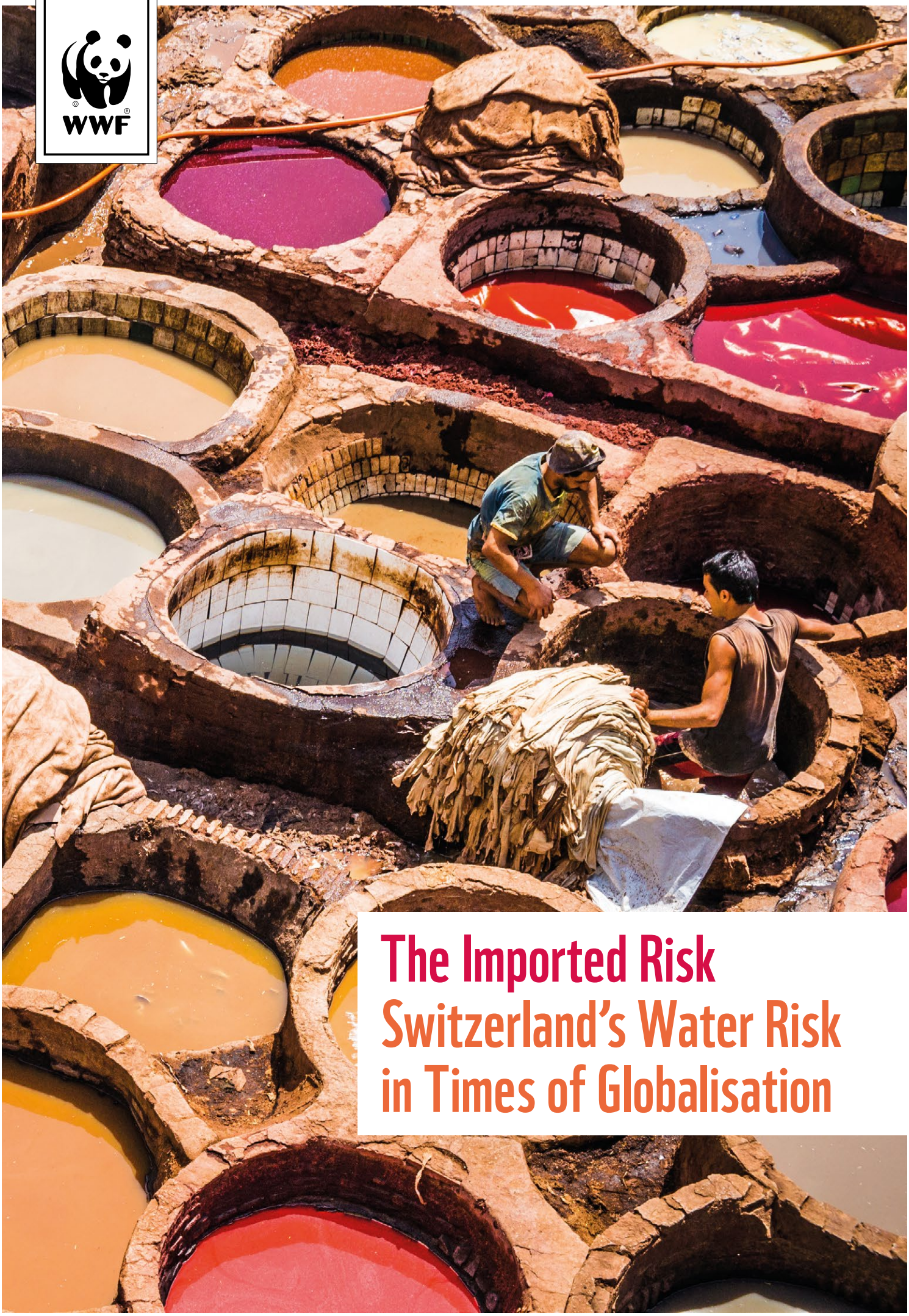

The Imported Risk
Switzerland's Water Risk in Times of Globalisation

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Foreword

More than 1500 lakes, rivers, and bodies of water provide Switzerland with an abundance of water. Our country is called the water castle of Europe. In spite of this fact, Switzerland is not insulated from water problems – not only in the future due to climate change, but even today. Why? As part of a globalized economy, Switzerland imports roughly 50 million tonnes of goods valued at CHF 250 billion from abroad. Many of these goods originate from regions with "stressed" water conditions. These regions are increasingly dealing with water shortage or water pollution. Such unsustainable water use results in considerable risks for people and nature: the fragile balance of water cycles is disrupted, and the function of freshwater ecosystems is increasingly at risk.

The consequences of water risks do not only impact far-off lands. The production processes for many sectors of the Swiss economy directly or indirectly depend on water from abroad, which can have a negative impact on their business performance. As an example: each year, Switzerland imports 126,000 tonnes of rice valued at CHF 90 million. A portion of this originates from India – a country affected by water-logging due to large-scale irrigation schemes, diminishing groundwater levels, and ground salination. Moreover, India shares watershed regions with Pakistan, Bangladesh, and Nepal, thus creating a major potential for conflict. Additional uncertainties are brought about by climate change, which is changing precipitation and temperature patterns. The effect on Swiss businesses could come in the form of more volatile prices or potential interruptions in resource availability. This report shows how water risks affect Switzerland's access to agricultural products, textiles, gold, crude oil, and other raw materials.

Switzerland has an inherent interest in building awareness for and in containing its water risks both for economic as well as ecological reasons. Businesses, investors, the government, and consumers are required to do their part. There are a number of ways to reduce water risks, for instance by optimizing water management practices, improving water efficiency, or reducing water pollution. The water stewardship approach expands these options by central aspects, in particular by fostering strategic collaboration between various stakeholders in a watershed. It is a worthwhile effort. The sustainable use of natural resources is an opportunity for people and nature but requires rigorous action.

Thomas Vellacott, CEO WWF Switzerland

Contents

Country Cases

Executive Summary

Compared to other countries, Switzerland has a fortunate water situation characterised by sufficient availability, good quality, and good governance. However, Switzerland's economy heavily depends on trade. The majority of imported goods originate in locations with water scarcity, deteriorating water quality, weak governance and regulatory challenges, poor infrastructure, vulnerable communities, or fragile ecosystems. Switzerland thus indirectly contributes to falling water tables or water pollution in these countries and inversely, water related issues in these countries affect the Swiss economy.

Water risks can be physical, regulatory, and reputational. They can relate to conditions linked to a specific location (basin-related) that can only be influenced through collective actions, or to a company's operations and be directly influenced by individual companies. Companies must understand their water risks and strive to sustainably mitigate them in order to ensure their long-term success. In order to arrive at a sustainable outcome, it is imperative that all sectors – business, government, investors, and civil society – collaborate.

Key findings

Six sectors – extractives, chemical, agriculture, textiles & apparel, financial services and retail – were identified and analysed based on their import volumes and relevance for the Swiss economy. Some of Switzerland's highest import countries with high water risk in at least one economic sector are:

- Extractives – Nigeria, Peru
- Chemicals – China
- Agriculture – Brazil, India
- Textiles & Apparel – Bangladesh

Though each sector is exposed to water risks, the risks differ by type, intensity, and the stage at which they arise in the value chain. Water quality does not affect oil extraction operations, however reputational risks arising from spills may lead end-consumers to boycott oil companies. The mining sector is hugely dependent on water resources and thus faces physical as well as regulatory and reputational risks at the extraction stage when conflicts over water use can lead to social unrest. The chemical industry, a major industrial water user, faces the greatest risk (in countries with lax regulation) during the processing stage due to pollution or in connection with the sourcing of raw materials. Agriculture is by far the world's greatest water consumer and is vulnerable to climate change-induced physical risks. Rapid agricultural expansion has led to rainforest destruction in large parts of the world, which has affected the water regime of entire regions. Within the textiles and apparel sector's value chain, cotton production is the most water-intense segment and is vulnerable to physical water risks. Textile processing is polluting water resources in countries with a weak regulatory environment and posing a reputational and potentially regulatory risk. The water risks for the retail and financial services sectors are to a large extent indirect since they are mostly connected to suppliers and investments.

Water Stewardship

Many risks only emerge because various stakeholders use the same water source. Thus, the root cause of water risk is often not the availability or use of water, but governance. Water stewardship is an opportunity for companies to contribute to the responsible and sustainable management of freshwater resources in a river basin. This step-by-step approach enables companies to create internal water awareness, analyse their water risks, and reduce these through internal and external measures. A company can rarely reduce all of the water risks it shares with water users in the same basin or other companies along its supply chain on their own. Water stewardship activities aim to drive companies towards collective action with other water users, public authorities, or civil societies in a given river basin.

Companies focused on reducing their risks by improving the local situation will have a competitive advantage. They will be able to stabilise their production volumes and quality by investing in long-term customer relations and trusted local partnerships. An increase in public awareness of the environmental impacts of production processes is accompanied by growing expectations for governments and companies to develop sustainable management strategies and equitably share water resources. In order to reach a sustainable outcome, it is imperative that all sectors – business, investors, government, and civil society – collaborate.

Call to Action

Companies – be water conscious!
Ultimately, companies bear the consequences of water-related risks. However, it is in their power to mitigate these risks in their direct operations or by defining standards within their supply chains. Internal actions that Swiss companies can take to become model water stewards include identifying risks, impacts, and responsibilities related to water, developing and implementing company-specific water stewardship strategies, and applying available sector-specific solutions. Externally, companies can engage in collective action for sustainable water management, drive transparency, and disclose their actions.

Investors– don't turn a blind eye to risky clients!
The financial services sector is very diverse and adequate responses to dealing with risk analysis and mitigation still have to be developed in many branches. Some strategies investors can take include developing internal standards and policies for decision-making processes regarding water risk, systematically assessing investments, clients, transactions, and portfolios for water-related risks, developing sector-specific sustainable strategies to reduce water risks, excluding clients that do not appropriately address and manage water-related risks, and proactively supporting companies that are seeking to reduce water-related risks.

Government – initiate and collaborate!
The Swiss government has a responsibility to mitigate water risks, in particular in countries from which Switzerland imports its goods. The Swiss government can become a model water steward by introducing water stewardship targets into the strategies of relevant Federal Offices, developing mandatory sustainable water criteria for sourcing in countries with high water-related risks, and ensuring the inclusion of all relevant stakeholders of the economy, civil society (including indigenous people), and NGOs in the implementation of basin management plans. Furthermore, the Swiss government should ensure that it delivers on its international commitment to the Sustainable Development Goals and as a Party to the UN Convention on Biological Diversity (CBD).

Consumers – demand better!
Consumers have the power to wield change by demanding sustainable choices from companies. By informing themselves about the origin of products and their associated water issues and supporting government and company action on water stewardship, they are in a position to push companies to work with responsible suppliers, to invest in sustainable solutions, and to take water resources seriously.

1 Global Water Challenges

Freshwater and freshwater ecosystems are key for life on earth, both for nature and humans. Freshwater ecosystems have a higher concentration of species relative to their area than either land or sea (Millennium Ecosystem Assessment, 2005). Clean, abundant water is fundamental to maintaining human well-being: for drinking, sanitation, agriculture, transport, electricity generation, recreation, and many religious ceremonies.

At the same time, almost every human activity impacts freshwater: through the direct use of surface and groundwater for irrigation, industry, or domestic use; through the use of rain water for agriculture before it reaches our lakes, rivers, and wetlands; through changes to freshwater's biological, chemical, and physical quality resulting from human activity; and through the habitat fragmentation as a result of dams and canals built for flood control, irrigation, transportation, or energy.

People already use 54 % of the planet's blue water (see Water Footprint vs. Water Stewardship below). Estimates suggest that this may increase to 70 % by 2025 (Postel et al., 1996). In addition, freshwater is unevenly distributed across the planet. Approximately 2.3 billion people currently live in river basins, which are under water stress (Revenga et al., 2000). The Food and Agriculture Organization (FAO) estimates that by 2025, two-thirds of the world population will live in water-stressed areas[1]. Climate change is expected to complicate the issue and lead to new stresses with increases in the frequency and severity of both droughts and floods (IPCC, 2014).

Whilst the direct impacts of water use are local or regional, the drivers are often global as products and services are traded internationally

Notably, agricultural production accounts for 92 % of humanity's global water footprint, with 78 % of world crop production relying on rainfall. In developing countries, an estimated 90 % of wastewater is discharged directly into rivers and streams without treatment (Millennium Ecosystem Assessment, 2005). Much of this wastewater is generated in the production process of goods exported to Europe.

These developments heavily impact not only human well-being, but also nature. WWF's Freshwater Living Planet Index (which tracks changes in populations of 714 species of fish, birds, mammals, reptiles, and amphibians found in temperate and tropical lakes, rivers, and wetlands) showed populations of freshwater species fell by 37 % between 1970 and 2010 – a larger decline than in marine and land ecosystems. In tropical regions, the decline was 76 % – the largest fall of any of the biome-based indices (WWF, 2014).

Increasingly, the economic sector is affected by these negative trends. The 2016 edition of the World Economic Forum's Global Risks Report rated water as the number one risk for the next ten years in terms of potential impact on society. Water's critical role in economic growth and development – be it related to primary resource production (e.g., food systems), energy security, or manufacturing – is increasingly acknowledged by all levels of society. The United Nations Sustainable Development Goals[2] have also identified water and its importance for and impact on humans as one of its key focal areas.

1 http://www.fao.org/nr/water/topics_scarcity.html
2 http://www.un.org/sustainabledevelopment/water-and-sanitation/

2 Switzerland's Water Risk

Switzerland has a very fortunate water situation. In comparison with other countries, sufficient water availability, good waterquality, a strong regulatory framework and governmental enforcement, as well as past and future investments in water structures reduces the water risks for production of Swiss goods and services.

Within Switzerland's top 10 trading partners are China and India, countries facing serious water issues

However, Switzerland's economy heavily depends on trade. In 2015, Switzerland imported 52 million tonnes of goods with a value of 244 billion CHF[3] – these included extractives (fuels and precious metals), chemicals, agricultural products, and raw materials. The majority of these goods originate in locations with water scarcity, deteriorating water quality, weak governance and regulatory challenges, poor infrastructure, vulnerable communities, or fragile ecosystems. Within Switzerland's top 10 trading partners are China and India, countries facing serious water issues[4]. Switzerland thus contributes to falling water tables or water pollution including its negative impacts on human well-being and nature in these countries. In turn, serious water-related issues and challenges in these countries inherently affect the Swiss economy.

Most sectors depend on water resources for production. Thus, a company's performance often directly and indirectly depends on water availability. Water risks can jeopardize a company's production ability and, depending on likelihood and severity, these risks will have financial implications. A company that has a factory in or that sources materials from a poorly managed river basin may find itself facing a range of water-related risks like absolute water scarcity, increased water cost or regulation, or reputational damage caused by the real or perceived water-related impacts of its operations on communities and habitats (WWF, 2009). The 2015 Water Disclosure Report reveals that 50 % of Swiss companies (that replied) already experienced detrimental water-related business impacts in the reporting year[5].

