water from growing population and associated increased demand for food and energy are already affecting the apparel sector in certain regions. This will become more severe in the future.
- Water represents a major resource risk for the sector in terms of continued security of supply, competitiveness and resilience.

4.1 COMPETITION FOR WATER

At the big picture level, there are competing uses for water which affect the apparel sector already and this will become more severe in the future. This represents a major resource risk for the sector in terms of continued security of supply, competitiveness and resilience. As illustrated in figure 10 competing demands for water come from growing population and associated increase in water demand for food and energy in particular. Key trends in this growth are increased demands from a growing global middle class and urbanisation. **By 2030, global population is expected to reach 9 billion and economic growth in emerging markets will be 6 percent with 2.7 percent in developed.**

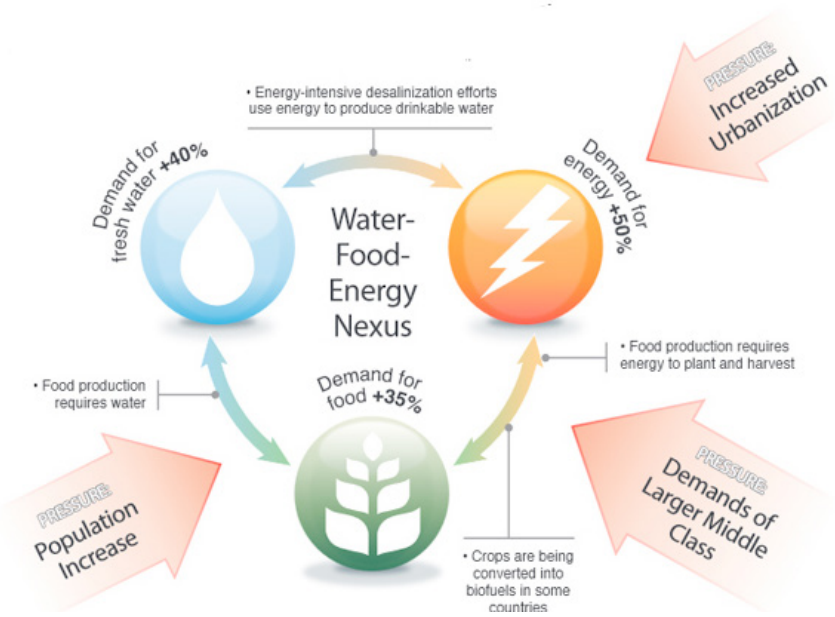

FIGURE 10: *Competing demands across the Water, Food and Energy Nexus (Source www.MakeWealthHistory.org)*

In the last century, water use has grown at over twice the rate of population. Growing population is increasing global competition for productive land and freshwater resources. There is also a growth in the use of land for food compared to other uses such as cotton fibre for apparel and this is expected to continue. **Agriculture is the largest consumer of water using 70% of accessible freshwater compared to other industries which use 16%, and domestic consumption using 14%. It also occupies 40% of the planet's land area[38].** By comparison, cotton production accounts for 2.6% of the global water footprint of all goods and services consumed globally[39].

COMPETING WATER USERS

Agriculture is the largest consumer of water using 70% of accessible freshwater compared to other industries which use 16% and domestic consumption using 14%.

Agriculture water use: 3100 billion cubic metres/annum now and estimated at 4500 billion cubic metres/annum by 2030[40].

As illustrated in figure 11, since 2005 rapid increases in large scale transnational land acquisitions is indicative of global competition for productive land and freshwater resources. Between 2005 and 2009, global land acquisitions by foreign investors were an estimated 47 million hectares (larger than Sweden).[41] One result is that large scale commercial farming is expanding at the expense of smallholder farmers and their access to land and water – in particular in Africa and parts of Asia. This has implications for land availability for cotton growing.

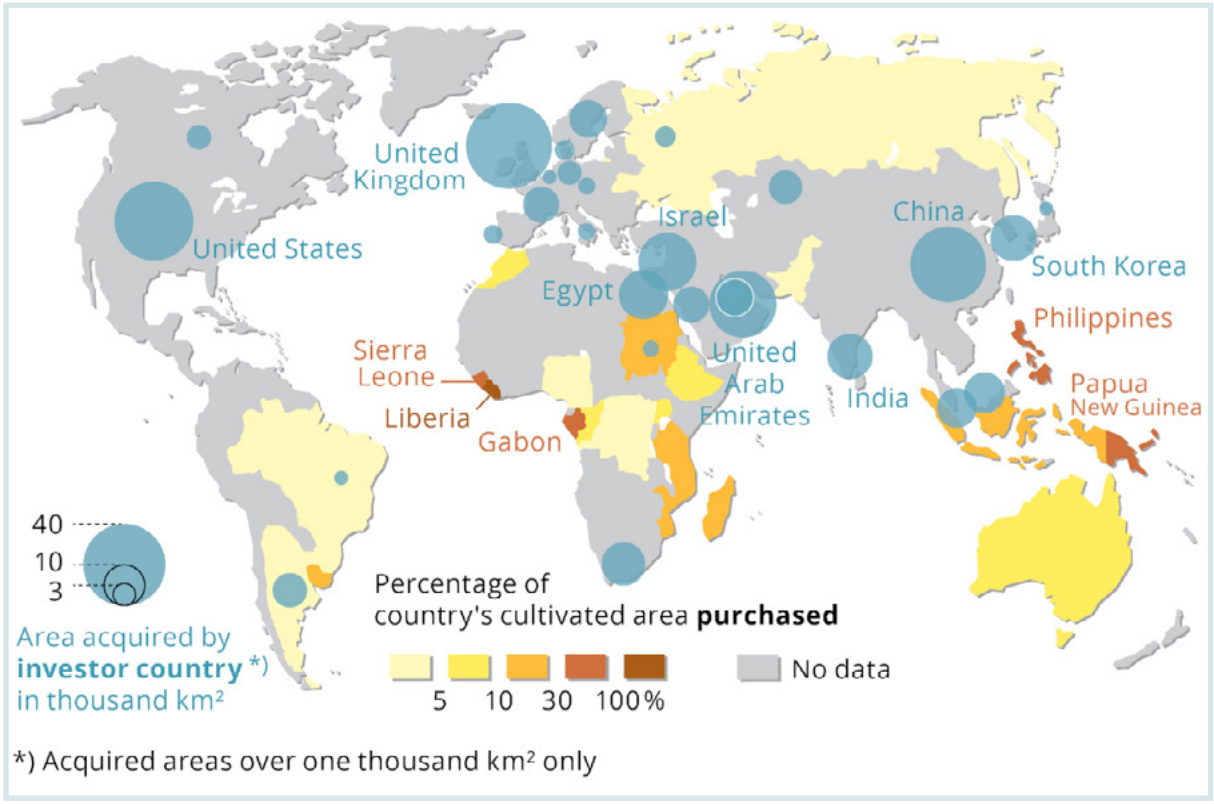

FIGURE 11: *Transnational land acquisitions, 2005-2009*
(Source: European Environment Agency (EEA), legal copyright holder, printed with permission[42])

There is also an inter-connection between the water, food and energy nexus that means water demands need to be considered in a systemic way. Climate change adaption also has significant water implications. Overall, water is a key enabler for food, energy and climate security. This presents serious implications for apparel due to the food/fibre, water, energy nexus as constraints on land and water continue into the future. The predicted water crisis is expected to have serious social and political implications impacting drinking water and food availability, growth and jobs, particularly for large water using sectors including food, energy, extractives and apparel[43].

4.2 WATER RISK FUTURE PROJECTIONS

Water risk for countries, business and investors is increasingly recognised. According to the World Economic Forum (WEF), the water crisis is the #1 global risk based on impact to society (as a measure of devastation), and the #8 global risk based on likelihood (likelihood of occurring within 10 years). Access to safe, clean drinking water supplies, hygiene and sanitation are the primary water risks from a human rights perspective. 68% of respondents to the 2014 CDP Water Program questionnaire reported that water poses a substantive risk to their business. 22% reported that water related issues could limit the growth of their business and, of these, one-third expected that constraint to be felt in the next 12 months[45]. WEF's Water Resource Group estimates that by 2030.

- **4 billion people will live in a high water stressed areas;**
- **Global freshwater demand will exceed supply by over 40% under business as usual practices.[46]**

WATER FACTS

WATER FACTS[47]

- **The World Health Organization recommends 7.5 litres per person daily to meet the requirements of most people under most conditions; and around 19 litres per person daily to cover basic hygiene and food hygiene needs.**
- **750 million people around the world lack access to safe water – approximately one in nine people.**
- **More than twice the population of the United States lives without access to safe water.**
- **Diarrhoea caused by inadequate drinking water, sanitation, and hand hygiene kills an estimated 842,000 people every year globally, or approximately 2,300 people per day.**
- **82% of those who lack access to improved water live in rural areas, while just 18% live in urban areas.**
- **$US 109 billion – The global GDP loss to droughts.**

Population growth, demand for food and climate change are expected to create significant threats to freshwater availability. By 2030, some estimates show global demand for food and energy could be as high as 50 percent. Within the next 15–20 years, water security risks triggering a global food crisis, with 30% shortfalls in grain production are predicted.[49] Scenarios on global food demand for 2050 point to severe water stress in many regions, even if strong efficiency gains in its use are made. This implies a threat to both human water security and to the functioning of ecosystems. Already today, around half of the world's major river basins, home to 2.7 billion people, face water scarcity in at least one month a year, and water restrictions are projected to be further amplified by climate change. Over 70 major rivers are already so over allocated that little of their water reaches the sea.[50]

India and China are two major water risk regions where severe water scarcity and high water pollution levels is exacerbated by the textile industry and the ability to have enough fresh water is already under threat. According to the Chinese Ministry of Environmental Protection, one fifth of surface water in China cannot be used for any purposes as it is so polluted[51]. In India, most of the cotton is grown in drier regions and the government subsidises the costs of farmers' electric pumps, placing no limits on the volumes of groundwater extracted at little or no cost. This has created a widespread pattern of unsustainable water use as well as strained electrical grids. According to the India Water Risk tool ground and surface water is being used at an unsustainable rate. As illustrated in figure 12, in 54 percent of the country 40 to 80 percent of annually available surface water is used and under high to extremely high water stress. To be sustainable, consumption should be less than 20 percent in humid zones and 5 percent in dry areas, to maintain the ecological function of rivers and wetlands. India's extensive groundwater resources are also rapidly being depleted, with 58% of wells in the drier northwest India experiencing declining water levels[52]. By 2030 demand will outstrip supply by 50 percent[53]. The water consumed to grow India's cotton exports in 2013 is enough to supply 85% of the country's 1.24 billion people with 100 liters of water every day for a year. At the same time, more than 100 million people in India do not have access to safe water[54].

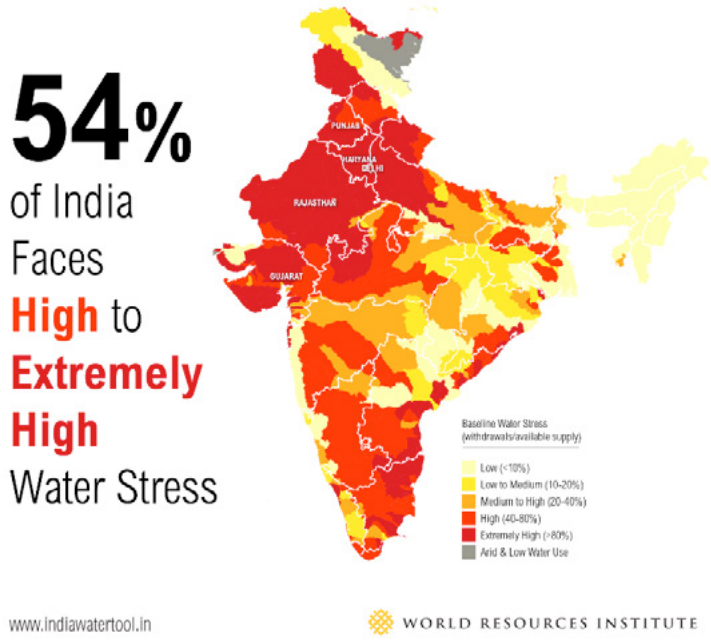

FIGURE 12: *Water Stress regions in India (Source: WRI and India Water Tool 2.0)*

A key element of the Indian government's approach to its water scarcity at a big picture level is engineering based. An $US168bn National River Linking Project will link 30 rivers with 15,000 kilometres of canals. This will transfer 137 billion cubic metres of water annually from wetter regions to drier ones. However, the country exports more water than that in virtual water in cotton and other exports[55].

PHOTO *Nexus 7, Shutterstock*

5.0 STATUS OF WATER IMPROVEMENT SOLUTIONS

- Improving water management, as with wider sustainability improvements, are driven and enabled by key levers and change agents. Drivers include **government regulation, market/ financial incentives** and the need for **supply chain traceability/accountability** for risk and reputation reasons. **Industry best practice,** in particular by global brands, can drive improvements down the supply chain through zero/low water focused sustainable design, raw material choices and procurement of suppliers.
- Suppliers investing in best practice can also drive change at key priority stages such as dyeing and finishing. Supporting relationships with these suppliers and other supply chain actors, from the farm to the dye house, to deliver these best practice solutions are key.
- At the bigger picture, the industry can shape **new business models** to deliver on water stewardship and use collaborations to identify and scale action. **Technology innovations** for water use, reuse, harvesting, field and factory based improvements can leap frog change.
- Water improvement solutions across these levers exist to different extents in apparel. Innovations are growing, but there are still gaps to fill.

This section summarises current water improvement activities relevant to apparel under the following categories:

- Regulatory and Market Incentives.
- Technology and Innovation.
- Collaboration Initiatives.
- Industry Practice.
- Awareness Raising.

Strengths, weaknesses and gaps in light of the solutions required are highlighted. Current examples of practice and innovative solutions are included.

5.1 REGULATORY AND MARKET INCENTIVES

In addition to increased demand for water, poor water management, governance and lack of regulatory or market incentives to manage water are key causal factors in water scarcity and pollution in the emerging markets. This is where the most significant water impacts are happening and often where the water risk is already high. The state of play on regulatory and market drivers is outlined below.

5.1.1 REGULATIONS, STANDARDS AND SCHEMES FOR TEXTILES

Regulations, standards and accredited schemes to drive chemicals management and effluent treatment for pollution management have been a major driver for water improvements in apparel and textiles. Reducing the chemical impacts in textiles has been one of the longest running sustainability focus areas for this sector. Much progress has been made through the EU Registration, Evaluation and Assessment of Chemicals (REACH) regulation, application of Restricted Substance Lists, sustainable cotton initiatives, production eco-efficiencies and effluent treatment best practices standards. Western countries have had regulations in place and enforced for many years. High standards for effluent treatment plants and their operation are standard practice in these markets. Examples of guidance and standards which drive water use efficiency and pollution management in textile production are outlined in **Text Box 1.**

TEXT BOX 1

TEXTILE INDUSTRY WATER GUIDES AND STANDARDS

- Bluesign® independent standard for chemicals and resource consumption supply chain management for chemical suppliers, textile manufacturers, brands and retailers with support tools (e.g. software and database) and 200 partners to date.
- Oeko-Tex Standard 100 Confidence in Textiles focuses issues including no carcinogenic dyes, release of heavy metals or biologically active finishes.
- Green Blue Sustainable Textile Standard and SMART Textile Standard.
- Made-By environmental benchmarking tools for fibres and wet processing.

In developing countries where the most significant impacts are happening, regulation is still limited and where it is in place, enforcement on the ground is poor. Best practice in effluent management and treatment plant infrastructure, both for textile production and public water supplies, are still not the norm. However, water stress and the risks this presents are driving increased action in these areas in many textile producing countries. China is a recent highly promoted example of increasingly stringent legislation and enforcement. From January 2015, China's environmental protection law imposed stricter daily fines for pollution across a range of high water using and polluting sectors including textiles. In addition to this strong regulatory enforcement approach, infrastructure developments for water supply, improving effluent treatment and financial incentives such as water tariff raises are a key focus. The Chinese government's approach is focusing on "Three Red Lines" on water – pollution, use and efficiency to shift from a "pay to pollute" to "polluter pays" regime. Released in April 2015, the Action Plan for Prevention and Control of Water Pollution (Clean Water Action Plan) aims to make more than 93 percent of the supply to cities meet drinking water standard by 2020, and raise the proportion of water meeting that standard in seven river basins by 70 percent. This involves a mandatory closure of small plants considered unable to invest in pollution control in 10 dirty industries and a clampdown on the tapping of underground water sources in a renewed effort to tackle contamination. Import tariffs on water pollution treatment technology have been reduced to incentivize their installation. In India several programs use government mandate, supported by investment in infrastructure, technology and operating practices in high stress water regions. These include in the Tiruppur, large textile production region, and Brandix India Apparel City (BIAC) in Andhra Pradesh. However they have had mixed results with Tiruppur having significant enforcement and governance challenges [58].

5.1.2 INTERNATIONAL WATER POLICY

At an international sustainable development policy level, water is a primary focus. **The big picture goal is to achieve availability and sustainable management of water and sanitation for all.** Targets are enshrined in the Millennium Development Goals set at the 1992 Earth Summit and will be replaced by the new Sustainable Development Goals (SDG) by late September 2015. The current version of this is in **Text Box 2.** Key SDG water focus areas of particular relevance to industry include (i) reducing pollution from untreated waste water, (ii) minimizing release of hazardous chemicals, (iii) increasing water use efficiency, (vi) technology solutions including water harvesting, re-use and waste water treatment (v) protection/restoration of water sources (v) implementing integrated water resources management to ensure sustainable withdrawals and supply of freshwater to address water scarcity using transboundary cooperation as necessary.[59]

TEXT BOX 2

SDG Goal 6 Ensure availability and sustainable management of water and sanitation for all.

- By 2030, achieve universal and equitable access to safe and affordable drinking water for all.
- By 2030, achieve access to adequate and equitable sanitation and hygiene for all, and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.
- By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and increasing recycling and safe reuse by x% globally.
- By 2030, substantially increase water use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity, and substantially reduce the number of people suffering from water scarcity.
- By 2030 implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.
- By 2020 protect and restore water related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.
- By 2030, expand international cooperation and capacity building support to developing countries in water and sanitation related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.
- Support and strengthen the participation of local communities for improving water and sanitation management.

The key challenge with the SDGs is that they are high level, voluntary, policy targets and dependent on effective country specific action for results. For business, they give a policy direction, but there are no compliance obligations. Country specific legislation and industry best practice guidance and standards play the primary role in managing water use and pollution at local and regional levels.