The water risks that the Swiss economy in general and Swiss companies in particular are exposed to are threefold – physical risks, regulatory risks, and reputational risks (see table 1). They can be basin-related or company-related. For the former, the risks relate to conditions linked to a specific location and can only be influenced through collective actions; whereas for the latter, they can be directly influenced by individual companies.

For these reasons, companies must understand their water risks and strive to sustainably mitigate them. Simply avoiding problems and risks related to water will not pay off for companies in the long-run. Companies focused on reducing their risks by improving the local situation (i. e. sustainable management of shared water resources, true collective action with local stakeholders, etc.) will have a competitive advantage over others. They will be able to secure their investments in the long term, optimize their

3 Swiss Impex, accessed on April 2016
4 http://www.bfs.admin.ch/bfs/portal/de/index/themen/06/05/blank/key/handelsbilanz.html
5 http://www.cdp.net

Physical risks	**Basin**	Water quantity (availability, scarcity, flooding, droughts), quality (pollution) and ecosystem health (ecosystem vulnerability, biodiversity) within a river basin and the impacts this might have on companies, society, and the environment.
	Company	Water quantity and quality issues related to a company's performance and its supply chain.
Regulatory risks	**Basin**	Strength and enforcement of water regulations and the consequences of restrictions by public institutions. Potential for conflict or political disagreement over trans-boundary river basins or national political imperatives, such as trade restrictions on food crops with high water footprints.
	Company	The potential changes in pricing of water supply and wastewater discharge, water rights, quality standards, and license to operate for a particular company or sector. Particularly possible in times of crisis (induced by physical risk) when regulatory regimes are changed unpredictably or incoherently, or they are inconsistently applied due to political expedience or lack of integrity.
Reputational risks	**Basin**	Perceptions around water use, pollution, and behaviour that may have negative impacts on the company brand and influence purchasing decisions. Public perceptions can emerge rapidly when local aquatic systems and community access to water are affected.
	Company	When the actions of the company are poorly executed, understood, or communicated to local stakeholders and when perceptions and brand suffer as a consequence.

***Table 1** – A general overview of water-related risks for companies*

Companies focused on reducing their risks by improving the local situation will be able to secure their investments in the long term and strengthen their public image and reputation

specific risk reduction strategies, and strengthen their public image and reputation. Long-term customer relations, increased trust, and continuous effects – such as stable production volumes and quality – will be direct benefits for these companies.

Public awareness of the environmental impacts of production processes is increasing, and expectations of governments and companies to develop sustainable management strategies and equitably share water resources are growing. In order to arrive at a sustainable outcome, it is imperative that all sectors – business, government, and civil society – collaborate. Due to its international trade and supply chains, the private sector plays a vital role in this context and needs to be actively engaged in current and future discussions – not only due to self-interest in ensuring future production, but also because of the sector's responsibility as a major economic player.

In the following sections, Switzerland's water risk for its most important import sectors is analyzed and illustrated with specific case studies. Possible pathways are described to mitigate these risks. Finally, there is a call to action for the various stakeholders: companies, governments, investors, and consumers.

Water Footprint vs. Water Stewardship

Each company has a so-called "water footprint", which is the total amount of water used when producing a good related to direct operations or supply chains. It takes into account the volumes of water consumed and polluted during different steps of the supply chain. A distinction is made between (WWF-Switzerland, 2012):

- **Blue water footprint:** volume of surface and groundwater used as a result of the production of a good or service.
- **Green water footprint**: volume of rainwater used during the production process.
- **Grey water footprint:** an indicator of freshwater pollution that can be associated with the production of a product over its entire supply chain.
- **Direct water use**: refers to the volume of freshwater consumed by a consumer for concrete activities (e.g. cooking or washing) or by a business within a local production process. Indirect water use refers to the volume of freshwater that is embedded in goods that were produced and imported from different regions, such as food, paper, cotton clothes, or in the case of businesses, products from earlier stages of the supply chain.

The difference between water footprint and water risk is important because the amount of water used does not necessarily indicate high risk. For example, risk may evolve even if a company is using a small amount of water but is located in an area with a highly unreliable water supply, or is located in an area where water is plentiful but risk remains high because of poor governance. If a company is focused on reducing its footprint without looking at risk, it may succeed in becoming more efficient but fail to reduce its risk.

3 Methodology

This report is based on an analysis of the 2015 import statistics published by Swiss-Impex on the 30th of April 2016[6] as well as calculations done with the Water Risk Filter[7]. Throughout the report, authors used the exchange rates from January 1, 2016 to convert all financial figures to Swiss Francs.

Calculations of the most important import sectors

Data from Swiss-Impex were allocated to the 34 different industries from the water risk filter. The four most important sectors, as defined by import volume (kg), were then chosen. In order of importance, these were extractives (mining and fossil fuel), chemicals, forestry and paper, and agriculture. The agriculture data was then segregated into 120 different commodities and the eleven most important commodities were identified. Though, textile and apparel was not among Switzerland's top four import sectors, it was still included in the report due to its extremely high impact on important watersheds. For each sector and agriculture commodity, the most important sourcing countries were then identified. As the top ten importing countries in the forestry and paper sectors are all within Europe and thus have a low over all water risk, this sector was ultimately not included in the report. However, as part of the sector – in particular pulp and paper – presents a high water risk, a box was included on this specific aspect (see 5 Chemicals, page 38). Retail and Finances were also included due to their impor-tance in the Swiss economy.

Calculations of the water risk

For every country and commodity combination, the water risk was calculated using the WWF Water Risk Filter, i.e. the tool's basin related water risk assessment. Results were further aggregated to the country level to obtain minimum, maximum, and area averaged[8] overall water risk scores per country. The WWF Water Risk Filter assesses a basin's and facility's or commodity's physical, regulatory, and reputational water risks using a set of 87 different indicators (see The Water Risk Filter Tool below). Risk scores varied between 1 (no/low risk) and 5 (very high risk)[9]. If the risk scores varied across a country, the maximum value was used to define the category.

6 http://www.swiss-impex.admin.ch

7 http://waterriskfilter.panda.org/

8 The WWF Water Risk Filter methodology uses weighted averages to aggregate risk indicators to an overall water risk score (i.e. every indicator and risk types have an individual weight). In a standard Water Risk Filter assessment, the data resolution is at the sub-basin level (area). For this report, the country level water risk was summarized using the area risk levels multiplied by the percentage of the areas as part of the whole country (i.e. area weighted average). In addition to the area weighted average, minimum and maximum risk levels within a country were calculated. In particular for large countries, risk levels are expected to vary dramatically since water issues are often local issues. The minimum, area weighted average, and maximum water risk is used to provide an indication of the risk distribution within a country.

9 Categories: Low Risk = 1 – 2.249; Medium Risk = 2.25 – 3.49; High Risk = 3.5 – 5

Methodological limitations

For all sectors presented, top import countries may include countries that are not the origin of the respective good or commodity. In these cases, a country imports goods and then re-exports them without further processing. For example, Germany is a major re-exporter to Switzerland, as is the case in the textiles and apparel, extractives, agriculture, and chemical sectors.

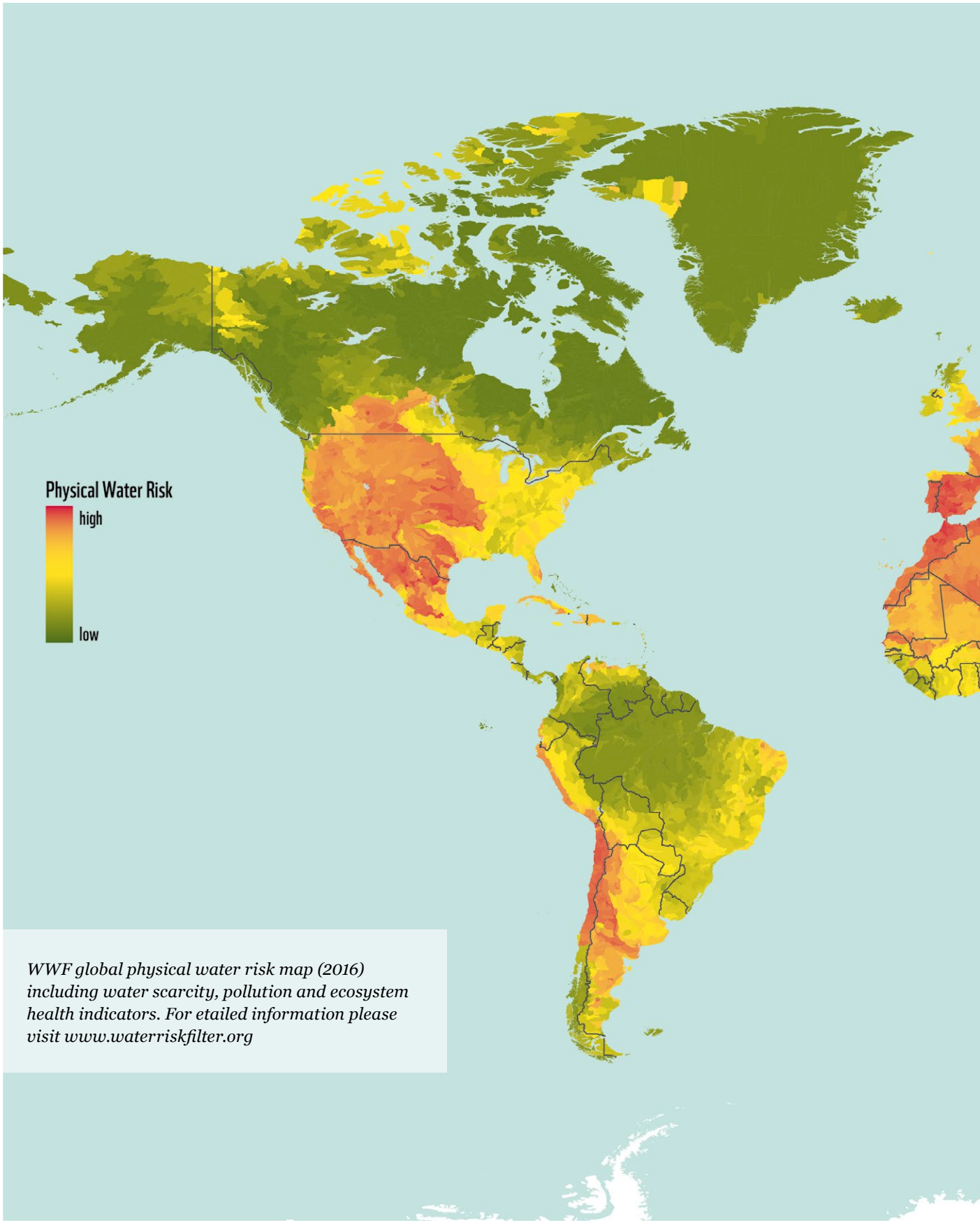
The possibility exists that particular risk scores for particular country / commodity combinations are overestimated since the maximum risk value was used in instances of variable score results.

The Water Risk Filter Tool

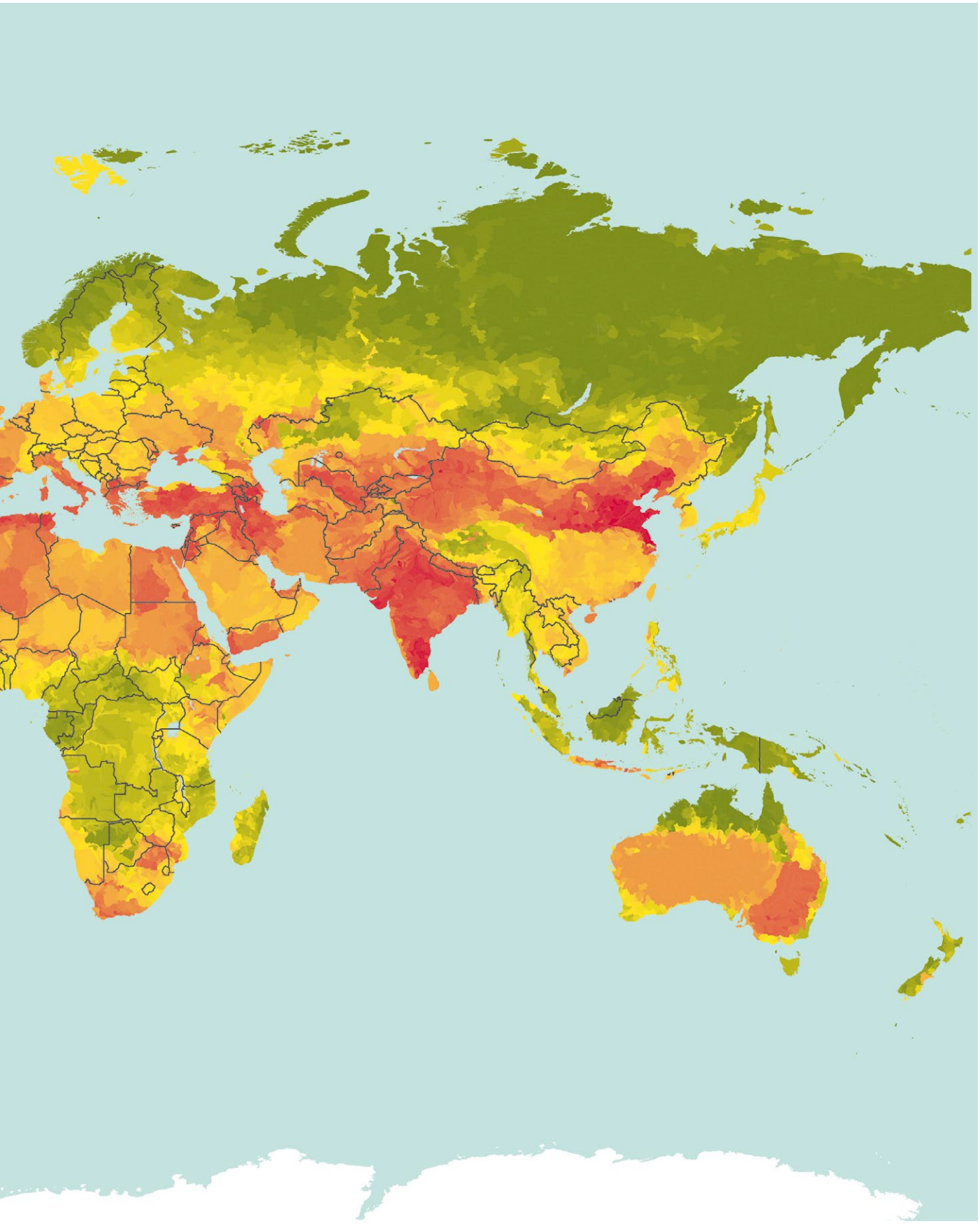
WWF/DEG's Water Risk Filter is a free online tool and platform to help assess business' water risk based on indicators of a facility's surrounding (basin related risk) as well as operational aspects (company related risk). It empowers companies and investors to make informed decisions in order to avoid any negative impacts to the company, surrounding communities, and other water users. The results can inform internal water management processes and help develop location specific water risk mitigation measures. This is done by guiding the user from the assessment through to the tool's mitigation toolbox, case studies, and country water profiles. The assessment consists of a local evaluation based on global datasets for the basin related risk and of a questionnaire addressing one's operational water risk at the facility level (i.e. the company related risk).