5.1.3 MARKET AND FINANCIAL

Financial instruments such as water pricing are essential levers for driving water management commensurate with water risk. Financially paying for water use by both business and consumers exists in an increasing number of countries, in particular in developed markets. Where business pays for water, use is metered and factories are charged based on the volume used. Local pricing is normally set based on government regulation and water utilities market data. However, paying for water is not the norm, in particular in emerging market textile producing countries where the water risks are greatest.

As with many resources and services provided by nature, market economics do not adequately price these. They are externalities which are not financially valued and hence there is no market incentive to manage them for the long term. The natural capital agenda is raising awareness on these issues. Market economics treats limited resources as if they have an unlimited supply, which is a market failure. If the externality costs of water and energy impacts and dependencies were factored into the cotton price, it is estimated to be really valued at $7.266 per tonne.[60] If these externalities were internalised in the market this would make all sustainable cotton options cheaper than conventional and encourage less water intensive production.

Recognition of water risk in textile supply chains is growing in finance. Investors have identified textiles as having a high exposure to business disruptions from water related issues at both the agricultural and manufacturing levels. This can increase production costs and negatively impact upon the Profit and Loss, and ultimately shareholder value. Investors also perceive a potential for **stranded assets**[e], in light of water scarcity and the growing threat of regulation and markets forcing internalisation of externality costs. Water risk also provides financial opportunities. Financial packages such as water funds are increasing in the food sector to support restoration of watersheds, infrastructure development and sustainable water management. However investor assessment of water risk is still early and financial analysis does not yet systemically include water use and pollution in water stressed regions. More tools are emerging to help both business and investors understand the financial implications of water risk to inform business decision making. Existing tools include:

- The WWF Water Risk Filter allows business and investors to assess and quantify their regional water risk.
- The World Resource Institute Aqueduct Water Risk Atlas, which was recently updated to assess water risks using 12 indicators including water quantity, quality reputational and regulatory factors.
- The Water Risk Monetizer developed by Trucost and EcoLab, which can be used to compare water efficiency of different cotton growing techniques across the worlds cotton growing regions to inform cotton sourcing decisions.
- The Bloomberg Water Risk tool in conjunction with the Natural Capital Declaration is still being trialled, but aims to augment investors existing Environmental Social and Government assessments to get a more detailed understanding of water risk .
- The Natural Capital Coalition is aiming to develop a standard for Natural Capital Accounting with supporting apparel and food sector guides by 2016. This should include techniques for financially valuing water risk as well as other forms of natural capital.

Water management accelerator programs are also increasing such as Imagine H_2O, and LAUNCH which foster breakthrough sustainability solutions. Launch is an open innovation platform founded by NASA, NIKE, U.S. Agency for International Development (USAID) and The U.S. Department of State. For apparel and footwear this is focusing on sustainable materials and green chemistry.

[e] *A **Stranded Asset** loses significant economic value well ahead of its anticipated useful life as a result of changes in legislation, regulation, market forces, disruptive innovation, societal norms, or environmental shocks.te will depend on its garment production operating capacity.*

5.2 COLLABORATION INITIATIVES

Several collaboration initiatives are focusing on water challenges in apparel. These include:

- WWF Water Stewardship multi stakeholder collaborations to improve water impacts and governance at local levels. One specific example is the H&M WWF water partnership – Taking a holistic approach to water stewardship, the aim is to improve responsible water use throughout the supply chain. The partnership targets four key areas: building water awareness, measuring water impact and risk, improving the use of water, and collective action.
- Zero Discharge of Hazardous Chemicals (ZDHC) – Beyond reducing chemicals and pollution, a drive for zero is now a key industry focus for ZHDC. This collaboration across major apparel and footwear brands is implementing a roadmap to achieve a shared commitment of zero discharge of hazardous chemicals by 2020. ZDHC has been the industry response to the high profile Greenpeace Detox Campaign started in 2011 which exposed links between textile manufacturing facilities causing toxic water pollution in China, and many of the world's top clothing brands.
- CEO Water Mandate focusing on water stewardship and which recently established Apparel and Food Water Action Hubs.

Several cleaner production textile programs bring capacity, technology, finance and government levers together to improve water management in high water stressed regions. This collaboration and mobilization of resources beyond what a single brand, initiative, or government can do on their own has scalability potential. These include:

- Sustainable Water Resources (SWAR) programs in 5 countries (India, China, Bangladesh, Turkey, Ethiopia) run by Stockholm International Water Institute (SIWI). More information is in the case example.

- Bangladesh Water PACT – Partnership for Cleaner Textiles – In conjunction with global brands (C&A, H&M, Inditex, G–Star, KappAhl, Lindex, Primark and Tesco), IFC, Solidaridad, WFN and TNO, PACT leverages the strengths of different participating actors across industry, government, technology, finance and capacity building. They have created a textile sustainability platform that improves water management in the Bangladesh textile wet processing sector. This is a region which already has severe groundwater supply shortages.

CASE

SWEDEN TEXTILE WATER INITIATIVE [SWAR]

The Sweden Textile Water Initiative is a collaboration between 30 Swedish brands and SIWI, with the aim of improving capacities in supply chains to work continuously with sustainable resource management. The Initiative pilot project, named "SWAR" started with 42 Indian suppliers and sub-suppliers to 3 Swedish brands during 2013-2014. Once proven successful, it was scaled up in a large public private program to provide capacity building and technical support for water and wider environmental improvement at 120 textile factories supplying 20 major Swedish brands in 5 countries – India, China, Bangladesh, Turkey and Ethiopia. The difference between SWAR and other Cleaner Production programs is that water is the primary focus and proxy to show the business case for wider resource consumption (diesel, electricity, chemicals). The program uses multiple levers including knowledge, tools, technology, financing and policy engagement to enable and scale long term sustainable textile production in and capacity development water stressed regions. It also uses a market-driven approach that creates demand for sustainable water use in production, based on real risk mitigation, and supplies management solutions to meet that demand. To date capacities have been built on multiple levels:

- **Brand sustainability departments to prioritize water management.**
- **Factory management and workers with information, training, technology and financing, thus creating a "mind shift" towards sustainable production.**
- **Local experts and consultants with knowledge and perspective in order to cater for the current and future market needs for sustainability consultations.**
- **Dialogue to share best-practices with other companies, industries, academic institutions, brands, international programs, local authorities, agencies, associations and other relevant stakeholders.**

FINANCIAL INFORMATION

The program model uses catalyst funding from brands, factories and the Swedish government to create the platform that continuously develops investment cases for sustainability investments that give a clear Return on Investment (ROI). The scale-up was designed based on economies of scale to minimize private investment risk and increase ROI base. Operating costs savings have been significant and average payback time for the investments was over 11 months (and up to three years).

COUNTRY & WATER STRESS

The pilot location of North Western India (Delhi and Jaipur) is a high water stress region. It has groundwater levels dropping beyond any other ground basin level in the world, and pollution continuing to impact human development in the region. The regions in the scaled program countries – China, Bangladesh, Turkey, Ethiopia and wider regions in India have been chosen because of risks associated with textile production in terms of water quality, quantity and governance.

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WATER IMPROVEMENT

For the India pilot SWAR saved 284 million liters of water for 2014 (a 7% improvement from the baseline). This is enough water to serve more than 15 Indian villages on an annual basis. This was achieved through capacity building on efficient water, energy and chemical use combined with implementing projects at the factory level to increase the efficiency of resource consumption through water reuse, pollution prevention, and effluent treatment. For example:

- **Installing stop-cock taps during 2014 saved 11 million liters of water per annum.**
- **Reverse Osmosis reject recovery during 2014 saved 128 million liters of water per annum.**
- **Effluent Treatment Plant discharge re-uses during 2014 saved 28 million liters of water per annum.**

Projected water and waste water management improvements are different per region but estimated to be 45–80% against the baseline.

FURTHER INFORMATION

SWAR project report and press release
Report on Swedish Television (SVT)

Other Cleaner Production programs incorporating water include:

- **NRDC's 2014 Clean by Design (CBD) program operating across 33 textiles mills in China with participants including Target, Gap, Levi Strauss and Co, H&M and IFC.**
- **Better Mills Initiative in China led by Solidaridad and H&M.**

One of the challenges for textile cleaner production programs, is they often only focus on "export oriented" factories which are only the tip of the iceberg. The real scale is in expanding beyond factories exporting to western brands, to include factories producing for other markets, including the local market. In order to do this important enablers include:

- **Successful cases with export-oriented factories in each country, that provides the business case for expansion;**
- **Working with governments to improve industrial water governance, transparency, and curb corruption;**
- **Involvement of private associations of manufacturers (beyond exporter associations);**
- **Programs and projects customised to the factory based on measured and validated data.**

Water in the context of wider sustainability management is also a focus of existing apparel industry collaborations focusing on guidance and tools such as the Sustainable Apparel Coalition's Higg Index and The Sustainability Consortium's Clothing, Footwear, and Textiles Working Group KPIs and cotton commodity mapping. The sustainable cotton initiatives **Organ**ic (certified Organic Content Standard (OCS)), **Better Cotton Initiative**

(BCI), **Cotton Made in Africa** (CiMA) and **Responsible Environment Enhanced Livelihoods** (REEL) (based on integrated pest management) all have reduced water use and pollution in comparison to conventional cotton. Organic has the most dramatic improvement particularly for pollution reduction. However as it represents approximately 1 percent (in 2013/14) of the global cotton market the scale is limited. While BCI is scaling production and now at 8 percent with good water improvements, neither initiative is likely to yield the improvements required in light of existing water stress and growing competing demands outside of textiles. All the sustainable cotton initiatives reduce water use (blue water footprint) but growing evidence is showing this is largely determined by the agricultural land management practices. Further information on these initiatives is in Text Box 3 below.

TEXT BOX 3

SUSTAINABLE COTTON INITIATIVES

Organic Cotton production has a lower net water use and less pollution compared to conventional because it is typically not irrigated and uses no chemicals[65]. Impact savings (per 1,000 kilograms of cotton fiber) over conventional are 91 percent reduced blue water consumption and 5 x less grey water footprint (pollution).[66] Based on a comparison study by C&A Foundation of over 200 Indian farms, the grey water footprint of the non organic farms measured (totalling over 40,000 cubic metres per tonne of cotton) was 98% greater than the organic farms' grey water footprint (over 700 cubic metres per tonne)[67]. Per farm this is the most significant improvement across any of the sustainable cotton initiatives. However, there are cases where conventional farming practices (perhaps a relatively low use of pesticides/fertilizers and good timing of application) allow a lower grey water footprint than was found on some organic farms. **This highlights that the farming practices (e.g. the specific application of pesticides and fertilizers) used by each individual farmer, whether organic or conventional, has a large influence on the grey water footprint and indicates the need to better understand specific farming practices as they relate to the water footprint.**

Many factors impact price and sustainable cotton can trade at prices higher than conventional. For example, Organic can range from on par with conventional to around 30% higher [67a]. However this is not about a price premium, it is reflecting the investment in a more sustainable system. This includes investments made by farmers who are protecting the environment, maintaining soil fertility, preserving biodiversity and conserving water – costs normally hidden in the market. The 10 leading retail users of organic cotton by volume are C&A, H&M, Tchibo, Decathlon, Nike, Carrefour, Target, Lindex , Inditex, and Puma[68].

Better Cotton Initiative reduces the use of pesticide, addresses water use, soil health and improves labour standards and profits for farmers. It recently partnered with Cotton Made in Africa, which also operates a best practice scheme for cotton production by smallholders in Sub-Saharan Africa. CimA's blue water footprint is just $1m^3$ per 1,000 kg of cotton lint compared to a world average of 2,120 m^3 per 1,000 kg. While there are regional differences, on average, BCI farmers use 14% less water than conventional cotton[69]. A trial in Pakistan using BCI farming methods resulted in a pesticide and water use reduction by 32 percent on average, with profits up 69 percent[70]. An M&S and WWF Better Cotton project in India with 20,000 farmers across 25k hectares resulted in 16 percent less water usage. BCI is not a third party verified certification scheme which can result in lower operating costs. By 2020, BCI intends its cotton to be 30 percent of the market. It has growing support from members and has global brands, suppliers, traders, mills, farmers and NGOs participating including Adidas, H&M, IKEA, Levi Strauss & Co., M&S and Nike.

Industry collaborations on water management in other sectors apparel can learn from include:

- **WEF 2030 Water Resources Group (WRG) (Chaired by Nestle SA, PepsiCo, SAB Miller, The Coca-Cola Company)**
- **Every Drop Matters with Coca Cola and others focusing on integrated resource water management and the Heineken and United Nations Industrial Development Organisation (UNIDO) water stewardship acceleration initiatives for breweries in water scarce countries and regions[71].**
- **The Savory Institute supported Future Ready Now including Patagonia and The Kering Group focusing on grassland land restoration with benefits for restoring water in soils and aquifers.**

5.3 TECHNOLOGY AND INNOVATION

The status of technology improvements for cotton, dyeing & finishing and consumer laundering are outlined in the sections below.

5.3.1 COTTON AND ALTERNATIVES

For cotton growing, water improvements to date have come from sustainable cotton initiatives (described in 5.2 above) and also irrigation technologies. For cotton irrigation for example, a shift from furrow to drip feed irrigation has achieved a 20% efficiency saving where it is used.

Low water cotton alternatives are also a slowly growing focus for the industry. Cotton alternatives with over 50 percent lower water impacts include the following:

- **Regenerated manmade fibres: Lyocell such as TENCEL® and Modal (regenerated cellulosic's made from wood pulp cellulose) and Ingeo (biopolymer made from sugar from corn).**
- **Flax, nettle and hemp which is increasingly blended with cotton[72].**

Cellulosic fibres made from wood pulp include conventional viscose rayon, Modal and Lyocell (TENCEL®). Environmental impacts associated with deforestation based on the source of the trees used, water and chemical use in production are associated with these fibres. From a chemical and water intensity perspective, of these the lowest impacts are currently considered to come from Lyocell[73]. From a deforestation perspective using pulp from Forest Stewardship Council (FSC) certified sources can ensure use of cellulosics is not contributing to deforestation. Initiatives such as Out of Fashion focus on supporting "forest friendly fabrics" in fashion.[74] Another alternative is recycled cotton fibres which have reduced water impacts from lower embedded impacts but still pose challenges beyond use in downcycled applications.

These alternatives have a growing market presence with brands such as H&M, Nike, Patagonia, Levis Strauss & Co, Diesel and G Star Raw. For example, as part of their Conscious Collection, H&M uses TENCEL® (suitable for jersey, knits and woven fashion garments) and recycled cotton from production waste[75]. G-Star Raw supplements cotton with nettle in their blended cotton/nettle denims.[76] While the functionality of these alternatives makes them good cotton alternatives, one of the potential barriers noted by industry is negative consumer perception.

5.3.2 DYEING AND FINISHING

Existing water improvements to dyeing and finishing processing have traditionally focused on eco-efficiencies. Cost and productivity improvements can still be obtained from these improvements in emerging markets and as such are still a primary focus.[77] The first improvement step generally seen is factory mechanisation and process improvements to reduce the dye-to-water ratio. A 1-to-30 ratio is common but a 1-10 is more efficient and offers good functionality.[78]

Beyond this, the more transformative water improvements emerging are though technologies enabling low or zero water use in dye houses and textile mills. Water reuse technologies such as rainwater harvesting are slowly growing and evident in the most innovative wet processing suppliers. Given the high water use in dyeing and finishing sustainable, low water technologies to dye cotton and synthetics offer "leap frog" improvement opportunities that have transformative potential. The only challenge is that they are not yet broadly adopted. Different fibres and fabrics require different manufacturing processes, so one best technology does not exist for low water or waterless dyeing. Polyester is the prime candidate because dyeing performs best in an airless environment with pressurised high heat, allowing dyes to disperse throughout the fabric. As polyester is the dominant synthetic fibre by volume in textiles it is an important breakthrough. Natural fibres such as cotton and wool are more challenging as they can become damaged undergoing a similar process.

Examples of technology solutions with significant water reductions include:

- **Spun dyed/fibre dyed – Only suited for synthetic fibres such as modal and viscose, this pre dyes the fibre at manufacturing. It is under exploited as pre dyeing can limit the opportunities to quickly change colours that fashion requires. For core colours such as black and navy, it provides a good solution.**
- **For cotton, ColourZen modifies cotton's molecular structure and allows dye to settle within the fibres, finishing cotton fabric using 90 percent less water and 75 percent less energy compared to conventional.**
- **AirDye printing and dyeing technology saves up to 95 percent water, 86 percent energy and 84 percent GHG emissions compared to conventional print and dye methods.**
- **Denim laundering technologies such as ozone and laser achieve the distressed or faded look fashion requires with significantly less water. Low water denim laundering examples include Levi Strauss Water<Less, the H&M used Jeanologica, Saitex, and The Crystal Group.**
- **Enzyme and production technologies that reduce chemical and water impacts of textile production include Novozymes CombiPolish™, Genercors PrimaGreen and Rahu Catalytics for reduced temperature cotton bleaching.**

Completely waterless dyeing offers the greatest leap frog opportunities, but is still far from mainstream. However technologies such as DyeCoo's DryDye dyes synthetic fabrics using compressed carbon dioxide as a solvent in a closed loop dyeing process as a water replacement. While this dry dye concept has existed for many years, its presence is only starting to grow in the market and requires scaling. Apparel brands including Adidas and Nike are focusing on these waterless technologies which could facilitate faster uptake. More information on the DryDye process is in the case example below.

CASE

DYECOO DRYDYE WATERLESS DYEING

DyeCoo Textile Systems B.V developed Drydye DyOx technology which enables water and chemical free fabric dyeing. It's CO_2 based dyeing process is more sustainable, cheaper to operate and gives the same functionality compared to conventional fabric dyeing technology. The technology uses reclaimed CO_2 as the dyeing medium in a closed loop dyeing system, recycling 95% of the used CO_2 after each batch. The technology is currently focused on dyeing polyesters. The technology can also be used with cotton but the dyes that do not require water for cotton are still in development. Dye companies are working on this and a key partnership with a major dye company and DyeCoo is planned. Use of Drydye technology is still small in market terms, but uptake is growing. It is currently being used by textile mills in Thailand and Taiwan to produce ranges for Adidas, Nike (Color Dye) and Peak Performance. Dryedye has previously only been used for synthetic technical knits. In recent months, for the Dyedron Jacket, a ski-wear jacket produced by Swedish outdoor business Peak Performance Drydye was re-engineered to be used on woven fabrics converted into waterproof/breathable laminates.

FINANCIAL INFORMATION

While the capital investment for Drydye equipment is higher than conventional dyeing, the operating costs are 45% less. This is due to no water, processing chemicals or effluent treatment being required, as well as lower energy use (over 50%). Less labor is also required for the processing which reduces labor costs for the supplier. Pay back on the original investment cost is estimated at 3-4 years.