In a world of growing disclosure demand, this tool not only raises awareness of relevant water issues, but also helps the user to identify risk hotspots as a starting point for developing further steps to become a good water steward.

www.waterriskfilter.org



WWF global physical water risk map (2016) including water scarcity, pollution and ecosystem health indicators. For etailed information please visit www.waterriskfilter.org



4 Extractives – “Black and Gold”

Oil and extractives are vital to many industries and civilization as a whole. In 2014, the world consumed approximately 4.2 billion tons of oil (BP, 2015). The trade in fuels and mining products made up 20.5 % of total world trade in merchandise in 2014 (WTO, 2015). Altogether, petroleum production, distribution, refining, and retailing represents the world’s largest industry in terms of dollar value. For certain commodities such as crude oil, Switzerland is the world’s largest marketplace: One-third of globally traded crude oil is bought and sold in Geneva, including up to 25 % of oil from state-owned African companies (EDA, EFD and WBF, 2013; Swiss Academies of Arts and Sciences, 2016).

In 2015, Switzerland imported more than CHF 8.5 billion worth of mineral fuels and oils[10]. Switzerland mainly imports its oil and fuel from Germany, France, the Netherlands, Nigeria and Italy (see Annex I). Of the 2.9 million tonnes of crude oil imported in 2015, almost 40 % came from Nigeria[11] (see Table 2).

	Import Quantity (kg)	Import Value (CHF)	Percentage of Import Quantity	Physical Risk	Regulatory Risk	Reputational Risk
Nigeria	1,143,015,000	456,694,213	39 %	●	●	●
Mexico	510,490,000	203,822,607	17 %	●	●	●
USA	355,069,000	134,585,458	12 %	●	●	●
Kazakhstan	247,251,385	104,982,863	8 %	●	●	●
Libya	175,789,723	81,200,819	6 %	●	●	●

***Table 2** – Top five countries from which Switzerland imports crude oil and their water risk (based on import quantity)*

10 Swiss Impex, accessed on April 2016, tariff heading 27 – mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes

11 Swiss Impex, accessed on April 2016, tariff heading 2709 – Petroleum oils and oils obtained from bituminous minerals, crude

Switzerland refines about 70 % of the world’s gold

Gold has had cultural significance for thousands of years and until today continues to be the foundation of our monetary systems (Millar, 2006). On average, Switzerland refines about 70 % of the world’s gold; four of the world’s six largest gold refineries are located in Switzerland (Popescu, 2014)[12]. In 2015, Switzerland imported over 2,500 metric tons of raw gold and re-exported 1,920 metric tons of gold[13]. For the role of Switzerland’s main gold importer, the United Kingdom, see Methodological limitations; otherwise, Switzerland mainly relies on South America, USA, Europe, and Asia for its gold imports (see Table 3).

	Import Quantity (kg)	Import Value (CHF)	Percentage of Import Quantity	Physical Risk	Regulatory Risk	Reputational Risk
United Kingdom	668,797	23,890,344,991	26 %	●	●	●
Argentina	388,461	1,133,686,077	15 %	●	●	●
USA	212,686	6,835,943,248	8 %	●	●	●
Peru	147,358	2,798,283,825	6 %	●	●	●
Chile	147,183	480,658,573	6 %	●	●	●
Turkey	122,489	4,485,845,720	5 %	●	●	●
Germany	77,467	2,324,798,891	3 %	●	●	●
Emirates, Arab	76,997	2,822,881,096	3 %	●	●	●
Italy	61,465	2,129,037,613	2 %	●	●	●
Uzbekistan	49,999	1,797,918,841	2 %	●	●	●

Table 3 *– Top ten countries from which Switzerland imports gold and their water risk (based on import value)*

12 http://www.swissinfo.ch/eng/precious-goods_switzerland--the-world-s-gold-hub/33706126

13 Swiss Impex, accessed on April 2016, tariff heading 7108 – Gold, incl. gold plated with platinum, unwrought or not further worked than semi-manufactured or in powder form

Sector water risk and water intensity

Mining and oil exploration operations cannot be relocated since they are dependent on the specific location of the ore or oil. This makes the sector susceptible to changing local water availability and quality and to community concerns about water use (UNEP FI, 2012).

Mining operations often take place in areas where water is already scarce and quality is already under pressure

The extractives industry has had a significant impact on ecosystems in which they operate (see Table 4). Extractive operations use and often degrade the quality of substantial quantities of water. The fact that mining operations often take place in areas where water is already scarce and quality is already under pressure only exacerbates these problems further (Miranda et al., 2010). Over the last decade, water use has emerged as one of the most important considerations in environmental impact assessments of proposed mining activities (UNEP FI, 2012).

Oil	Oil explorations use large amounts of water for well drilling, site development, and fracturing. Water contamination is a significant risk when oil operations intersect with drinking water supplies, or is transported via long pipelines, which are difficult to monitor, in the case of uncontrolled spills or wastewater discharge or through unconventional forms of extraction, like oil sands. Pumping oil out of the ground produces large volumes of low-quality water known as “produced water.” The movement and disposal of this heavily polluted water is part of the debate on the environmental impact of oil extraction. Oil refineries are often situated near navigable rivers, lakes, or seaports for transport reasons. Low water levels increase costs for shipping oil.
Ore mining	Many mining operations extract ore from below the water table, which can affect local hydrology and ecosystems. Acid runoff affects water quality by reducing pH levels and increasing concentrations of toxic or heavy metals like copper, lead, and mercury in mine drainage water (acid mine drainage). Cyanide spills can severely affect freshwater resources. Liquid mercury used in artisanal mining poses a serious threat to water quality in some parts of the world. Closed mines can pose long-term environmental liabilities as they must be pumped and treated indefinitely to prevent contamination of surface and ground water.

***Table 4** – Extractives sector impacts on water (UNEP FI, 2012)[14,15]*

14 http://www.miningfacts.org/Environment/What-are-the-water-quality-concerns-at-mines-/
15 https://www.earthworksaction.org/issues/detail/acid_mine_drainage#.VwzLMqThDIU

Extractive industries are often considered strategic national industries with privileged access to government. However, the industry’s negative impacts on local water resources can create conflicts and therefore increase pressure on water rights and prices and on the license to operate. Large-scale oil spills, such as the 2010 Deepwater Horizon accident in the Gulf of Mexico, harm the global oil industry’s image and have forced the industry to reconsider its security and environmental policies. In Peru and Argentina, public opposition due to anticipated impacts on local water resources has led to forestalling gold mining operations (CERES, 2010). This adds to the already tainted reputation of mining activities that are often associated with corruption or with financing armed conflict in some parts of the world (“conflict minerals”) (EDA, EFD and WBF, 2013)[16]. See Table 5 for a general overview of water-related risks facing the extractives sector.

Extractives water facts

- Depending on the maturity of the oil field, between 1–40 litres of water are needed to extract one litre of oil (Schauwecker, 2009).
- It takes an average of 716 cubic metres of water to produce one tonne of gold (Miranda et al. 2010).
- Costs for treating water polluted by acid mine drainage in South Africa are estimated at up to CHF 992.48 million (US$1 billion)[17].
- A recent estimate puts outstanding cleanup liabilities for abandoned coal-mines in the USA at CHF 3.57 billion (U$3.6 billion) (Sanzillo & Schlissel, 2016).
- CHF 7.6 billion (US$7.7 billion) was the estimated total annual spent on water-related infrastructure serving the mining industry in 2011 (Toledano & Roorda, 2014).

16 http://www.sourceintelligence.com/what-are-conflict-minerals/
17 http://www.moneyweb.co.za/archive/sa-needs-1bn-to-make-toxic-mine-water-potable/

Physical risks	**Basin**	Freshwater availability (quantity) under pressure due to increasing demand from other basin users – e.g. in remote areas where agriculture can only develop with irrigation. Other basin users may pollute freshwater sources (quality). Increasing air and water temperatures imply increasing amount of water needed for cooling and operation, while evaporation of water sources is increasing.
	Company	High reliance on large freshwater volumes. Mining and drilling cannot be relocated in case of water scarcity. • Mining and drilling is often in remote areas (including ocean platforms) with limited access to freshwater. • Groundwater sources may be depleted if recharge is insufficient. • Intensive desalination results in pollution. • Oil sands are especially water-intensive. Disruption of operations due to extreme weather events like severe rainfall or flooding due to climate change.
Regulatory risks	**Basin**	Large multinationals are often easy targets for (local) governments. • Local companies often favoured over large multinationals for e.g. taxes and regulation. No/limited regulation or no/limited enforcement by local governments can impact water quantity and quality. If operating in a multi-national basin, differences in regulations and enforcement per country can have greater impact on water quantity and quality downstream.
	Company	Governments increasingly responsive to community demands to reject new mining/ oil projects. Increasing competition with other water users in the basin may lead to withdrawal of water rights. Stricter regulation and increased enforcement by governments may increase cost for freshwater and wastewater treatment and discharge. • Lawmakers may force companies to use innovative production technologies to reduce impact on water. • Significant impact on potential price considering the required volumes.
Reputational risks	**Basin**	Reputational risk, especially for large multinationals, is high in case of local water scarcity or wastewater pollution in the basin that the company operates in. This is even the case if the company follows best practice in water use and sewage and water rights have been purchased properly. End-user (consumer) pressure not to buy raw ore/oil from mines and wells in troubled basins.
	Company	Oil spills have a highly negative impact on reputation. Stakeholders (governments, communities, NGOs, and companies looking at their own supply chain footprint) increasingly concerned with the high amount of toxic wastewater and mine drainage that may have negative impacts on water resources and surrounding ecosystems. Potential depletion of the freshwater source, which may impact all stakeholders in the basin. Reputational damage can directly impact sales of oil companies since they are often vertically integrated and sell directly to end-users. Direct reputational damage is limited for the mining industry, as most companies do not sell directly to end-users.

***Table 5** – A general overview of water-related risks for the extractives sector*

Country case: Crude oil from Nigeria

Share of global production (BP, 2015)	2.7 %
Share of imports to Switzerland[18]	39.0 %

Nigeria is Africa’s largest oil producer and its economy relies heavily on oil and gas extraction. The oil and gas sector accounts for around 35 % of its gross domestic product, and petroleum export revenues represent over 90 % of total export revenues[19]. Between 2011 and 2013, Swiss trading companies bought CHF 36.7 billion (US$37 billion) worth of crude oil from the Nigerian government and national oil companies, an amount equal to more than 18 % of the Nigerian government’s revenues (Gillies et al., 2014).

Water situation

Nigeria’s total annual renewable water resources are estimated at 286.2 km^3. Exploitable surface water resources are around 96 km^3/year and annual extractable groundwater resources are about 59.51 km^3. Agriculture was the biggest water user in 2000 with 5.5 km^3, or 69 % of the total water withdrawn[20].

Considered one of the most important wetland and marine ecosystems in the world, the Niger Delta is the largest wetland in Africa

Some parts of Nigeria are seeing water stress due to unsustainable management of water resources. For example, the Hadejia Nguru Wetlands in the northeast of the country have been diminished by more than half due to drought and upstream dams. Expansion of irrigated crop production has led to a lowering of the water table in some areas[21]. It has been predicted that in the next 25 years, water will become the main source of trans-boundary conflict as Nigeria shares its main surface water resources (the Niger and Benue rivers) with Niger, Benin, and Cameroon (and indirectly with Mali and Guinea) (Gusikit & Lar, 2014).

The vast majority of Nigeria’s oil and gas reserves are located in the Niger Delta and on the country’s continental shelf. The Niger Delta consists of diverse ecosystems of mangrove swamps, fresh water swamps, and rain forest. Considered one of the most important wetland and marine ecosystems in the world, it is the largest wetland in Africa and harbours a high concentration of biodiversity (UNDP, 2012).

Oil extraction in the Niger Delta has been going on since the 1950s and has adversely affected the livelihood and health of the region’s inhabitants (Linden & Palsson, 2013). Pollution from produced water, oil spills and pipeline leaks have contaminated streams and rivers, destroyed forests and led to biodiversity loss; the area has been labelled an “ecological wasteland” (Ite et al., 2013; Ogwu et al., 2015).

18 Swiss Impex, accessed on April 2016
19 http://www.opec.org/opec_web/en/about_us/167.htm
20 Water Risk Filter: Nigeria
21 ibid

The pollution of the Niger delta jeopardizes the livelihoods of over 30 million people

The pollution of the Niger delta jeopardizes the livelihoods of over 30 million people[22]. Studies have shown that at least 9–13 million barrels of oil were spilled since the oil industry’s inception in the Niger delta (Ogwu et al., 2015). Oil has penetrated soils down to several metres and has contaminated ground water over large areas. One study found up to 7.4 mg/l of oil in stream and creek water and up to 42.20 mg/l of petroleum hydrocarbons in drinking water wells, which is about 14,000 times Nigeria’s standard for drinking water. Even if the pollution were to stop, the recovery of the affected mangroves and wetlands could be a matter of decades (Linden & Palsson, 2013). Pollution of the ocean, water resources, and soils is threatening the livelihoods of the local population, has reduced fish populations, and has caused social upheaval and significant migration to the cities (Ogwu et al., 2015; Ite et al., 2013; Boele et al., 2001).

Physical risk

Since oil production does not depend on unpolluted water resources, the Nigerian oil industry’s risks arising from water pollution are indirect. Environmental pollution by produced water effluents, oil spills, and pipeline leakages will have direct financial implications for oil companies if they have to assume their environmental costs[23] (see regulatory risks below).

Regulatory risk

A number of oil-related environmental laws are in place in Nigeria (Owolabi et al., 2014). However, oil companies do not fully observe them and seemingly violate them with impunity. The regulatory environment in Nigeria is uncertain; there have been repeated cases of irregularities in the handling of oil revenues, and an oil company has been heavily criticized for close ties to government security forces (e.g. Allen, 2012; Cohen & Ibukun, 2015; Klasa, 2014; Al Jazeera, 2015)[24]. In 2010, it became known that Shell had apparently inserted staff in all of Nigeria’s governmental ministries (Smith, 2010; Amies, 2010). Given the importance of oil for Nigeria’s economy, regulatory risks from the Nigerian authorities can be expected to be limited for the time being.

In December 2015 however, a Dutch court ruled that Shell can be held liable for oil spills in the Niger delta (Aljazeera, 2015). In a separate incident that same year, Shell agreed to a CHF 80.8 million (£55 million) payout to individuals and a community affected by oil spills in order to avoid a London High Court case (Vidal, 2015). In 2011, Shell had already assumed responsibility for two oil spills in Ogoniland after a class action suit in London, facing a bill of hundreds of millions of US dollars (Vidal, 2011). These cases could represent landmark precedents for legal action against parent companies operating in countries with weak regulatory environments.

Incidents such as these and the UN’s Environmental Assessment of Ogoniland, published in 2011 (UNEP, 2011) have induced Shell Nigeria to review its remediation practices and increase transparency (Vidal, 2011b).

22 http://www.peacepalacelibrary.nl/2013/02/shell-and-ogoni-people-soil-pollution-in-the-niger-delta/

23 Environmental costs are costs connected with the actual or potential deterioration of natural assets due to economic activities. https://stats.oecd.org/glossary/detail.asp?ID=819

24 https://milieudefensie.nl/english/shell/courtcase/our-courtcase-against-shell

Reputational risk

Reputational risk is high for oil companies operating in Nigeria. The petroleum industry has repeatedly been involved in scandals and conflicts relating to corruption, bribery, armed conflict, and social injustice in the region and is therefore subject to risk arising from these (e.g. Mason & Blackden, 2010; Klasa, 2014; Cohen & Ibukun, 2015)[25]. Oil companies are usually vertically integrated, which means they are susceptible to actions and boycotts from final consumers.

Apart from the negative image from contaminating the Niger Delta, oil companies can be subject to action from local communities. Local public opposition forced oil exploration and production activities out of Ogoniland in the Niger Delta in 1993 after the community protested against activities that polluted their land and water. The conflict made international headlines when military repression resulted in thousands of Ogoni killed and nine of their leaders executed (Boele et al., 2001; UNEP, 2011). Although oil extraction ceased in Ogoniland in the early 1990s, the region is still crossed by major pipelines that continue to spill oil due to a lack of maintenance and vandalism[26].

Pollution from produced water, oil spills and pipeline leaks have contaminated streams and rivers, destroyed forests and led to biodiversity loss

25 See also other sources above in this chapter or google “Nigeria oil scandal” for an impression of the range of issues pervading the oil industry in Nigeria

26 http://www.unep.org/disastersandconflicts/CountryOperations/Nigeria/AboutOgoniland/Ogonilandsoilhistory/tabid/54184/Default.aspx

Country case: Gold mining in Peru

Share of global production (USGS, 2015)	5.2 %
Share of imports to Switzerland[27]	5.8 %

Switzerland was Peru’s third-ranking export destination in 2013 in terms of dollar value, after the United States and China[28]. The mining industry plays a significant role for Peru and is strongly backed and facilitated by the Peruvian government as a chance to boost the country’s economy. In 2013, the mining sector accounted for 5 % of the gross domestic product (GDP) (EY Peru, 2014). In that year, the country’s exports were led by gold, which represented 18.9 % of its total exports, followed by copper ore, which accounted for 17.8 % in terms of dollar value[29]. Other top exports also related to the mining industry are crude and refined petroleum or refined copper. Holding 4 % of the world’s estimated gold reserves[30], Peru was the world’s sixth-largest gold producer in 2014 (USGS, 2015). In 2014, 48 % of the gold (legally) mined in Peru was exported to Switzerland[31].

Water situation

The Andes divide Peru into three natural drainage basins: the Pacific basin (279,000km² with 53 rivers), Atlantic basin (959,000km² with 44 rivers) and Lake Titicaca basin (47,000km² with 9 rivers)[32]. Water resources in Peru are abundant in the Amazon region (Atlantic basin) and scarce in the coastal area (Pacific basin), which accounts for only 1.8 % of the country’s freshwater resources while being home to more than half of the population and hosting the most significant economic activities (OECD, 2015).

In 2009, the current Water Resources Law was passed, taking a decentralized approach and promoting integrated water resources management. This was necessary to reflect Peru’s structural changes as a result of a decentralization processes in the late 1980s and the drastic changes in the scale and nature of water use in Peru since the 1990s after the growth of water-using industries, which included the extractive industries (Budds & Hinojosa-Valencia, 2012).

Much of Peru’s mineral reserves lie in the highlands of the arid Pacific slope where the rural population depends on agriculture for their livelihoods and 20 % are considered extremely poor (IFAD, 2013). Agriculture accounts for 80 % of water use in Peru[33]. At the same time, the mining boom since the early 1990s has resulted in a significant growth in demand for water used in mineral extraction and processing (Bury et al., 2013; Bebbington & Williams, 2008).

27 Swiss Impex, accessed on April 2016
28 http://atlas.media.mit.edu/en/profile/country/per/
29 ibid
30 http://www.minem.gob.pe/_detallenoticia.php?idSector=3&idTitular=5862
31 http://atlas.media.mit.edu/en/visualize/tree_map/hs92/export/per/show/7108/2013/
32 Water Risk Filter: Peru
33 ibid

Substantial threats to Peru’s water resources also arise from artisanal and small-scale gold mining (ASGM), which is a highly unregulated subsector of the Peruvian mining industry. ASGM is associated with significant environmental damage and water pollution through the intensive use of mercury, most notably in the Madre de Dios region in the Amazon basin (Webster, 2012). In this area, ASGM has increased significantly since 2000 and has led to substantial political and social controversy, and mercury contamination of water is affecting downstream communities that are not involved in mining activities (Diringer et al., 2015).

Physical risks

Water scarcity has emerged as a major risk affecting both existing and new mining operations. Mining companies are being forced to use seawater and desalination plants (Toledano & Roorda, 2014). As almost 100 % of industrial mining activities in Peru take place on inhabited land (Alforte et al., 2014), there is fierce competition over water usage. Upstream glacier recession is occurring concurrently to this rapid and water-intensive economic development (Bury et al., 2013).

Peru declared a state of emergency at a mine near Lima over fears that its tailings dam could release arsenic, lead, and cadmium into the main water supply

Mineral concessions comprise a high percentage of the area of river basins in the coastal and Andean highland regions of Peru: In 2009, watersheds supplying the cities of Lima, Trujillo, Chiclayo, and Ica each had 30 % or more of their land surface under concession and up to 64 % of watershed surfaces were affected in Cajamarca (Bebbington & Bury, 2009). In 2011, mineral concessions occupied over 75 % of the surface area in seven river basins in the departments of Arequipa, Moquegua, and Puno (Cuba et al., 2014).

Concerns over water supply are intensified by pollution from acid mine drainage (AMD). AMD is persistent and costly and tends to be a liability for mining companies long after they cease to operate. AMD arises at metal mines where the target ore, such as gold, is rich in sulfide minerals. When the sulfides are exposed to water and air, they react to form sulfuric acid, which dissolves harmful metals and metalloids (like arsenic) from the surrounding rock, rendering the water toxic as the dissolved metals leach into the water (Sumi & Gestring, 2013). It has been estimated that every year over 13 billion m^3 of effluents from mining and metallurgy are released into Peru’s watercourses (Bebbington & Williams, 2008). In July 2008, Peru declared a state of emergency at a mine near Lima over fears that its tailings dam could release arsenic, lead, and cadmium into the main water supply for the capital (Bebbington & Williams, 2008).

Regulatory risks

A 2013 survey by the Gold Council found that community and environmental issues and obtaining a license to operate were rated as the most serious challenges facing the global gold industry (GlobeScan, 2013). The Mining Law, approved in 1992 with the aim of attracting foreign investment in the sector, has seen a number of countervailing laws that focus on sustainable development enacted since 2000 (KPMG, 2013).

Major protests following instances of industrial pollution from mines have prompted the Peruvian government to strengthen environmental enforcement. Measures were introduced to double the fines for companies polluting the environment in 2013 and to close legal loopholes that allowed companies to avoid paying environmental fines for years (KPMG, 2013; Reuters, 2013). Fines in 2013 ranged from 2 million PEN (CHF 574,274) to 30 million PEN (CHF 8.6 million) (KPMG, 2013).

Most mines involved in ASGM currently operate illegally since the procedures to formalize operations are complicated, costly, and not accessible to many artisanal miners (Elbein, 2015). In 2012, the government signed a regulation criminalizing informal ASGM activities as well as their financing as a result of concerns over increasing environmental devastation and social conflicts (Elbein, 2015). After seizing a ton of illegal gold between 2013 and 2014, Peruvian authorities opened 25 criminal cases and have targeted international companies, including Swiss refineries, that are suspected of being implicated in illicit gold trade (Castilla et al., 2015).

Peruvian authorities opened 25 criminal cases and have targeted international companies, including Swiss refineries, that are suspected of being implicated in illicit gold trade

Social mobilization and protest have been affecting industry expansion. This includes slowing project development timetables, forcing the redesign of mining operations or the implementation of compensation schemes, and, in some instances, blocking companies’ access to mineral deposits (Himley, 2014). Since 2010, social conflicts have resulted in the indefinite suspension of CHF 21.3 billion ($US 21.5 billion) worth of mining projects, accruing to a loss of CHF 14.8 billion ($US 14.9 billion) in anticipated mining export revenue for Peru (Schneider, 2016). In 2014, less than 2 % of all of the country’s mining concessions were active, mostly due to social conflicts (Alforte et al., 2014).

Some examples of social conflicts related to mining and water issues that have affected mining companies’ license to operate:

- In Cajamarca, plans for Newmont’s proposed CHF 4.76 billion (US$4.8 billion) gold and copper Conga mine involved drying four lakes to create optimal conditions for the enterprise. Contamination from mining activities had already severely impacted the environment. Protests against the mine evolved into violent clashes with at least 30 dead. The federal government called an emergency state twice due to social conflicts, and in 2011 the protests led to the Prime Minister’s resignation. The operation was halted in early 2012 and after a long period of further protests, the company abandoned its plans for developing the Conga mine in 2016 (Alforte et al., 2014; Sampat, 2016). The case is particularly relevant for Switzerland as Newmont, until 2015, had shares in Swiss refinery Valcambi and maintains refining relationships under the new ownership structure (Newmont, 2015).

- In 2012, the expansion of gold, copper, and silver concessions caused concern amongst local communities in Llusco (Cuzco) regarding the impacts on their agricultural activities and access to water. The protest took the form of a nine-day complete strike in the city. Local authorities threatened to take over the mining installations if the companies did not leave. After an extended legal dispute, the federal government required a new environmental impact assessment for two mines and permanently suspended the license for another one (Alforte et al., 2014).

Andean people in Peru set fire to areas surrounding a dam, built by Newmont Mining’s Conga project near the Perol lake. Thousands of opponents circled a lake high in the Andes, vowing to stop the company from eventually draining it to make way for Peru’s most expensive mine

- In Pulán, Cajamarca, operations of a gold and silver mine have been interrupted on several occasions since 2004, when Buenaventura halted operations for about a year due to protests that demanded a more comprehensive environmental impact assessment. In 2008, the companies involved held a public audience, in which nearly 3,000 rural workers were blocked from entering. This led to several protests where they closed access roads and demanded the project’s suspension. Two years later, the local government demanded several conservation measures from the company, such as protecting basin headwaters. In 2012, the suspension of Minas Conga (see above) triggered strong pressure to stop operations. In September 2013, there was a large strike in the region protesting against the lack of significant action on the basin headwaters (Alforte et al., 2014).

Reputational risks

The sometimes severe socio-environmental conflicts related to both large and artisanal and small scale mining operations in Peru can pose reputational risks to mining companies, companies sourcing from them, and their investors. Reputational risks for mining companies are more limited than the oil industry’s, because they rarely sell directly to end-users. However, there have been instances where negative publicity has adversely affected companies in the metal processing business. Nearly half of the stakeholders interviewed for a study for the Gold Council in 2013 stated, “gold sourced from war or conflict zones impacts the reputation of the industry as a whole” (GlobeScan, 2013).

In Andean Peru, where livelihoods are predominantly based on agriculture and livestock farming, increasing concern about future water supplies is triggering numerous and even violent conflicts between miners and communities (Bebbington & Williams, 2008; Himley, 2014). The poor populations living in rural or remote areas are most affected by mining activities. The marginalization of this segment of society and persistent economic inequality despite economic growth from increasing revenues from the extraction of natural resources further aggravates conflicts (Vasquez, 2010). In March 2016, the Peruvian ombudsman’s office recorded 208 active social conflicts, 79 % of which were of a socio-economic nature. Of these, 63.7 % were related to mining activities[34].

The names of some large gold mining enterprises are already tainted with incidents of pollution and human rights violations, and, most saliently, water issues. In 2012, due to mining giant Rio Tinto’s tarnished reputation, environmental and human rights groups protested the company’s contract to provide the 2012 Olympic medals (Boyd, 2014). In 2005/2006, after being wrongly accused of buying illegal gold from the Democratic Republic of the Congo in a UN-report, a Ticino-based gold refinery suffered severe economic damage as this news caused many business partners to distance themselves from the company (EDA, EFD and WBF, 2013). Swiss gold refineries PAMP and Metalor made headlines in 2012 for buying illegal gold from Peru’s Madre de Dios region, where both social conflicts and environmental degradation are severe (Wells, 2013; Castilla, 2013).

34 http://www.defensoria.gob.pe/conflictos-sociales/objetos/paginas/6/48reporte-mensual-de-conflictos-sociales-n-145-marzo.pdf

Gold mining in the watershed context – Peru’s Río Santa

Río Santa drains a total watershed of 12,200 km² and is the second largest river along Peru’s Pacific Coast. The principal economic activities competing for Río Santa’s water are agriculture, mining, hydropower, and urban use. Millions of people depend on Río Santa’s water for their energy needs and it is the main water source for Chimbote, Peru’s third largest city. Increasing competition for water is creating hostility between economic sectors, authorities, and upstream and downstream users in the watershed, and is provoking local and regional conflict (Lynch, 2012). In addition, over the past three decades, the glaciers that feed the river have shrunk by some 15 percent (Bury et al., 2013). The many upstream–downstream conflicts are likely to intensify with climate change as glaciers retreat further.

Mining has become a significant water user within the Río Santa watershed. In 2008, Barrick’s Pierina gold mine consumed approximately 10 million cubic metres of freshwater (Bury et al., 2013). Mining has had a significant impact on water quality for downstream populations in particular. Water studies since 1981 have shown that Peruvian water quality standards for certain contaminants, including toxic metals like arsenic, iron, lead, manganese and zinc, were exceeded on a frequent basis (ibid). Additionally, leaching from mine tailings continues unabated. Mining has also been blamed for stream acidification and reduction of vegetation in Huascarán National Park located within the Santa watershed (Bury et al., 2013). Authorities have been reluctant to impose sanctions that could affect the sector’s financial performance, which in turn has affected rural communities who rely on shared waters for domestic use, livestock, and crops (Lynch, 2012).

Above 3,300 metres and near the Santa’s headwaters, most disputes revolve around mine pollution. In 2010, a decision to grant a permit for mineral exploration next to Laguna Conococha, which lies in the headwaters of the Santa, led to a massive protest by livestock-producing and farming communities, urban water users, and defenders of the park (Lynch, 2012). Local leaders warned of the potential impacts of mine contamination on the agricultural economy of the entire watershed. The strike, accompanied by police violence and vandalism, continued until the government suspended the exploration permit.