WATER IMPROVEMENTS

DyeCoo uses no water and zero processing chemicals hence reducing water pollution. DyeCoo machines have a capacity of 300 kg of fabric per day or 100,000 kg/annum. Per year DyeCoo technology saves 15 million liters of water and 6500 kg processing chemicals per machine.

Zero water dyeing is a disruptive technology that offers a transformative shift away from the current high water using and polluting dyeing and finishing process. It is a win win for sustainability and financially for suppliers on operating costs once the initial investment is made. Technologically, it offers the greatest leap frog opportunity in water improvement compared to other dyeing and finishing improvements.

FURTHER INFORMATION

DyeCoo technology report & animation
Launching customer DryDye

One of the challenges with low water solutions for dyeing and finishing is the variety of fibres, fabrics and products. This makes it hard to get a standardised approach which can quickly scale. Also, getting third party verified water saving data is still a challenge as most suppliers are providing their own generated data at present for water savings[79].

cent less energy and 50 percent less detergent than conventional machines. In Xeros washing machines the use of water is largely replaced by polymer beads, due to their ability to gently agitate stain and soil from textile surfaces easily. To date, Xeros is only operating in commercial laundry applications with domestic machines, where the big water savings are, planned for the future. In the company's words, they highlight this innovation:

> "Traditional laundry machines still operate on the basic principle of dousing fabrics in hot water and detergent, soaking them for long periods of time, and then dropping and slopping them around with an aggressive mechanical action. In that same time, humanity has developed technology to land a man on the moon (1969)." From "The future of Xeros[80]"

5.4 INDUSTRY PRACTICE

In general for understanding the water challenges facing business, a shift from an efficiency only focus to a water stewardship focus is being advocated[81 82 83]. This stewardship approach is about considering the systemic risks and nexus connections for competing water demands. For apparel brands, suppliers and farmers it is about assessing their water risk taking these wider considerations into account. There are many issues relevant to water that are becoming more prevalent, including diminishing water quality, contamination, flooding, pollution, stress, scarcity and watershed pressure. Understanding the interconnectivity of the issues is seen as key to informing long term sustainable water solutions[84].

Water management approaches for countries and apparel supply chains focus on both global and local considerations. At the big picture, the challenge of managing water resources is being framed within the complexity of managing the water/food/energy/climate change nexus. At the regional level, the river basin and local watersheds focus requires a landscape and catchment management approach.

For the apparel industry the next steps on shifting to water stewardship present many new challenges. For example, collaboration and finding effective solutions can require a different approach. Companies cannot directly control water availability or hedge as they can with some other commodity based sustainability challenges. For example, in water stressed local regions engagement with government on water allocation in river basins and resource management policies is essential. This represents a shift to "collective water management" and the necessity to incorporate other actors in water solutions. In the mainstream, apparel brands and suppliers are not yet engaging in this way. Other water intense sectors such as food/beverage/agriculture and mining are starting to do this and lessons can be learned. Another challenge is that quick wins are more elusive on water solutions which may require landscape level systemic solutions with longer timelines for delivery. This is different to other environmental impacts where quick wins in the short term can be achieved and demonstrates the business case to shareholders. Overall, the business model for water stewardship is new and still evolving. As one example, initiatives such as the Alliance for Water Stewardship (AWS) standard[85] define water stewardship guidance for site and catchment level water management.

As illustrated in the sections above, a range of innovations in best practice are emerging and several collaborations in the sector. Individual brands are focusing on water management in their supply chains such as Levis

Strauss & Co, H&M, C&A, Adidas, IKEA, Marks and Spencer's, Lindex, Remie, Esquel and Pratibha Syntex. Below are two case examples that demonstrate a shift towards a full supply chain approach that targets the priority impacts representing different industry segments:

- **Levi Strauss & Co. – an example of an international cotton denim brand**
- **Pratibha Syntex – an example of a vertically integrated textile manufacturer in water stressed regions of India.**

CASE

LEVI STRAUSS & CO [LS&CO] – WATER IMPROVEMENT ACROSS THE SUPPLY CHAIN

Levi Strauss & Co.'s water management approach focuses on the priority water challenges for denim garments in an integrated way across the supply chain – cotton growing, production and consumer laundering. Their approach incorporates:

- Mapping their water and wider environmental risks across the supply chain.
- Participating in Better Cotton Initiative to invest in cotton that uses less water and pesticides while improving farmer livelihoods.
- Implementing the Water<Less™ approach to reduce water use in denim production.
- Working with IFC's Global Trade Supplier Finance program to provide low cost capital financing to suppliers in emerging markets who demonstrate strong performance on LS&Co's standards for social and environmental sustainability.
- Aiming to influence consumers to wash less through the Care Tag for Our Planet and "Are You Ready to Come Clean?" campaigns.

FINANCIAL INFORMATION

- Water<Less™ saves on average US$ 0.6 cents per pair of jeans.
- BCI cotton is priced the same price as conventional cotton.

COUNTRY & WATER STRESS

LS&Co cotton growing and Water<Less™ production operates in water stressed regions. Cotton growing regions include United States, India, Pakistan, Brazil, China and Australia.

WATER IMPROVEMENTS

Approximately 3,800 liters of water are used during the full life cycle of a single pair of Levi's® 501® jeans. This is equivalent to 3 days worth of one US household's total water needs. The most water is consumed by fiber production, predominantly cotton (68%) followed by consumer care (23%). Water improvements achieved to date are:

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COTTON

- LS&Co currently source 6% BCI cotton today and plan to source 75% by 2020. On average, BCI farmers use 14% less water than farmers who do not. For China this has been 23% less.

PRODUCTION

- LS&Co. has saved 1 billion liters of water through its Water<Less™ process including the implementation of the apparel industry's first water recycle/reuse standard since 2011. Water<Less™ reduces the water used in garment finishing by up to 96 %. So far, 24% of LS&Co brand are using Water<Less™. This is to be scaled by 75% by 2020. On average a pair of jeans uses 42 liters of water to produce. The Water<Less™ collection in the US will reduce water consumption by an average of 28% and up to 96% for some new products in the line. Non LS&Co suppliers can avail of the approach allowing for greater scalability.

FURTHER INFORMATION

http://levistrauss.com/sustainability
Levi Strauss & Co, 2015, Understanding the environmental impact of a pair of Levi's® 501® jeans

CASE

PRATIBHA SYNTEX – WATER MANAGEMENT IN AN INDIAN VERTICALLY INTEGRATED MANUFACTURER

Pratibha

Pratibha Syntex is a large, vertically integrated manufacturer of knitted textile products. Operations range from the farm to the finished product. It produces yarns, fabrics, manufactures inner wear, sleep & lounge wear, knit tops & bottoms, leisure wear and thermals. With operations based in a water stressed region of India, focus on water stewardship is not only a responsibility but also an imperative. Pratibha Syntex's responsible water management approach focuses on reducing impact in cotton growing regions and production supply chain. Key activities include:

a) Technology upgrades in fibre, fabric and dyeing/finishing techniques to reduce water use.
b) Enhanced water treatment capabilities to recycle 92% of water for reuse.
c) Sustainable cotton (Organic, BCI and Fair-trade), increasing use of preferred fibres (recycled polyester, spun dyed viscose, modal and lyocell)
d) Provision of training and technology including drip irrigation to farmers.
e) Using rainwater harvesting for ground water discharge and replenishment.

Pratibha Syntex employs 10,000 people, engages with 30,000 farmers while supplying in 20 countries to global brands including Nike, C&A, Patagonia, MEC, Woolworths, etc.

FINANCIAL INFORMATION

The company has invested US$90 million since its inception in sustainability initiatives. Significant further investment is in the pipeline for dyeing and water treatment. They have seen ongoing cost savings based on efficiency based reduced operating costs.

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COUNTRY & WATER STRESS

Pratibha Syntex is located in Madhya Pradesh in central India that has high water stress and has experienced water shortages for over a decade. Their Vasudha Organic sustainable cotton project operates with farmers both in Madhya Pradesh and in Rajasthan situated in northern India.

WATER IMPROVEMENT

In total, Pratibha Syntex has reduced its blue water footprint by 53% in 2014-15 from the base year 2010-11 with the following improvements:

Alternatives fibres/fabrics and low water dyeing technology/process improvements:

- **Fabric production - Use of spun dyed viscose fibres, which eliminates the need for dyeing and saves 85% water and 35% energy ("Allure fabrics" range). This is the equivalent of the water requirement for 1800 families.**
- **Doubling production of Mélange fabrics and garments, which considerably consume less water than conventional dyeing.**
- **Optimising the colour palette by pro-actively engaging with business partners in reducing colour shades to 18 from 52.**
- **Certified to the strictest chemicals management standards like Bluesign, GOTS, etc. in order to manage the dyeing impacts responsibly.**

Cotton Farming:

- **Drip irrigation and training provided to farmers adopt water efficient farming techniques e.g. ridge & furrow irrigation.**
- **Reducing the need for irrigation to every fortnight vs. every week.**
- **Use of Organic, BCI and recycled cotton**

On an average the amount of water required to dye 1 kg cotton fabric is 150 litres. Less than half of which is consumed to dye a kilogram of fabric at Pratibha Syntex.