Twenty percent of the Santa watershed’s irrigated area is used by 70 % of the farmers in the watershed’s upper reaches, while the lower basin accounts for some 80 % of irrigated area used by 30 % of farmers (USAID, 2011). Large exporting agribusiness enterprises and small farms prevail on the coast and in the higher reaches of the watershed, respectively. While landowners in the lowlands are entitled to a fixed yearly water allocation, highland irrigators have the right to a share of available water volume. In times of drought, which could be exacerbated by glacier recession, this means that water would have to be diverted from the highlands to the farmers in the lower basin, deepening the vulnerability of highland food producers and urban water users and also potentially putting mining operations at risk (Lynch, 2012).

5 Chemicals

In 2014, Switzerland was the fourth largest exporter of chemicals globally

In 2014, (non-pharmaceutical) chemicals accounted for CHF 2,224 billion (€ 2,054 billion) in global exports, representing 11.1 % of world trade in merchandise and 16.8 % of world trade in manufactured goods (WTO, 2015). In 2014, Switzerland was the fourth largest exporter of chemicals globally after the European Union, United States, and China with approximately CHF 89 million (€ 82 million) worth of (non-pharmaceutical) chemicals being exported (WTO, 2015). Switzerland's Ineos and Syngenta rank amongst the world's top 40 chemical producers (Tullo, 2014).

Chemicals are used to make virtually every man-made product – more than 96 % of all manufactured goods depend on the chemical industry[35]. The chemicals sector is comprised of base (petrochemicals and derivatives and inorganics), specialty (auxiliaries for industry, paints & inks, crop protection, dyes & pigments), or consumer (soap, detergents, bleaches, hair and skin care products, essential oils, fragrances, etc.) chemicals. The majority of the tens of thousands of substances produced by the global chemicals industry is used by other chemical companies or industries (e.g. metal, glass, electronics) (OECD, 2001). Around 20,000 different types of chemicals are produced and used in Swiss households, gardening, farming, and industrial production[36].

Top countries of import to Switzerland and their water risk

While the majority of Switzerland's chemical imports stem from European countries and the USA (see Table 6), this often reflects products in the processing stage of the value chain or companies that import and then re-export raw materials (see Methodological limitations). Europe itself is relatively poor in natural resources and relies extensively on imported raw materials to produce its chemicals products. Whereas the re-distributor could change at any moment, the raw material source country will continue to produce until its reserve is exhausted. Based on data from 2015, the Swiss chemical industry imported over 1.1 million tonnes of organic raw materials[37] and 739,485 tonnes of inorganic raw materials (minerals)[38]. Table 6 shows the risk of the top countries exporting chemicals to Switzerland, while Table 7 shows Switzerland's top inorganic chemical imports.

35 http://www.americanchemistry.com/chemistry-industry-facts
36 http://www.bafu.admin.ch/chemikalien/15208/index.html?lang=en
37 Swiss Impex, accessed on April 2016, tariff heading 29 – organic chemicals
38 Swiss Impex, accessed on April 2016, tariff heading 28 – inorganic chemicals; organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or of isotopes

	Import Quantity (kg)	Import Value (CHF)	Percentage of Import Quantity	Physical Risk	Regulatory Risk	Reputational Risk
Germany	684,440,141	1,405,548,556	37%	🟠	🟢	🟠
France	408,879,226	402,674,276	22%	🔴	🟢	🟠
Netherlands	162,985,420	202,665,371	9%	🟠	🟢	🟠
China	93,522,811	767,027,716	5%	🔴	🔴	🔴
Belgium	87,609,468	189,722,626	5%	🟠	🟢	🟠
USA	84,013,862	480,827,464	5%	🔴	🟢	🟠
Italy	69,823,022	332,009,519	4%	🔴	🟢	🟠
Austria	38,969,895	98,538,480	2%	🟠	🟢	🔴
United Kingdom	36,781,357	1,468,145,751	2%	🟠	🟢	🟠
India	28,501,515	389,670,042	2%	🔴	🟠	🔴

Table 6 *– Top ten countries from which Switzerland imports chemicals and their water risk (based on import value)*

Imported Inorganic Chemicals	Import Quantity (kg)	Import Value (CHF)	Percentage of Import Quantity
Sodium hydroxide “caustic soda”, potassium hydroxide “caustic potash”; peroxides of sodium or potassium	165,221,329	38,252,023	22 %
Chlorides, chloride oxides and chloride hydroxides; bromides and bromide oxides; iodides and iodide oxides	65,758,214	24,625,241	9 %
Carbonates; peroxocarbonates “percarbonates”; commercial ammonium carbonate containing ammonium carbamate	56,718,858	25,984,164	8 %
Inorganic acids and inorganic oxygen compounds of non-metals[39]	54,844,667	40,674,606	7 %
Sulphates; alums; peroxosulphates “persulphates”	51,469,305	17,859,932	7 %
Salts of inorganic acids or peroxoacids, incl. aluminosilicates whether or not chemically defined[40]	39,932,379	11,595,862	5 %
Hydrogen, rare gases and other non-metals	36,119,050	31,567,618	5 %
Fluorine, chlorine, bromine and iodine	34,451,249	5,703,730	5 %
Artificial corundum, whether or not chemically defined; aluminium oxide; aluminium hydroxide	33,795,013	30,277,084	5 %
Hydrogen chloride “hydrochloric acid”; chlorosulphuric acid	28,835,318	3,479,121	4 %

***Table 7** – Top ten inorganic chemicals imported by Switzerland*

39 excl. hydrogen chloride “hydrochloric acid”, chlorosulphuric acid, sulphuric acid, oleum, nitric acid, sulphonitric acids, diphosphorus pentaoxide, phosphoric acid, polyphosphoric acids, oxides of boron and boric acids

40 excl. of oxometallic or peroxometallic acids and azides, and inorganic or organic compounds of mercury

Sector Water Risk and Water Intensity

The chemical industry is known as one of the major industrial users of water, with cooling requiring the highest usage. Water is also used to make and wash chemical products and for steam generation, cleaning, safety-related activities (i.e. deluge systems), and re-use processes.

While one of the greatest risks for the chemical industry is pollution during the processing stage, this is only the case in countries with weak or non-existent regulations (see Table 8 for general overview of the chemical sector's water-related risks). For those countries with weak control where contaminated and/or heated water used during the chemical production enters into the water systems, companies face regulatory and reputational risk. Otherwise, the greatest risk lies in the raw materials (organic or inorganic) that provide the base for the chemicals industry. The water risk during the extraction of oil and salts and during the production of Sulphur is particularly high.

Water Impacts of the Chemicals Industry

- Compared to all other manufacturing industries, the chemicals industry in OECD countries was the largest water consumer (43 %) in 1995 (OECD, 2001; Buccini, 2004).
- Clariant, one of Switzerland's major chemicals company, created a product called 'Advanced Denim' which uses fewer chemical dyes and less water to produce its denim. If this technology were to be implemented to produce a mere 25 % of jeans on the market it would – according to own statements – "save 62 million cubic metres of water per year – or the annual water consumption of over 1.7 million people – and up to 8.3 million cubic metres of waste water per year would not be wasted or treated" [41].
- In 1986, a fire at Sandoz chemical company in Basel encompassed the region in a cloud of smoke contaminated with 1,350 tonnes of pesticides and agrochemicals. The thousands of cubic metres of water used to fight the blaze caused the factory's retention basin to overflow. This overspill led to 30 tonnes of chemical products leaking into the Rhine, which turned red. The river's flora and fauna were destroyed and hundreds of tonnes of dead fish and other dead animals were found in the river over the following days. Soil and groundwater were also contaminated (Mir, 2011).

41 http://www.advanceddenim.clariant.com/index.php/eco-efficiency/resource-savings.html

Physical risks	**Basin**	Freshwater availability (quantity) under pressure due to increasing demand from other basin users. Other basin users may pollute freshwater sources (quality). Increasing air and water temperatures imply increasing amount of water needed for cooling and operation, while evaporation of water sources is increasing.
	Company	Disruptions or declines in water supply limit industrial use for production, material processing, cleaning, and especially cooling, which demands the most water. As the industry's manufacturing footprint expands to more water-stressed regions of the world including the Middle East, India, and China, water scarcity will become a greater issue. Highly polluted water may require on-site water purification for operations.
Regulatory risks	**Basin**	Large multinational are often easy targets for (local) governments. • Local companies often favoured over large multinationals for e.g. taxes and regulation. No or limited regulation or no or limited enforcement by local governments can impact water quantity and quality. If operating in a multi-national basin, differences in regulations and enforcement per country can have greater impact on water quantity and quality downstream. A company can lose its license to operate or incur higher costs because of changes in water rights, pricing, and wastewater treatment requirements. Especially, as the chemicals industry shifts to areas facing severe physical and economic water scarcity, companies competing with local communities could lose their license to operate.
	Company	Further tighter regulation and increased enforcement by governments may increase cost for freshwater and wastewater treatment and discharge. • Lawmakers may force companies to use innovative production technologies to reduce impact on water. • Impact of potential price increases is significant, considering the required volumes. • Companies must comply with numerous international, regional, and national standards. • The EU's Water Framework Directive[42] is driving the phase out of 33 priority chemicals with the goal of improving water quality in key river basins. The EU legislation, REACH[43], places greater responsibility on industry to manage the risks to the environment and health.
Reputational risks	**Basin**	In case of local water scarcity or wastewater pollution in the basin of operation, reputation of especially large multinationals is vulnerable in local communities. End-user (consumer) pressure not to buy products in troubled basins.
	Company	Reputational risk is particularly high as a result of accidents, spills, or product impacts on water resources and environment (e.g. Union Carbide factory explosion in 1984 in Bhopal, India[44]). Governments, communities, NGOs and industrial client companies looking at their own supply chain footprint are increasingly concerned with the high amount of chemical discharge and potential negative impacts on water resources and surrounding ecosystems. Conflicts with local communities over access to water threaten license to operate and damage to brand image. Waste discharge on water quality, with consequences for downstream users and aquatic ecosystems.

***Table 8** – A general overview of water-related risks for the chemical sector (CERES, 2010; PWC, 2011).*

42 The Water Framework Directive establishes a legal framework to protect and clean water across Europe and ensure its long-term, sustainable use. For more information, http://ec.europa.eu/environment/water/water-framework/index_en.html

43 REACH is a regulation of the European Union, adopted to improve the protection of human health and the environment from the risks that can be posed by chemicals, while enhancing the competitiveness of the EU chemicals industry. It also promotes alternative methods for the hazard assessment of substances in order to reduce the number of tests on animals. For more information, http://echa.europa.eu/regulations/reach

44 http://www.britannica.com/event/Bhopal-disaster

Country Case: Chemical industry in China

Share of global production (CEFIC, 2016)	34.4 %
Share of imports to Switzerland[45]	5.0 %

China was the world's largest chemical producer in 2014 with sales far exceeding other countries (CHF 1.19 trillion vs. CHF 506.6 billion from USA, the second largest producer) (CEFIC, 2016). Accounting for 10 % of China's GDP, the chemical industry is the country's third largest sector (KPMG, 2011). ChemChina's planned purchase of Swiss pesticide seed group Syngenta, Switzerland's second largest chemical producer, would reshape the chemicals landscape. The merged companies would in fact most likely generate more revenue than rival Monsanto (Bloomberg News, 2016).

Water Situation

While 20 % of the world's population resides in China, the country only has 7 % of the planet's freshwater reserves[46]. China can be divided into nine main river basin groups, yet approximately 80 % of the country's renewable surface water resources are in the south. To balance this unequal distribution, a huge water diversion project is underway to transfer water from the south to the north, which could potentially have serious environmental implications for the south.

The main water problems facing China are: groundwater over-extraction and falling water tables (particularly in the north); pollution – 70 % of China's rivers and lakes are significantly contaminated, 50 % of China's cities have polluted groundwater, and over 30 % of China is affected by acid rain (Carmody, 2010); and severe water stress – 44.7 % of the country suffers from water stress[47]. China's Ministry of Water Resources predicts that water supply will not be able to meet demand by 2030 if China does not make some drastic changes[48].

Physical Risks

Over 45,000 kinds of synthetic chemicals are being produced, used, and discharged into China's waterways

Over 45,000 kinds of synthetic chemicals are being produced, used, and discharged into China's waterways[49]. Twenty per cent of the groundwater used as drinking water in China's urban areas is contaminated, sometimes with carcinogenic hazardous chemicals (Gleick, 2008).

Ninety percent of China's shallow groundwater is polluted and 37 % is considered so foul as to be untreatable for use as drinking water. An estimated 190 million Chinese fall ill and 60,000 die from water pollution every year. The World Bank has estimated that these illnesses cost the government CHF 22.8 billion annually – or 1 % of China's gross domestic product (Anderson, 2015).

45 Swiss Impex, accessed on April 2016, tariff heading 28 – Inorganic chemicals; organic or inorganic compounds of precious metals, of rare earth metals, of radioactive elements or of isotopes and tariff heading 29 – organic chemicals
46 http://chinawaterrisk.org/big-picture/china-water-crisis/
47 Water Risk Filter: China
48 http://chinawaterrisk.org/wp-content/uploads/2011/10/ChinaWaterRisk-Economy-Runs-on-Water.pdf
49 http://chinawaterrisk.org/opinions/no-chemicals-please/

Recent amendments to the existing legislation have raised financial penalties for polluters with no maximum limit specified for serious incidents

The 2030 Water Resources Group, comprising a consortium of multinational corporations, the World Bank Group, and McKinsey, estimates a shortfall of 201 billion cubic meters of water in 2030 (assuming productivity and efficiency remain constant to 2005 levels). Though the agricultural sector will place the greatest overall demand on China's water resources, its 0.6 % increase in water demand is far less taxing than the industrial sector's 2.9 % increase in demand between 2005–2030 (2030 Water Resources Group, 2009).

Regulatory Risks

The regulatory landscape varies within China's different regions, which requires companies to pay close attention to both local and national regulations. Responsibilities for water resources, data and information, infrastructure construction, environmental protection, agricultural development, transportation, and other water-related activities are split among possibly competing or conflicting institutions (PWC, 2008).

China's 1984 Law on the Prevention and Control of Water Pollution (revised in 2008) and 2002 Water Law established regulatory control to prevent and control freshwater pollution and water resource use. Some of the Water Law's provisions allow for tougher penalties for polluters, a discharge permitting system, citizens to bring class action suits against polluters, improved standards, and increased transparency and penalties for inadequate government enforcement[50]. In an effort to reduce overlapping responsibilities among agencies and what many considered a demonstration towards greater environmental protection, the government established five "super ministries", which includes the Ministry of Environmental Protection[51].

Though China has introduced numerous environmental laws and regulations recently, effective implementation and enforcement remains an issue. Compliance is reportedly as low as 10 % and only 30 % of penalized companies actually pay their fee to the central government[52]. While it was often more profitable for companies in China to pay pollution fines rather than implement prevention measures, recent amendments to the Water Pollution Prevention Control Law have raised financial penalties for polluters with no maximum limit specified for serious incidents[53].