FURTHER INFORMATION

http://www.pratibhasyntex.com/
Vasudha Organic project
Parivartan Sustainable Business Award
http://map.2degreesnetwork.com/#/markers/524

[1] *http://www.waterfootprint.org/Reports/Chapagain_et_al_2006_cotton.pdf*

5.5 AWARENESS RAISING – BUSINESS AND CONSUMERS

In addition to the collaboration initiatives described above, there are awareness raising initiatives to inform business and consumer audiences on water and textiles. For consumers, low impact laundering campaigns such as "I prefer 30 degrees" aim to influence consumer behaviour change to lower the impact of laundering. Several apparel brands, retailers and detergent manufacturers have also run consumer behaviour campaigns for the same purpose such as Procter and Gamble, Unilever LS&Co and Marks and Spencer's. TSC Cold Water Wash Initiative campaign is operating in the US with detergent and appliances manufacturers.

For apparel business and their investors, China Water Risk has significantly raised awareness on the business risk water presents for apparel. Further information is in the case example below.

CASE

CHINA WATER RISK

China Water Risk (CWR) is a Hong Kong based non-profit initiative designed to help investors, businesses and government understand and mitigate risk from China's water crisis. Through its web portal and events it provides evidence, showcases research and provides a consultation platform on China water risks to business & finance across five sectors – power, mining, food, apparel & electronics. The 2014 Dirty Thirsty Fashion report is their main evidence study on apparel which has raised awareness in the apparel sector and its investors on textile related water risks in China. Its mission is to accelerate sustainable water practices in China by raising awareness in investors and the corporate community on water-related risks in their portfolios and business operations. They also provide a dialogue platform for these stakeholders, government and civil society.

COUNTRY & WATER STRESS

China is highly water stressed from over use of water and pollution. Textiles are one of the top five water intensive industries in China and the third most polluting. 80 – 90 percent of yarn, cloth and chemical fibers are made in water scarce and stressed regions in China, plus 25 percent of cotton is grown in the North China Plain.

FUTURE INFORMATION

http://chinawaterrisk.org/resources/intelligence/textiles/
Dirty Thirsty Fashion: Blindsided by China's Water Wars (Sept. 2014) report[f]

[f] *CLSA, 2014, "Dirty Thirsty Fashion: Blindsided by China's water wars", September 2014*

PHOTO *Suzanne Tucker, Shutterstock*

6.0 CONCLUSIONS AND NEXT STEPS

- The growing water crisis is the elephant in the board room for apparel and textile companies that needs to be acknowledged.
- A strategy and roadmap is needed for the sector to work towards a water stewardship vision that is commensurate with the true scale of the water challenge.
- This incorporates not just maximising the wealth of improvement potential still available from efficiency but also a shift in the long term goal of what responsible water management in apparel and textiles needs to look like by 2030.

6.0 CONCLUSIONS AND NEXT STEPS

In apparel a shift to focus on water stewardship and responsible water management that goes beyond efficiency only approaches is starting. Awareness of the criticality of water risk in water stressed cotton growing regions and production facilities is growing. This report has highlighted examples of innovators across the industry, technology, financial, government and collaborative initiatives that are taking actions to understand these risks and develop actions to reduce the water use and pollution of apparel and textiles. However, a major gap is still a lack of recognition of the extent that growing demand for water from non apparel competing users will impact the sector. Tackling this challenge requires a mindset shift from being "users of water that treat pollution" to being "water stewards" managing the real risks and opportunities this presents across textile supply chains and at the local river basin level. The growing water crisis is the elephant in the board room for apparel and textile companies that needs to be acknowledged. In particular, with competition for productive land and water resources expected to be 50 percent by 2030, the future strategy for cotton, both conventional and sustainable options, needs serious consideration. As demands for food exceed those for fibre, non land based alternatives for cotton need to be a greater part of the solution.

A strategy and roadmap is needed for the sector to work towards a water stewardship vision that is commensurate with the true scale of the water challenge. This incorporates not just maximising the wealth of improvement potential still available from efficiency, but also a shift in the long term goal of what responsible water management in apparel and textiles needs to look like by 2030. To get there requires actions in the short and long term. These include the business models, practices, investment in infrastructure, technologies, government regulation/enforcement, financial incentives and collaborative platforms to enable a shift toward water stewardship. As part of this the apparel and textile sectors will also need to engage with other land dependent, high water using sectors including food/beverage/agriculture to collaborate on water management solutions in a more systemic way than we see now. Shifts in sourcing practices, especially in light of water scarcity and more stringent regulatory enforcement in particular in China, is resulting in moves to other markets such as Cambodia, Vietnam and Africa. Ensuring the same problems of overuse and pollution do not reoccur in these new sourcing countries needs to be an integral part of the solution.

Figure 13 illustrates a possible roadmap incorporating key short and long term solutions needed to achieve a water stewardship vision. This is a framework for the apparel sector to consider. It highlights the key opportunity levers and change agent actors for transformative action on water improvement across the priority supply chain stages in light of wider competing demands. Suggested elements for this roadmap with actions for change agents to the level needed in light of increasing water constraints and associated business risk are outlined.

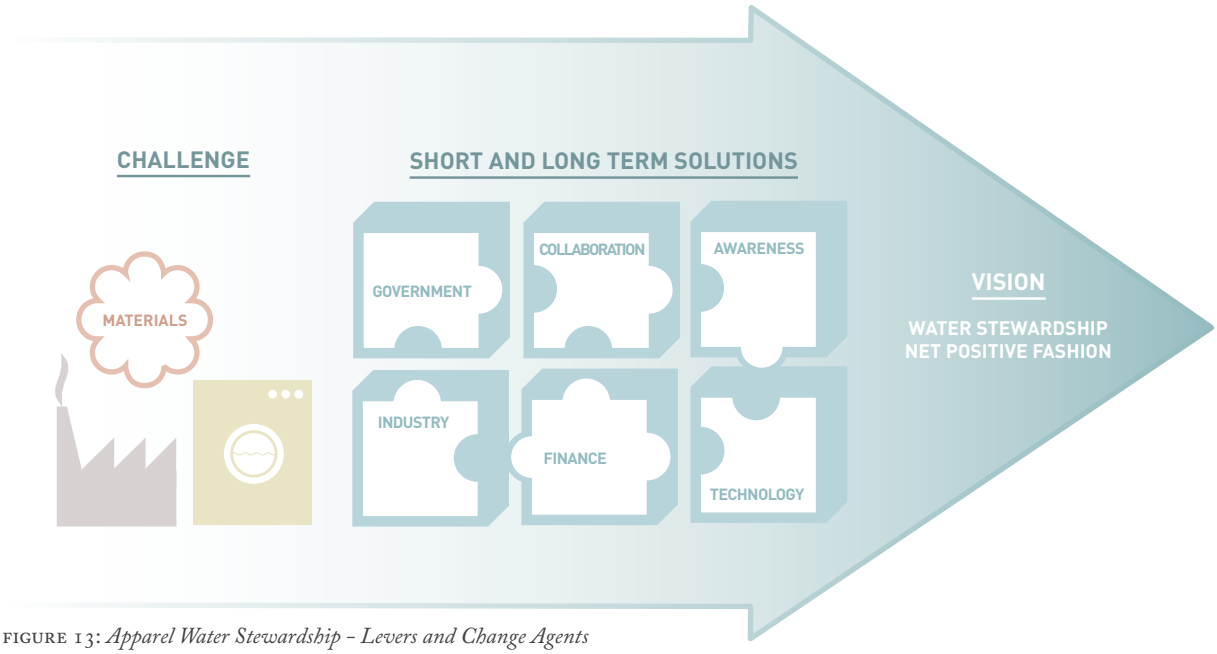

FIGURE 13: *Apparel Water Stewardship – Levers and Change Agents*

6.1 INDUSTRY AND TECHNOLOGY

For apparel and textiles, key actions include the following:

i. **Vision and business model shift to focus on what water stewardship needs to look like by 2030 -** This includes not just understanding the water impacts the apparel sector has from abstraction for use and pollution, but the consequences of this for the business and competing water users in high water risk regions. "Zero" is now replacing "reduction" for textile sector chemical and pollution impacts such as in the ZDHC Roadmap. This trend in apparel is also seen in other sectors where there is a shift away from the "doing less bad" approach of impact reduction to "enhancing" the environment and society with which a business interacts. **For apparel and textiles, perhaps the end vision for water stewardship is "low or zero water fashion" or even " net positive fashion"?** These are business models concepts to consider as a vision. "Low or zero water" means water is significantly reduced or eliminated in water intensive processes or across the value chain. Examples of low and zero water fashion in production are slowly emerging such as closed loop systems or DyeCoo's zero water dye technology. However apparel using zero water across the full value chain does not yet exist. The "net positive" business model already exists in different forms in other sectors with high reliance on natural resources such as food, timber and mining. For example, DIY retailer Kingfisher Group's **"Net Positive"** or Marks and Spencer's **"Net Benefit"** are examples. The Kingfisher Group has a strong reliance on timber and aims to be Net Positive by creating more forests than it uses and only use certified sustainable sources by 2020. Marks and Spencer's aim to generate more sustainability benefit for people and the planet through its business activities than it takes away. Food and beverage companies Coca Cola and Unilever are using a similar approach to water where they are focusing on **enhancing** watersheds they use as raw materials to maintain their supply for the long term. According to The Net Positive Group led by Forum for the Future, Net Positive water use means creating more accessible, better quality water than is consumed in operations or across the value chain. This has challenges in practice as water is location and quality specific. For example, a Net Positive approach would require that at a local level, at least the same amount of water taken from a watershed is replaced to the same one. This may not always be possible and agreed metrics to verify it is still an evolving area.