China has relatively few international water agreements with its neighbours, especially its southern downstream neighbours, which could potentially be explained by its extremely low dependency on external water resources[54].

Reputational Risks

As a consequence of growing internal dissent and conflict over both water allocation and water quality, the central and regional governments are facing increasing pressure to address water problems. Chinese citizens are increasingly aware of environmental issues, and activism against water pollution is also on the rise. There were an estimated 187,000 environmental protests in 2012, which averages to 500 protests a day[55].

50 http://chinawaterrisk.org/regulations/overview/
51 ibid
52 http://chinawaterrisk.org/regulations/enforcement/
53 http://chinawaterrisk.org/regulations/enforcement/pollution-fines/
54 http://chinawaterrisk.org/resources/analysis-reviews/water-treaties-a-question-of-rights/
55 http://chinawaterrisk.org/resources/analysis-reviews/2012-review-5-trends-for-2013/

Authorities have scooped up around 100,000 kilograms of dead fish they say were poisoned by ammonia from a chemical plant[57]

In 2005, a chemical plant explosion in the city of Jilin contaminated the Songhua River with 100 tonnes of benzene-related pollutants. Local residents reported tap water turning red or yellow (Brice, 2008). Water supply to nearly 4 million people in Harbin, the capital of Heilongjiang Province, was suspended (Gleick, 2008). Though the government responded with plans to build over 200 "pollution control projects" along the Songhua River and shut down a small number of commercial and industrial enterprises in an effort to cut the worst pollution, China continues to suffer chemical accidents and severe pollution.

40 % of the more than 40,000 plants in the petrochemical, chemical, and pharmaceutical industries surveyed pose a severe threat to public health

For the first time ever, the Chinese government has officially acknowledged the existence of so called cancer villages, which are often located near factory complexes. These villages rely on rivers polluted with toxic chemicals for their drinking, washing, and cooking water[56]. The Ministry of Environment determined that 40 % of the more than 40,000 plants in the petrochemical, chemical, and pharmaceutical industries surveyed pose a severe threat to public health (Jing, 2013). However, this official declaration was quickly declared a mistake and the ministry was reprimanded; authorities instead respond with "denial, intimidation, and silence" (Kaiman, 2013). A local resident in an affected 'cancer village' explained, "No matter how much we talk about this, they won't compensate us. So we don't talk about it any more" Kaiman, 2013). Despite government officials attempting to keep news of chemical industry accidents and impacts out of the news, international news outlets continue to report on this, which can eventually lead to reputational risks for companies.

56 http://www.greenpeace.org/eastasia/campaigns/toxics/problems/water-pollution/
57 https://www.theguardian.com/world/2013/sep/04/china-poisoned-fish-river

Pulp and Paper

The pulp and paper industry accounts for more than 40 % of industrial wood traded globally[58]. The processing of pulp and paper is also one of the primary markets for basic chemicals (OECD, 2001). The dominant method for producing paper from wood pulp is the Kraft (sulphate) process, and the vast majority of Kraft pulp production is bleached using "Elemental Chlorine Free" (ECF) technology – a technology that is reliant on the use of chlorine dioxide. ECF technology accounts for over 90 % of global market share[59].

The industry is the *single largest consumer of water used in industrial activities in developed countries*[60], requiring on average 54 cubic meters of water per metric tonne of finished product[61]. Water is used in nearly every step of the industrial pulp and paper production process, resulting in large volumes of wastewater and residual sludge. Often situated near rivers, lakes or coastlines, paper mills may discharge many pollutants into these surrounding water bodies with negative impacts to the aquatic ecosystems and health of the people that live near the mill. As demand for paper-based products continues to grow, closer scrutiny needs to be applied to the environmental impacts of the chemicals used in their production, in particular the bleaching of wood pulp.

Physical risks [62]

The pulp and paper industry is exposed to quantitative and qualitative physical risk in their operations. Naturally, large amounts of freshwater are required within this particular industry. Most of the required water is used as process water, which is not consumed within the production process but is highly loaded with pollutants (including temperature) causing negative impacts on environment when not treated properly prior to its release into the recipient water body. The operation requires constant and reliable access to vast amounts of water of certain quality (higher water pollution levels would incur costs for water treatment) to guarantee economic production. Physical risks can have natural causes or are triggered through other stakeholders within the catchment (e.g. pollution event, and upstream over abstraction).

While in a "Total Chlorine Free" (TCF) bleaching process oxygen, ozone and/or hydrogen peroxide are applied, "Elemental Chlorine Free" (ECF) technology relies on the use of the hazardous compound chlorine dioxide. If hazardous chlorinated compounds or other by-products of the pulp process are discharged into waterways, they can pollute the water and degrade the environment. As these compounds are bio-accumulative, they enter the food chain and can cause adverse health effects[63].

Due to the accumulation of chlorine compounds in industrial filter systems, it is also more challenging for ECF mills to create closed loop pulping systems that recycle wastewater from the bleaching process[64], which would reduce their consumption of water from natural systems. This means mills have limited capacity to undertake improvements around water efficiency, which could result in higher operational costs over time – not just for water consumption, but also in regards to chemical and energy use.

Regulatory risks

Due to potentially large impact as regards water quantity and water quality, the pulp and paper industry is controlled by many laws and regulations, which can differ substantially between different countries. More importantly the effect of these laws and regulations depends on the level of their implementation and enforcement. Changes in water licences, water pricing and allowed pollution levels in the effluent have a particular high impact on the cost of operation. Constant improvement of water efficiency and treatment efforts has to take place to respond to the regulatory framework. Regulatory compliance issues can appear within a company and are imposed through local or regional governments. Regulatory risks are lower in well-regulated environments where the company is not faced with sudden and frequently changing regulations imposed by governments.

58 http://www.worldwildlife.org/industries/pulp-and-paper
59 ibid
60 ibid
61 www.waterworld.com/articles/iww/print/volume-12/issue-3/feature-editorial/water-treatment-in-the-pulp-and-paper-industry.html
62 The italicized text in Physical, Regulatory, and Reputational risks originates from ACE & WWF, 2015
63 www.ejnet.org/dioxin/
64 http://www.energy.ca.gov/process/pubs/LP_CLOSED_CYCLE_FINAL.PDF

Thousands of Black Neck Swans wiped out in the Carols Anwandter Nature Sanctuary following major contamination by Celco-Arauco in 2005

Reputational risks

If a company and/or particular parts of the operation perform insufficiently or even attract a wider negative media attention, this can challenge the acceptance of the company and its products by basin stakeholders (local population, NGO's, other industries, governments). The license to operate might be challenged, even beyond the facility, at the company and sectoral level. Disclosure of and gaining knowledge about its own operational and sectoral environmental impacts are seen as the main pathways for showing willingness of the company to improve and to show success and lessons learned. A poor reputation may also affect the industry's attraction to future co-workers.

A number of influential NGOs (such as Greenpeace and Amnesty International) are running targeted Detox campaigns as related to industrial water (see reputational risk under 7 Textiles and Apparel). Companies are facing increasing scrutiny over the hazardous nature of their factory discharges and are being urged to go beyond standard compliance requirements. Demands to clean up 'dirty' operations are unlikely to diminish given this push for hazardous chemicals elimination.

In Focus – Chile

In 2014, Chile was the fourth largest exporter of pulp for paper and wood pulp (after Brazil, Canada, and the US)[65]. It is expected that between 2010–2025, Latin America's wood pulp exports will become the main source for the world with the most significant flow heading towards Western Europe (see Figure 13 in WBCSD & Pöyry, 2012). According to WWF, many global pulp and paper companies are moving their production to the South due to lower production costs and proximity to fast growing pulpwood plantations[66].

A pulp mill's impact on Latin America's first wetland of international importance

In 2004, effluents were discharged into the Cruces river from Celulosa Arauco y Constitución (Celco-Arauco) Valdivia's pulp mill, which was built in close proximity (32km) to the Carlos Anwandter Nature Sanctuary, Latin America's first Ramsar designated wetland of international importance. This caused the river and wetland's rapid environmental degradation, including the decimation of one of South America's largest black-necked swan breeding colonies along with many other water birds and aquatic species (WWF, 2005). Legal battles ensued, resulting in the temporary closure of the mill before it was re-opened with new restrictions placed on its environmental permit. After the State Defence Council brought charges against Celco-Arauco, the Civil Court of Valdivia found the company guilty of causing the Carlos Anwandter wetlands disaster and ordered mitigation measures nine years after the fact in 2013[67]. Celco-Arauco has decided not to appeal against the decision.

Degradation of the Carlos Anwandter Nature Sanctuary caused tremendous public controversy in Chile, even resulting in a citizen-led movement – Acción por los Cisnes (Action for the Swans) – which played a key role in bringing attention to the issue at both the regional and national level (WWF, 2005). The indigenous Mapuche community of Tralcao, which resides on the edge of the sanctuary, found their livelihoods threatened by the ruin of an agro-tourism initiative, loss of irrigation water, and harm to markets for their agricultural products (WWF, 2005).

While Celco-Arauco operated with a series of permits that did not comply with established environmental regulations eleven years ago, they have slowly recognized the need to incorporate their social and environmental performance into their business model. As Celco-Arauco continues to mend the environmental and social damage inflicted on the wetland and its surroundings, as well as restoring civil society's trust, they must continue to demonstrate their genuine acceptance of this challenge to the community[68].

In January 2016, Chile's environmental regulator again pressed charges against CELCO's Planta Valdivia mill for 11 alleged environmental violations with fines up to CHF 29.3 million (US$29.5 million) and a possible revocation of its permit (Reuters, 2016).

65 http://faostat3.fao.org/browse/F/FO/E
66 http://wwf.panda.org/about_our_earth/deforestation/forest_sector_transformation/pulp_and_paper/
67 http://www.lanacion.cl/condenan-a-celco-por-dano-ambiental-al-santuario-del-rio-cruces/noticias/2013-07-27/180317.html
68 https://verdeseo.cl/2013/10/03/celco-y-el-desastre-del-rio-cruces-un-giro-inesperado/

6 Agriculture

In 2014, agricultural products made up 9.5 % of total world trade in merchandise; Switzerland imported CHF 13.85 billion of agricultural products or 5.1 % of the Swiss economy's total merchandise imports (WTO, 2015). Switzerland's 2013 self-sufficiency rate (defined as the ratio of domestic production to domestic consumption) was 50.2 %[69].

The top five importing countries for Switzerland's main agricultural import commodities and the associated country's water risks are presented in Table 9[70]. Physical risk poses the greatest threat to Switzerland's agricultural imports, closely followed by reputational risk. While the EU is the most important trade partner, Brazil, Ecuador, Colombia, and South Africa are also important trade partners.

Sector Water Risk and Water Intensity

Roughly 70 % of the surface and ground water used globally is for agriculture, with 94 % of water dedicated to agriculture in least developed countries

Roughly 70 % of the surface and ground water used globally is for agriculture, with 94 % of water dedicated to agriculture in least developed countries (UN, 2012; FAO, 2011). A recent United Nations' Principles for Responsible Investment (UNPRI) report on water risks in agricultural supply chains found that "agricultural products have the highest water consumption in highly and severely water stressed regions" (PRI, 2014). Currently, one-third of total food production is found in areas of high or extremely high water stress (Roberts & Barton, 2015).

Competition for water, weak regulation, aging / inadequate infrastructure, water pollution, and climate change & weather variability are the main water risk drivers affecting the water security of the food sector (Roberts & Barton, 2015). Within the competition for water, a particularly significant risk for the sector is the high water demand for irrigation, which is expected to be aggravated by growing competition from urbanization, industrialization, and climate change impacts. The latter is likely to affect water supply and agriculture through changes in the seasonal timing of rainfall and snow-pack melt, as well as higher incidence and severity of floods and droughts[71]. This will be exacerbated as many of the world's croplands are in semi-arid areas that are expected to become even drier due to climate change.

Though irrigated agriculture produces on average more than twice the yields of rain-fed agriculture, the latter remains the world's predominant production system (Metabolic, 2016). Between 15–35 % of water use by agriculture is estimated to be unsustainable; additionally, agriculture wastes 60 % of the water it uses each year[72]. Agriculture is one of the main causes of water pollution with the most important problems stemming from excess nutrients accumulating in surface and coastal waters, nitrate accumulating

69 http://www.agrarbericht.ch/de/markt/marktentwicklungen/selbstversorgungsgrad
70 Swiss Impex, accessed on April 2016
71 http://www.oecd.org/agriculture/wateruseinagriculture.htm
72 http://wwf.panda.org/what_we_do/footprint/agriculture/impacts/water_use/

Commodity	Import Quantity (kg)	Import Value (CHF)	Country	Percentage of Import Quantity	Physical Risk	Regulatory Risk	Reputational Risk
Wheat and Meslin	397,284,830	125,132,150	Germany	31%	🟠	🟢	🟠
			France	29%	🔴	🟢	🟠
			Austria	16%	🟠	🟢	🔴
			Canada	15%	🟠	🟢	🔴
			Czech Republic	2%	🟠	🟠	🟠
Soy beans & Soy oilcake and other solid residues	287,073,105	157,192,376	Brazil	58%	🔴	🟠	🔴
			Russia	16%	🔴	🔴	🟠
			Netherlands	8%	🟠	🟢	🟠
			Italy	7%	🔴	🟢	🟠
			China	3%	🔴	🔴	🔴
Coffee	159,339,432	752,515,999	Brazil	28%	🔴	🟠	🔴
			Colombia	16%	🟠	🟠	🔴
			Viet Nam	9%	🔴	🟠	🔴
			India	8%	🔴	🟠	🔴
			Costa Rica	6%	🟠	🟠	🟠
Rice	126,200,077	90,228,532	Brazil	43%	🔴	🟠	🔴
			Italy	19%	🔴	🟢	🟠
			Thailand	13%	🔴	🟠	🟠
			India	12%	🔴	🟠	🔴
			Spain	2%	🔴	🟢	🟠
Banana	88,618,697	103,097,062	Panama	41%	🟠	🟠	🟠
			Colombia	19%	🟠	🟠	🔴
			Peru	13%	🔴	🔴	🟠
			Ecuador	12%	🔴	🟠	🟢
			Dom. Republic	8%	🟠	🔴	🟢
Oranges	69,219,278	68,800,394	Spain	60%	🔴	🟢	🟠
			Italy	27%	🔴	🟢	🟠
			South Africa	9%	🔴	🟠	🟠
			Portugal	1%	🔴	🟠	🟠
			Egypt	1%	🔴	🟠	🔴

***Table 9** – Switzerland's main agricultural imports from the top five importing countries and their associated water risks*

Commodity	Import Quantity (kg)	Import Value (CHF)	Country	Percentage of Import Quantity	Physical Risk	Regulatory Risk	Reputational Risk
Cocoa beans	44,087,475	143,257,874	Ghana	50 %	🟠	🔴	🟠
			Ecuador	25 %	🔴	🟠	🟢
			Côte d'Ivoire	13 %	🟠	🔴	🟠
			Madagascar	4 %	🟠	🔴	🟠
			Venezuela	2 %	🔴	🔴	🟠
Tomatoes	39,063,663	77,443,816	Spain	44 %	🔴	🟢	🟠
			Italy	18 %	🔴	🟢	🟠
			Morocco	17 %	🔴	🔴	🟠
			Netherlands	13 %	🟠	🟢	🟠
			Belgium	4 %	🟠	🟢	🟠
Grapes	38,629,551	83,572,501	Italy	63 %	🔴	🟢	🟠
			South Africa	9 %	🔴	🟠	🟠
			Turkey	7 %	🔴	🟠	🟠
			France	7 %	🔴	🟢	🟠
			Spain	3 %	🔴	🟢	🟠
Potatoes	37,810,327	15,231,608	Germany	31 %	🟠	🟢	🟠
			Netherlands	27 %	🟠	🟢	🟠
			Israel	18 %	🔴	🟠	🔴
			France	14 %	🔴	🟢	🟠
			Belgium	5 %	🟠	🟢	🟠
Meat of bovine animals	25,983,234	196,952,645	Germany	44 %	🟠	🟢	🟠
			Austria	12 %	🟠	🟢	🔴
			Ireland	8 %	🟢	🟢	🟢
			Uruguay	8 %	🟢	🔴	🟠
			Brazil	4 %	🔴	🟠	🔴

in groundwater, and pesticides accumulating in groundwater and surface-water bodies (Metabolic, 2016; FAO, 2011). At the same time, the sector is dependent on good quality water resources in order to avoid contamination of crops (see Table 10 for a general overview of the agricultural sector's water-related risks).