ii. **Assessment of risk and opportunities to the business and wider stakeholders** – The apparel sector is already sophisticated at measuring its water use and pollution. But it needs to go further to understand the business' relationship with water and risks from competing demands in water scarce regions of its supply chain. This includes understanding the dependency the business and wider local stakeholders has on water in a region(s), the associated risks and mitigation actions needed in the short and long term.

iii. **Cotton and water limits** – Cotton can only be grown sustainably as long as there is water and productive land to grow cotton on. In light of competing demands this is time limited. As a result, even scaling sustainable cotton initiatives may not be enough. It may be that sustainable cotton initiatives can only provide a transitional solution as a textile raw material in the short to medium term. Given the significant social and economic implications of shifts away from cotton for cotton growing countries, a clear strategy is essential. Competing demands and greater profit margin are also expected to impact these markets shifting from fiber to food. The strategy for cotton water improvements in the short/medium term and moving "beyond cotton" to alternative raw materials needs clear, evidence based actions informed by the impacted stakeholders. These include:

- Assessment of water risk and solutions should be included in cotton sourcing decisions. This is key for regions and river basins where water risk is already high.
- Best agricultural practice from sustainable cotton initiatives should be scaled to maximise water savings, as well as land management, soil fertility and biodiversity benefits. In light of the large grey water footprint, training farmers in alternatives to conventional pesticides is a key for improving water quality. This shift, together with better soil and crop management, more efficient irrigation technologies, mulching and timing of planting, could enable cotton farmers to improve yields, livelihood and contribute to more sustainable water use.
- Low impact materials - transitioning from cotton, to the use of lower water impact alternatives in the market. These alternatives are slowly growing in apparel use, but require clarity on the best environmental options and then scaling. It is important to choose alternatives that have evidence based water benefits and this is not at the expense of creating other environmental impacts. One example is regenerated cellulosic's and cellulosic's from agricultural by products and waste streams which need to come from sustainable sources not contributing to deforestation. Recycled cotton is part of the solution, albeit for lower quality downcycled garments based on current recycling technologies.

iv. **Commitment to water stewardship benchmarks** – Technology solutions from rainwater harvesting, to low/zero water dyeing and finishing are emerging from innovative suppliers. However, outside of a few leaders, brands are not fully committed to procuring low or zero best practice solutions and suppliers in the mainstream. Including water improvements in cotton sourcing and zero/low water using dyeing and finishing is a key action needed to ensure security of water supply for brands operating in high water risk regions. Suppliers, often SMEs, can have limited finance and access to drive change. As a result, brand commitment is important to enabling suppliers to invest in best practice technology.

6.2 COLLABORATION AND AWARENESS RAISING

(i) As awareness of the scale of the water challenge in the apparel sector is still limited, **awareness raising** on the business case for action is needed in the mainstream.

(ii) The consumer role in influencing apparel water impacts is most relevant to the laundering stage. This report has highlighted many examples of campaigns to influence consumer behavior change to lower laundering impacts from brands, retailers, detergent and washing machine manufacturers, as well as NGOs. These affect not just water, but also energy and chemical impacts. The ability of consumer focused campaigns to actually shift behavior change is difficult to measure, but some improvements such as reduced washing temperature have been seen. Differences in washing behaviors across countries and cultures complicate the challenge. Supply side measures such as improvements in washing machine and detergents have been key factors in the impact reductions seen to date. The use of tertiary effluent treatment plants for public water supplies manages the water pollution generated from laundering to high standards generally in developed countries. However, this is not necessarily the case in developing countries and where the main pollution challenge remains.

(iii) **Collaboration** is key to identifying and scaling effective, local solutions. Water stewardship requires a commitment to sustainable management of shared water resources through collective action with other businesses, governments, NGOs and communities at a local water basin level. In addition, the textile sector should collaborate with the food and beverage sector on sustainable water quality management for growing food and fibers. In the short term a focus on key river basins under stress from both sectors can fast track systemic improvements. Overall for increasing collaboration existing water collaborative platforms such as WWF Water Stewardship, the CEO Water Mandate (Apparel and Food Water Action Hubs) or WEF 2030 Water Resources Group (WRG) provide an opportunity that avoids creating yet another new initiative. Further, textile specific water focused initiatives such as PACT and SWAR already provide existing multi-stakeholder collaboration platforms in specific countries. The wider apparel and textile industry collaborations such as SAC, TE, TSC and sustainable cotton initiatives Organic, BCI, CmIA and Fair-Trade can facilitate this engagement and scale by encouraging action in their members which are highly influential in the market. Existing programs to drive water stewardship provide lighthouse examples that can be learned from. These include the UN and Coca-Cola Every Drop Matters partnership or Heineken and UN program for breweries in water scarce countries and regions.

6.3 GOVERNMENT AND FINANCIAL

For policy makers, incentives for water improvements from regulation and the market to the level required are limited. Action areas include:

(i) **Regulation and enforcement** – Government environmental regulations and enforcement in emerging markets where production and the associated major environmental impacts occur are variable. Effective regulation, governance and enforcement is a key part of incentivising water improvements in textile production. For example, factory licences in developing countries often have no required limits on water and energy use or quality as they do in developed countries. They are often based on space and apparel unit capacity targets. Resource based targets would incentivise business on water, energy and chemical management.

(ii) **Water management strategies and true value water pricing** – One of the main barriers to long term water management is a lack of market pricing to reflect the true value of water. This can be introduced by legal or market measures. The price or limits of use required need to be considered locally in light of availability and water risk. Market incentives to drive enhancement of groundwater, river basin and watershed supplies are needed to maintain water supplies which still have the potential for recharge.

(iii) **Resilience to climate change and water shortages** – In government strategies for developing infrastructure solutions to water scarcity, the main focus is on ensuring the right quantity and quality of water is available now and in the future. In addition, there is a need to future proof these by building in resilience to climate change, increased flooding and drought.

(iv) **Subsidies** – In general, removing quotas and subsidies for cotton growing in water stressed regions will stop artificially reducing the cotton price and incentivising cotton growing in climates where the water impacts are increased. This needs consideration at country and region level with local stakeholders to determine specific actions and avoid unintended consequences.

(v) **Agriculture and land management policies** - The apparel sector should engage in agriculture policy development as a focus for driving sustainable agriculture practices for cotton. In addition to current engagement on environmental policy, this may provide a more scalable way to leverage improvements.

For Investors actions include:

(i) Financial Institutions can drive change through requiring key benchmarks for water management as part of their lending agreements where water is a risk. As one example, IFC Performance Standard 3 requires this for water plus other resource and pollution risks. For the industry and its investors water is recognised as an increasing constraint, risk and material for commodity price rises. As such, incorporating water performance in ESG assessments and setting water improvement benchmarks in lending agreements is expected to grow.

(ii) **Financial products** to support water source restoration and other improvements in textile producing regions with high water risk are needed.

(iii) Existing financing schemes and incubator platforms that connect investors with technology providers such as those offered by the IFC, PACT, SWAR and LAUNCH are important role models. However, given the scale of the challenge, financial sector engagement with these and other existing platforms needs to increase. Key focus areas for financial support to target are to encourage greater investment in R&D, support new ventures and scale promising technologies.

Overall, the above roadmap actions aim to reduce consumption and pollution of water resources in the textile supply chain to enable water security for business and water use to be sustainable, efficient and equitable for wider stakeholders into the long term.

7.0 REFERENCES

1 WEF, *Global Risks Report, 2014*

2 UNDP *Integrated Water Resource Mangement*

3 WEF, *Global Risks Report, 2014*

4 Orr, S and Pegram, G. 2015, *Business Strategy for Water Challenges, From Risk to Opportunity, Do Sustainability publishers, http://www.dosustainability.com/wp-content/uploads/2014/10/water-risk-map.jpg)*

5 The Fibre Year, 2014; *EuroMonitor International, 2014 Global Apparel, Footwear and Textiles Market Update; EC, 2010, Environmental Improvement Potentials of Textiles, (IMPRO-Textiles), Final Report, BIO Intelligence Services in conjunction with Ensait for IPTS, EC JRC,*

6 Allwood, J, et al, P. (2006) *Well dressed? The present and future sustainability of clothing and textiles in the United Kingdom. University of Cambridge Institute for Manufacturing.*

7 Hoekstra, A.Y., Mekonnen, M.M., Chapagain, A.K., Mathews, R.E. and Richter, B.D., 2012, *Global monthly water scarcity: blue water footprints versus blue water availability, PLoS ONE 7(2), e32688*

8 WWF, 1999, *The Impact Of Cotton On Fresh Water Resources And Ecosystems; Ferrigno, S. (2012). An insider's guide to cotton and sustainability. West Yorkshire: MCL Global.*

8a *June, 2015, Oxford Marin School, New data means cotton farmers can make a more informed choice of crop.*

9 WWF and Accenture, 2013, *Water Stewardship For Industries The Need For A Paradigm Shift In India*

10 EJF, 2012, *The True Costs of Cotton: Cotton Production and Water Insecurity, Sept. 2012*

11 Chapagain, A, Hoekstra, A et al, 2006, *The water footprint of cotton consumption: An assessment of the impact of worldwide consumption of cotton products on the water resources in the cotton producing countries, Ecological Economics, 60 (2006); Mekonnen, M.M. and Hoekstra, A.Y. (2010) The green, blue and grey water footprint of crops and derived crop products, Value of Water Research Report Series No.47, UNESCO-IHE; Mekonnen, M.M. and Hoekstra, A.Y. (2011) The green, blue and grey water footprint of crops and derived crop products, Hydrology and Earth System Sciences, 15(5): 1577-1600 all at http://waterfootprint.org/en/resources/interactive-tools/product-gallery/; Cotton Incorporated, 2012, Life Cycle Assessment of Cotton Fiber & Fabric http://cottontoday.cottoninc.com/wp-content/uploads/2014/07/LCA_Full_Report.pdf*