Water risks related to agricultural production are comparatively low for commodities produced in Switzerland as the country has abundant water resources and relatively well-developed water resources management systems in place. However, Swiss manufacturers and retailers can face significant water-related risks along their supply chains if agricultural raw materials are imported from regions experiencing water problems. Prominent examples are the food and beverage sectors that are heavily dependent on water for production of their input and final good, either as a direct ingredient or to process raw materials.

Average water footprints for some of Switzerland's top agricultural goods[73]:

- Coffee (roasted): 18.900 l/kg or 130 litres for 1 cup of coffee
- Chocolate: 17.196 litre/kg or 1.700 litres for 100-gram chocolate bar
- Beef: 15.415 litre/kg
- Rice: 2.497 litre/kg
- Banana: 790 litre/kg or 160 litres for 1 banana
- Oranges: 560 litre/kg or 80 litres for 1 orange
- Potatoes: 287 litre/kg
- Tomatoes: 214 litre/kg or 50 litres for 1 tomato

73 http://waterfootprint.org/en/resources/interactive-tools/product-gallery/

Physical risks	**Basin**	Freshwater availability (quantity) under pressure due to increasing demand from other basin users. Other basin users may pollute freshwater sources (quality). Increasing air and water temperatures implies increasing amount of water needed for irrigation due to evaporation.
	Company	High reliance on large freshwater volumes for direct use. • Potable water is a principal and non-substitutable ingredient for beverage products. Water scarcity or contamination of water sources may force bottling or manufacturing facilities to shut down or relocate. The most significant water use is embedded in crop or livestock production (suppliers). • Changes in precipitation patterns and severe drought and flooding due to climate change may decrease crop yield and quality and raise water requirements for crops and livestock.
Regulatory risks	**Basin**	No or limited regulation or no or limited enforcement by local governments can impact water quantity and quality in a basin. • New distribution of water rights if government sells more water than available. If operating in a multi-national basin, differences in regulations and enforcement per country can have greater impact on water quantity and quality downstream. Large multinationals are often easy targets for (local) governments. • Local companies often favoured over large multinationals for e.g. taxes and regulation.
	Company	Increasing competition with other water users in the basin may lead to withdrawal of water rights. Further tighter regulation and increased enforcement by governments may increase cost for freshwater and wastewater treatment and discharge. • Lawmakers may force companies to use innovative production technologies to reduce impact on water. • Impact of potential price increases or change in pricing structure may be significant, considering the required volumes, especially for agriculture suppliers.
Reputational risks	**Basin**	Decline in economic, social, and physical well-being of consumers due to the lack of access to clean water may affect local market growth. • Beverage producers are often vertically integrated and sell directly to end-users in local markets. Reputation of especially large multi-nationals is vulnerable to uprise of local communities.
	Company	Consumers becoming more sensitive to the impact of food and beverage production on local environment and populations. Agricultural runoff and wastewater from food/meat processing facilities may have negative impacts on local water sources and ecosystems, potentially damaging company's brand image and reputation.

***Table 10** – A general overview of water-related risks for the agriculture sector*

Country Case: Rice production in India

Share of global production (Government of India, 2015)	21.38 %
Share of imports to Switzerland[74]	12.12 %

After China, India is the second largest rice producer[75]. In 2012, India produced 157.8 million tonnes of (paddy) rice on 42,410,000 hectares or 14 % of India's landmass (Government of India, 2015). Rice is India's most exported commodity – exports from the 2013 crop totalled over 11.3 million tonnes worth CHF 8.14 billion (US$ 8.2 billion)[76]. Despite having the highest area of land under rice cultivation, India's yield (3.61 tonnes/hectare) is very low in comparison to other top rice-producing countries (China – 6.89 tonnes/hectare; Indonesia, 3rd largest producer – 4.77 tonnes/hectare)[77].

Rice is grown on more than a quarter of India's cultivated land under four distinct systems – irrigation, rain-fed uplands, rain-fed lowlands, and flood prone[78]. In 2011–12, 58.7 % of India's rice production came from irrigated systems (Government of India, 2015). The top three producing states of rice in 2013–14 were West Bengal (15.31 million tonnes, 14.37 % of national production), Uttar Pradesh (14.63 million tonnes, 13.7 % of national production), and Andhra Pradesh (13.03 million tonnes, 12.23 % of national production) (Government of India, 2015).

The majority (84 %) of India's rice crop is cultivated during the winter monsoon (or kharif) season, though a small share is also grown in the rabi/summer season with irrigation (9 %)[79]. In 2013–2014, kharif yields were 2326 kg/hectare and rabi yields were 3273 kg/hectare (Government of India, 2015).

The eastern states have the highest intensity of rice cultivation under mainly rain-fed conditions in the basins of the Ganges and Mahanadi rivers. In the northeast, rice is grown under rain-fed conditions in the Brahmaputra river basin. Due to cold winters, a single crop of rice is grown mainly under irrigation in the northern region. Rice in the western states of Gujarat, Maharashtra and Rajasthan is largely grown under rain-fed conditions during June-August to October – December. In the south, rice is mainly grown in deltaic tracts of the Godavari, Krishna, and Cauvery rivers under irrigated condition and the non-deltaic rain-fed area of Tamil Nadu and Andhra Pradesh[80].

74 Swiss Impex, accessed on April 2016, tariff head 1006 – Rice, tariff head 1008.9024 – Wild rice Zizania aquatica, for human consumption, out of tariff quota
75 www.faostat.fao.org
76 ibid
77 based on 2015 „Harvested Area", „Yield –paddy", and „Production – paddy", http://ricestat.irri.org:8080/wrsv3/entrypoint.htm
78 http://farmer.gov.in/imagedefault/pestanddiseasescrops/rice.pdf
79 ibid
80 ibid

Water Situation

India's two main water sources are rainfall and glacial snowmelt from the Himalayas. About 80 % of India's river-flow occurs during the four to five months of the southwest monsoon season[81]. Many areas experience localized and severe water shortages before the summer rains and are then subject to flooding during the monsoon. Water resource availability and exploitation across India are also highly variable due to climate and social factors. Although most rivers are of good quality in their upper reaches, water use in cities, agriculture and industries, and the lack of wastewater treatment plants in the middle and lower reaches of most rivers causes major degradation of surface water quality. Municipal, industrial, and agricultural pollutants also affect groundwater[82]. Nearly 80 % of untreated urban wastewater ends up in rivers (WWF India, 2013). Additionally, salt-water intrusion in coastal aquifers due to groundwater over-exploitation affects yield and farmers' and agribusiness' operations.

In April 2016, at least 330 million people were affected by a severe drought

After two consecutive years of poor monsoons, India is dealing with potentially its worst ever water crisis. In April 2016, at least 330 million people were affected by a severe drought with 91 reservoirs left with a mere 29 % of their total storage capacity (BBC, 2016).

Water has become the greatest constraint in cultivating more rice to meet India's increasing demand and future food security, which is under threat unless the government intensifies production by two million tonnes annually (Jishnu et al., 2010).

India's main rice-producing region and the Ganges river basin

India's top rice producing state of West Bengal is the lower most riparian state in the Ganges river basin (74,732 km^2), and to a lesser extent, in the Brahmaputra (11,860 km^2) and Subarnarekha (2,160 km^2) river basins. In total, the trans-boundary Ganges river basin extends over 1 million sq. km and covers more than one-quarter of India.

The main physical risks for the Ganges sub-basin are pollution, flooding, and insufficient flow during the non-monsoon season to meet the competing demands of drinking water supply, agriculture, and industry. In addition to the 1.3 billion litres of sewage that flows directly into the river daily, 260 million litres of largely untreated industrial wastewater, runoff from the more than 6 million tonnes of chemical fertilizers and 9,000 tonnes of pesticides applied annually, and thousands of animal carcasses further pollute the Ganges[83]. An estimated 32,000 corpses are cremated annually along the Ganges with 200 tonnes of half-burnt human flesh dumped into India's most sacred river (Mallet, 2015)[84].

81 Water Risk Filter: India
82 ibid
83 http://wwf.panda.org/about_our_earth/about_freshwater/rivers/irbm/cases/ganges_river_case_study/
84 http://www.india-wris.nrsc.gov.in/wrpinfo/index.php?title=Ganga

WWF has identified the following serious threats to the Ganges:
"Barrages control all of the tributaries to the Ganges and divert approximately 60 % of the river flow to large-scale irrigation. A plan to link 37 major rivers would further divert vast quantities of water from the Ganges (and Brahmaputra) to support water and agriculture needs of the drought-prone states in the south and east. In addition, governments along the Ganges are heavily subsidizing electricity for tube well pumps, plan to expand surface water irrigation, and ban distribution of all surface water diversion.

Over-extraction for agriculture in the Ganges has caused the reduction in surface water resources. This has increased dependence on ground water, the loss of water-based livelihoods, and the destruction of habitat for 109 fish species, and other aquatic and amphibian fauna.

Lowering water levels have indirectly led to deficiencies in soil organic content, and reduced agricultural productivity. Lastly, over-extraction of ground water has seriously affected water quality. Inadequate recharging of groundwater impairs the natural cleansing of arsenic, which becomes water soluble when exposed to air, and threatens the health of 75 million people.

Climate change will exacerbate the problems caused by water extraction. The Himalayan glaciers are estimated to supply 30–40% of the water in the Ganges, which is particularly critical in the dry season prior to the monsoon rains".[85]

In a study on rice production and climate change, authors found that rice production in the upper Ganges Basin is strongly affected by rainfall variation and vulnerable to rainfall shortages, whereas rice production in the lower Ganges Basin is more strongly affected by floods (World Bank, 2013). A study on the effect of climate change on rice production in the Ganges Basin found that yield will vary by –5.9 to –43.2% in the upper basin and by +1.2 to –22.6 % in the lower basin from 2011–2040 (Mishra et al., 2013).

85 http://wwf.panda.org/about_our_earth/about_freshwater/freshwater_problems/river_decline/10_rivers_risk/ganges/ganges_threats/

Runoff from the more than 6 million tonnes of chemical fertilizers and 9,000 tonnes of pesticides applied annually pollute the Ganges

Physical Risks

India is in a state of water stress, which is defined as annual water supplies below 1,700 m^3 per person. In 2014, India's renewable internal freshwater resource was 1,116 m^3 per person[86]. Before 2025, India is expected to reach a state of water scarcity with overall per capita water availability falling below 1,000m^3[87] (UNEP FI, 2009). It is estimated that 8.4 million hectares of wet-season irrigated rice in north and central India and 2 million hectares in central India will experience 'physical water scarcity' by 2025 (Tuong & Bouman, 2003).

Climate change is considered the greatest threat to India's economy (Krishnan & Beniwal, 2015). Climate change will directly affect rain-fed rice yield through precipitation and temperature changes and irrigated rice through temperature changes directly and water availability indirectly (Nelson et al., 2009). Significantly reduced rice yields can already be observed after one rainless week in upland rice-growing areas or two rainless weeks in shallow lowland rice-growing areas. During severe drought years, average yield reduction in rain-fed, drought-prone areas has ranged from 17–40 %[88]. For every 1°C rise in mean temperature, there is an estimated corresponding 7 % decline in rice yield (Africare et al, 2010). It is estimated that climate change will increase rice prices by an additional 32–37 % (Nelson et al., 2009).

86 http://data.worldbank.org/indicator/ER.H2O.INTR.PC
87 see http://indiawatertool.in/ for demand and availability projections in 2025
88 http://irri.org/news/hot-topics/rice-and-climate-change

Irrigated rice is characterized by high cropping densities and intensive use of agrochemicals, energy, and water. In India, 90.41 % of the total water withdrawal stems from agriculture; 70 % of this is allocated to rice cultivation[89,90]. Irrigated agriculture across India is vulnerable to falling groundwater tables and the decreasing quality of these resources. As a result of unreliable and declining surface water supplies, farmers and urban dwellers pump groundwater unchecked – more than 60 % of irrigated agriculture and 85 % of drinking water supplies stem from extracted groundwater (World Bank, 2012).

Improperly developed irrigation schemes result in poor drainage, which in turn causes problems of water-logging, ground water depletion, salinity and alkalinity (Tran, 1997). Water-logging (the over-saturation of soils with water), especially in large-scale irrigation schemes, has left vast areas unproductive throughout India (Panigrahi, et al, 2015). Salinity is caused by saline water intrusion from the sea in the coastal regions and by the upward movement of salt-water in soils, and salt accumulation on the soil surface due to fast evaporation (Tran, 1997).

Upland rice can increase deforestation and soil erosion if the fallow period is short as the fallow period is intended to let the soil rest and regenerate its productivity (Tran, 1997). Shortened fallow periods contribute to declining soil fertility and increasing soil erosion, which results in decreased agricultural productivity. This in turn, leads to further encroachment into forest areas and increasing cultivation of marginal lands (CGIAR Science Council, 2006).

Regulatory Risks

In India, the use, management, and ownership of water is often linked to land or irrigation structures rather than to the resource itself; hence property rights to water are poorly defined. As a consequence, legal disputes over water are often complex and costly (UNEP FI, 2009).