12 Levi Strauss & Co, 2015, *The Lifecycle of a Jean, Understanding the environmental impact of a pair of Levi's® 501® jeans*

13 The World Counts, Cotton, 2015 and Cotton Incorporated 2013/2014 market data, http://www.cottoninc.com/corporate/Market-Data/MonthlyEconomicLetter/pdfs/English-pdf-charts-and-tables/World-Cotton-Production-Exp.pdf

14 ICAC SEEP, 2010

14a TE, 2014, Organic Cotton Market Report

15 Compass, *GMO Compass*

16 Cotton Connect, 2014, *More Crop Per Drop, Water Report On The Cotton Industry*

17 Statistica, *Cotton World Statistics, accessed April 2015*

18 WRI, World Resource Institute Aquaduct, *Water Risk & Opportunities Atlas*

19 WWF, 1999, *WWF, The impact of cotton on freshwater resources and ecosystems*

20 China Water Risk, *Water Wars, accessed April 2015*

21 Allwood, J, et al, P. (2006) *Well dressed? The present and future sustainability of clothing and textiles in the United Kingdom. University of Cambridge Institute for Manufacturing.*

22 Raybin, A, 2009 *Water pollution and textiles industry.30 September, 2009*

23 Levi Strauss & Co, 2015, *The Lifecycle of a Jean, Understanding the environmental impact of a pair of Levi's® 501® jeans; European Commission, 2014 Ecodesign of Energy Using Products Preparatory Studies LOT14 Washing Machines and Dishwashers*

24 Bio Intelligence Services, 2009, *Reducing the Environmental Impact of Clothes, Cleaning, Defra, 2009*

25 European Committee of Domestic Equipment Manufacturers (CECED), 2013 *I prefer 30 degrees - Substantiation Dossier. Chesire, UK.*

26 AISE, 2015, *International Association for Soaps, Detergents and Maintenance Products*

27 Levi Strauss & Co, 2015, *Understanding the environmental impact of a pair of Levi's® 501® jeans, 2015*

28 FERA, DeMontford and Leeds Universities, 2010, *Role and Business Case for Existing and Emerging Fibres in Sustainable Clothing, FERA, a report for Defra, 2010*

29 FERA, DeMontford and Leeds Universities, 2010, *Role and Business Case for Existing and Emerging Fibres in Sustainable Clothing, FERA, a report for Defra, 2010*

30 Statistica, 2014, *Apparel Market Statistics by region*

31 McKinsey, 2014, *Fashionscope, Unleashing Fashion Growth City by City, 2014*

32 McKinsey, 2014, *Fashionscope, Unleashing Fashion Growth City by City, 2014*

33 DfID, 2013, *Responsible and Accountable Garment Sector Challenge Fund (RAGS)*
Working Together for a Responsible RMG Sector – *Lessons Learned, November 2013*

34 McKinsey, 2012, *Bangladesh's ready-made garments landscape: The challenge of growth*

35 CLSA, 2014, *Dirty Thirsty Fashion: Blindsided by China's Water Wars, China Water Risk for CLSA*

36 The World Counts, Cotton, 2015

37 OECD, 2013, *Aid for trade and value chains in textiles and apparel © OECD/WTO/IDE-JETRO 2013*

38 Pfister, S., Bayer, P., Koehler, A. and Hellweg, S. (2011), *'Projected water consumption in future global agriculture: scenarios and related impacts', Science of the Total Environment 409(20), 4206–4216.*

39 Hoekstra, A.Y., Mekonnen, M.M., Chapagain, A.K., Mathews, R.E. and Richter, B.D. (2012), *'Global monthly water scarcity: blue water footprints versus blue water availability', PLoS ONE 7(2), e32688.*

40 Pfister, S., Bayer, P., Koehler, A. and Hellweg, S. (2011), *'Projected water consumption in future global agriculture: scenarios and related impacts', Science of the Total Environment 409(20), 4206–4216.*

41 Rulli, M.C., Saviori, A. and D'Odorico, P. (2013), *'Global land and water grabbing', PNAS 110(3), 892–897*

42 European Environment Agency, Data Sets *(from Rulli, M.C., Saviori, A. and D'Odorico, P. (2013), 'Global land and water grabbing', PNAS 110(3), 892–897)*

43 McKinsey, 2011, *Resource revolution: Meeting the world's energy, materials, food, and water needs*

44 WEF, *Global Risks Report, 2014*

45 CDP, 2014, *From water risk to value creation, CDP Global Water Report 2014*

46 WEF WRG, 2009, *Charting Our Water Future*

47 Water Facts, *Water.org, accessed April 2015*

48 National Intelligence Council, 2012, *Global Trends 2030: Alternative Worlds and UNESCO UN-Water, March 2012, UN World Water Development Report #4*

49 WEF, Water Security, 2011 *The Water-Energy-Food-Climate Nexus*

50 European Environment Agency Global Trends

51 Ministry of the Environment, *People's Republic of China, State of the Environment Report, 2011*

52 India Water Tool 2, 2015, *http://www.indiawatertool.in/*

53 WRI, *3 Maps Explain India's Growing Water Risk*

54 Guardian, March 2015, *Cost of Cotton in Water Challenged India*

55 Bloomberg Business, 2014, *India's Grand 'River Linkage' Project: Agricultural Salvation or Folly?, 11 July 2014*

56 European Commission, *REACH*

57 Ministry of the Environment, *People's Republic of China, Clean Water Action Plan*

58 A. Mathews, 13 Aug. 2015, The Environmental Crisis in Your Closet, Newsweek, http://www.newsweek.com/2015/08/21/environmental-crisis-your-closet-362409.html

59 UN, 2015, Sustainable Development Goals

60 Money, A. 2012. *Managing what you measure: Corporate governance, CSR and water risk. SSRN, 19 April. Available at SSRN: http://ssrn.com/abstract=2042564*

61 Innovation Forum, 2015, *Sustainable and ethical cotton sourcing, Management briefing* How to get it right, and make it pay for your business, March 2015, *http://innovation-forum.co.uk/*

62 Forest Trends, 2014, *Status of WaterShed Investments*

63 Bloomberg, 2014, *Water risk to business is no small drip*

64 NRDC, 2015, *The textile industry leaps forward with Clean By Design: Less Environmental Impact with Bigger Profits*

65 PE International, 2014, *Life Cycle Assessment (LCA) of Organic Cotton - A global average, a report for Textile Exchange, Nov. 2014*

66 GOTs and Soil Association, 2014 *Have you Cottoned On Yet Briefing Paper- The Organic Cotton Initiative*

67 Nicolas, F and Mathews, R, *Water Footprint Network, Grey Water Footprint Indicator of Water Pollution in the Production of Organic vs. Conventional Cotton in India, C&A Foundation*

67a IISD, 2014, *State of Sustainability Initiatives (SSI) Review*

68 Soil Association and GOTS, *Have you Cottoned On Yet - The Organic Cotton Initiative Briefing Paper. TE, 2015, Organic Cotton Market Report*

69 BCI, 2013, *Better Cotton Initiative 2013 Harvest Report*

70 GreenBiz, 2011, *A Better Way to Make Cotton Better, M. Koburi*

71 Edie, 2 March 2015, *Heineken partners with UNIDO to tackle water scarcity in developing markets*

72 FERA, DeMontford and Leeds Universities, 2010, *Role and Business Case for Existing and Emerging Fibres in Sustainable Clothing, FERA, a report for Defra, 2010*

73 NRDC, Cleaner by Design, *Understanding the Three Generations of Viscose Rayon*

74 Out of fashion, accessed April 2015

75 H&M Conscious Collection

76 G Star Raw Sustainable Products

77 OECD, 2013, *Aid for trade and value chains in textiles and apparel © OECD/WTO/IDE-JETRO 2013*

78 EU, Textile industry BREF *(Best available techniques REFerence guidance*

79 Step Change Innovations, 2015, *Science znd Technology Waterless Dyeing*

80 Xeros the future, accessed April 2015

81 BITC, 2015, *Water: securing the resources for future prosperity*

82 Cotton Connect, 2014, *More Crop Per Drop, Water Report On The Cotton Industry*

83 Orr, S and Pegram, G. 2015, *Business Strategy for Water Challenges, From Risk to Opportunity, Do Sustainability publishers, http://www.dosustainability.com/wp-content/uploads/2014/10/water-risk-map.jpg)*

84 UNDP Integrated Water Resource Management

85 AWS International Water Stewardship Standard, 2014

86 Kingfisher Group plc, Net Positive, *http://www.kingfisher.com/netpositive/index.asp?pageid=1*

87 Hoekstra et al, 2007, *Globalisation of Water Sharing the Planet's Freshwater Resources, ISBN 1405163356, Arjen Y., Hoekstra , Ashok K. Chapagain, 2007*

88 Edie, Heinekin partnership in African supply chain

89 Murray, S.J., Foster, P.N. and Prentice, I.C. (2012), *'Future global water resources with respect to climate change and water withdrawals as estimated by a dynamic global vegetation model', Journal of Hydrology 448–449, 14–29*

90 IFC, 2012, *Environmental and Social Performance Standards and Guidance Notes*

91 KPMG, 2012, *Expect the Unexpected: Building business value in a changing world*