There is no comprehensive single treaty for the Ganges Basin, but rather numerous bi-lateral agreements; nor is there a well-defined conflict resolution mechanism

India's agricultural sector is dominated by small, marginal holdings with generally low levels of mechanization – 80 % of India's farmers have less than one hectare of land (Africare et al., 2010). Levels of irrigation efficiency are relatively low, as inadequate attention has been given to irrigation schemes' maintenance and government agencies do not have the resources or capacity to support India's increasing amount of marginal farmers. As a result, the government has integrated farmers into the distribution and management of irrigation systems through Participatory Irrigation Management (PIM) and Water Users' Associations (WUAs), most recently through India's 2012 National Water Policy. As of 2014, 25 of India's 28 states have adopted the PIM approach partially or fully by forming WUAs (Sinha, 2014). Results have been mixed; unsurprisingly, in cases where they're implemented in a top-down approach, they've failed to take off (Sinha, 2014)[91].

89 http://www.sri-india.net/

90 http://www.fao.org/nr/water/aquastat/maps/World-Map.WithA.Twith_eng.htm

91 for an extensive review of why WUAs fail or succeed in India, see http://wrmin.nic.in/writereaddata/PIM11.pdf

To improve India's food security in the mid-1960's, policies were instituted to create a minimum support price and input subsidies (for fertilizer, seed, water, electricity, machinery) for farmers and a food subsidy for the poor (Mohanty, 2015). These policies still remain in place. Especially in arid areas with unreliable water supply, the government heavily subsidizes farmers' electric pumps and does not regulate how much groundwater is extracted (Shiao et al., 2015).

India shares a number of trans-boundary rivers with Pakistan, Bangladesh, and Nepal. Water-sharing agreements can be a source of tension, especially as complicated political issues between India and its neighbours often make the smallest water issues seemingly problematic. There is no comprehensive single treaty for the Ganges Basin, but rather numerous bi-lateral agreements; nor is there a well-defined conflict resolution mechanism. The Chief Minster of West Bengal, India's top rice producing state, has refused to assent to the Teesta River equal water sharing agreement with Bangladesh as she argues it will disrupt a major paddy growing region in her state (Jayaram, 2013).

Reputational Risks

A long-standing water conflict continues between India and Pakistan despite the Indus Water Treaty. Indian Hindu right-wing groups have called on the government to stop the flow of water into Pakistan or to flood it. Meanwhile Islamic radicals in Pakistan have called for water jihad against India[92]. Should the inter-country water conflict reach this extent, the international market could be reluctant or even avoid purchasing rice from this region so as not to get involved.

As a result of farmers protesting about decreasing supplies, the Coca-Cola company aborted a CHF 23.8 million (US$ 24 million) expansion in Uttar Pradesh state, citing delays in water extraction permits (Chaudhary, 2015). Thus companies are facing increasing reputational risk when operating in water-stressed regions in India.

92 http://thediplomat.com/2014/11/interview-the-india-pakistan-water-dispute/

Country Case: Cattle and soy oilcake production in Brazil

	Cattle	Soy beans & Soy oilcake
Share of global production	16.40 % (USDA FAS, 2016)	21.00 %[94]
Share of imports to Switzerland	4.44 %[93]	58.49 %[95]

In 2015, Brazil was the second largest producer of beef and veal and the third largest exporter (USDA FAS, 2016). The majority (82.56 %) of the 9,425,000 metric tonnes of beef produced in 2015 were consumed domestically (USDA FAS, 2016). At the end of 2012, Brazil's 211.3 million cattle occupied 172 million hectares (which is approximately equivalent to Switzerland, Germany, Italy, Austria, and Spain combined), or 70 percent of Brazil's agricultural land (Heinrich Boll Foundation and Friends of Earth Europe, 2014). Brazil's centre-west states of Mato Grosso (13.5 %), Goiás (10.1 %), Mato Grosso do Sul (9.9 %), southeast state of Minas Gerais (11.2 %), and northern state of Pará (9.4 %) are Brazil's largest cattle producing states, based on amount of cattle head[96]. Brazil's Ministry of Agriculture projects beef production to increase at a rate of 1.9 % and exports to increase at a rate of 3.4 % between 2014–2024 (Brazil Ministry of Agriculture, Livestock, and Food Supply, 2014).

In 2015, over 97 million tonnes of soybean were harvested on 32.1 million hectares of land in Brazil, mainly under rain-fed conditions[97]. Brazil's centre-west state of Mato Grosso (27.8 %), and the southern states of Paraná (17.2 %) and Rio Grande do Sul (16 %) are the leading state of soybean production[98]. Brazil's Ministry of Agriculture projects a 36.9 % increase in production and a 44 % increase in exports between 2014–2024 (Brazil Ministry of Agriculture, Livestock, and Food Supply, 2014). Among the top oilseed producing countries, Brazil has the greatest potential to expand production, particularly in the northern states of Maranhão, Tocantins, Piauí and Bahia (OECD & FAO, 2015).

When soy is pressed, about 20 % of oil can be generated while the remaining 80 % is leftover as cake, which is mainly used for animal feed. In 2014, Brazil exported over CHF 6.95 million worth of soy oilcake and other solid residues[99]. Forty-seven per cent of soy oilcake is consumed domestically (Pacheco, 2012).

93 Swiss Impex, accessed on April 2016, tariff head 0201 – Meat of bovine animals, fresh or chilled, tariff head 0206.29 – Frozen edible bovine offal (excl. tongues and livers), tariff head 0202 – Meat of bovine animals, frozen, tariff head 0206.22 Frozen edible bovine livers, code 0206.10 – Fresh or chilled edible offal of bovine animals, code 0206.21 – Frozen edible bovine tongues

94 based on own calculation, FAOStat data

95 Swiss Impex, accessed on April 2016, tariff head 1201 – Soya beans, whether or not broken, code 2304 – Oilcake and other solid residues, whether or not ground or in the form of pellets, resulting from the extraction of soya-bean oil

96 http://www.ibge.gov.br/english/estatistica/economia/ppm/2014/default.shtm

97 http://www.ibge.gov.br/english/estatistica/indicadores/agropecuaria/lspa/defaulttab.shtm

98 ftp://ftp.ibge.gov.br/Producao_Agricola/Levantamento_Sistematico_da_Producao_Agricola_[mensal]/Comentarios/lspa_201603comentarios.pdf

99 http://www.ers.usda.gov/media/295642/wrs013f_1_.pdf

Brazil's centre-west and southern states have higher rainfall, better soils and more developed infrastructure (OECD & FAO, 2015). The northeast and the Amazon basin area lack well distributed rainfall and good soils; however, cheap land prices are causing a land rush. As the soils of tropical rainforests are not that fertile, deforested areas can only be used temporarily as pastures, after which soybean producers take over the worn out cattle pastures and ranchers move deeper into the forest. Ranchers sell their land to soy farmers at high prices only to re-invest in clearing forested land elsewhere (WWF, 2014b). Ultimately, it's cheaper and more profitable to slash and burn forests than replant fallowed fields (Tollefson, 2015).

The environmental impact on Mato Grosso – Brazil's greatest soy and livestock producer

In Mato Grosso, the most important environmental cost of agro-livestock expansion is the conversion of the Amazon forest and Cerrado savannah (Pacheco, 2012). Since 1996, cultivated land has increased by a third and most of this has been in the Cerrado, which accounts for 70 % of Brazil's farm output (Economist, 2010).

Originally covering 200 million hectares in Brazil, half of the Cerrado has been converted to agriculture and the remainder is severely fragmented (WWF International, 2015). Though deforestation rates in the Amazon had been decreasing in the past years, 2015 saw an increase of 63 % compared to the previous year. Some environmentalists say this is due to the recently revised National Forest Law, which relaxed regulations for private landowners on the maintenance of forest cover and eliminated fines for illegal deforestation for small farmers. Salazar points to the recent economic slowdown, which has pushed farmers to focus on the more profitable exports of soy and cattle (Salazar, 2016).

The clearing of the Cerrado and the Amazon forest leads to soil erosion and the impoverishment of watersheds, alters the regional climate pattern, is a major source of greenhouse gas emissions, a major driver of biodiversity loss, and increases the risk of fire and extreme events (Willaarts et al, 2011). The Cerrado accounts for more than 70 % of the water in three major hydrological basins – Tocantins/Araguaia, São Francisco, and Paraná-Paraguay (La Plata) –as well as in part of the Amazon (WWF-UK, 2011).

The Cerrado only became so agriculturally productive after scientists discovered that adding 3–8 tonnes of lime per hectare reduced the acidity and neutralized the free aluminium in the soil; however as a result, soil organic matter deteriorates more rapidly in these tropical and sub-tropical soils (Brown, 2005). In addition to soy production and livestock, corn, wheat, rice, cotton, tree crops (principally coffee and oranges), sugar cane, and food crops (e.g., pulses, tubers, and vegetable crops) compete for available agricultural resources[100].

100 http://www.ers.usda.gov/media/295642/wrs013f_1_.pdf

Water Situation

While Brazil is considered rich in water – 12 % of the world's surface water resources are located in the country – it is unevenly distributed among regions[101]. The Amazon River basin covers 48 % of the country's territory and accounts for 68 % of Brazil's freshwater resources but only 12 % of the population lives here. Alternatively, 3 % of the country's water resources are in the northeast, which is subject to recurrent severe droughts, harvest failures, and food shortages for 28 % of Brazil's population. The northeast's limited water resources are a severe constraint to agriculture, but large public-sector irrigation schemes are being constructed. Of Brazil's 12 hydrographical regions, the Amazon and the Tocantins-Araguaia basins in the north account for 56 % of Brazil's total drainage area. In Brazil, 54.59 % of the total water withdrawal stems from agriculture[102].

Groundwater is being used on a large scale in areas where surface water sources are scarce, heavily used, or where their use is problematic due to heavy water pollution (as in central and southern Brazil)[103]. Irrigation accounts for 72 % of Brazil's water use (Glickhouse, 2015). Particularly in the northeast, ineffective irrigation is causing salinization and drainage problems, which reduces these lands' productivity[104].

In 2014, water was rationed to nearly 6 million people in a total of 142 cities across 11 Brazilian states

Brazil's major water-related environmental problems are water pollution in large cities and due to improper mining activities, wetland degradation, and severe oil spills. Sewage is a major cause of water pollution that affects quality of life, health, and economic development in large metropolitan areas and particularly the poor in the slums surrounding Brazil's largest cities[105]. Deforestation also impacts the balance between the water on land and water in the atmosphere, which results in changes in precipitation and river flow.

2014 saw Brazil's worst drought in at least 80 years that severely impacted economic output. Soy production shrank 17 % and the cost of beef went up 22 % as a result of the drought (Glickhouse, 2015). Water was rationed to nearly 6 million people in a total of 142 cities across 11 Brazilian states as average reservoir levels in the southeast and central-west regions fell to 41 percent (RT, 2014).

Physical Risks

Including the indirect water footprint of animal feed and the direct water footprint related to drinking water and service water consumed, Brazil's livestock industry's average water footprint is 19,488 litre/kg[106] (Mekonnen & Hoekstra, 2010).

101 Water Risk Filter: Brazil
102 http://www.fao.org/nr/water/aquastat/maps/World-Map.WithA.Twith_eng.htm
103 Water Risk Filter: Brazil
104 ibid
105 ibid
106 The most substantial element of the animal water footprint stems from the feed given to the cattle. As a result, country footprints differ from the global average due to this and the differences between the three production systems (grazing, mixed, and industrial) employed in each country.

The link between deforestation and water

A WWF study on the "State of the Amazon" found that deforestation over large spatial scales may reduce rainfall, alter rain seasonality, and decrease dry season discharge, which in turn can lead to erratic stream flows, characterized by flashier storm flows, earlier annual floods and changes in riverine morphology (e.g. incision, bed armouring and siltation). Land-cover change in uplands and riparian zones increases erosion, surface runoff, and the delivery of sediments and pollutants to adjacent freshwaters. In tropical agricultural landscapes, these hydrological alterations are exacerbated by land management practices that compact soils, increase inputs of fertilizers and pesticides, and generally decrease water quality (Macedo & Castello, 2015)

Deforestation as a result of farming or cattle ranching reduces how much rainfall can be recycled inland (Brown, 2005). Intact Amazon and Cerrado habitats enjoy heavy rainfall thanks to a ratio of one fourth run off into the Atlantic Ocean to three fourths evaporation into the atmosphere either directly or through transpiration that is carried further inland to again come down as rainfall. In deforested areas, the runoff/evaporation ratio is reversed with only one fourth evaporating and being carried further inland. By clearing forests, the water recycling mechanism that brings water to the agricultural regions of south-central Brazil is being weakened (Brown, 2005).

Water pollution caused by nitrates and phosphorus from manure and fertilizers and pesticides used to maintain or improve pasture areas or to increase feed grain production is a major issue in the livestock industry. Untreated slaughterhouse run-off can damage freshwater sources and negatively impact public health (WWF-EPO, 2006), while eutrophication of water systems can cause large-scale algal blooms that kill aquatic life (WWF-EPO, 2006).

The combination of higher rainfall interception in soybean fields (than in transitional tropical forests) with faster run-off due to soil compaction reduces the amount of water percolating into deeper soils and groundwater (WWF, 2014b). A lack of soil cover and deficient protection from the wind in soy production leads to erosion and infertile soils, which in turn, leads to increased fertilizer use (WWF, 2006). Large-scale use of synthetic fertilizers and pesticides can pollute ground water and surface water, which threatens the existence of various native plants and animal species and poses a human health risk, especially for agricultural labourers and indigenous population groups.

Future production will need to meet a growing population's hunger and changing diet towards more meat, which will require more feed; however a reduction in rainfall (be it as a result of deforestation, climate change, La Niña dryer years, etc) for a mainly rainfed crop will require an ever-greater dependence on irrigation. The lack of a well-defined national irrigation plan, infrastructure regarding water and energy availability, and accessible credit for irrigation are current limiting factors (Sentelhas et al., 2015).

Regulatory Risks

The Brazilian Water Act decrees that water resources must be collectively managed in a decentralized manner by the government, users, and communities to allow multiple uses. As related to livestock, the Act specifies that in situations of water scarcity, water needs of humans and animal production have priority over other needs, such as those for irrigation[107], industry, navigation, and hydropower (Doreau et al, 2013).

Though Brazil has various laws protecting its forests, the most important is the Forest Code, which relates to private farms. Under this law and when enforced, landowners in the Amazon are obliged to maintain 80 % forest cover, while landowners in Cerrado regions within the area legally classified as the Amazon biome (Mato Grosso state and parts of Maranhão and Tocantins) are supposed to maintain 35 % of land, plus all permanent preservation areas, under natural vegetation. In other Cerrado regions, the figure is 20 %, plus all permanent preservation areas (WWF, 2014b). For public land, there is an extensive protected area network in the Amazon, and smaller protected area systems in the Cerrado.

In an effort to make soy exports more competitive, Brazil is building new highways and ports connecting soybean farms to domestic and international markets; however, weak governance in frontier regions will most likely exacerbate deforestation, especially along newly paved highways (WWF, 2014b), which in turn will impact the water quality and quantity available (see *The link between deforestation and water* above).

Reputational Risks

Brazil's major soy exporters and slaughterhouses were pushed to declare a moratorium on the purchase of soy and beef from illegally cleared forests

As a result of Greenpeace's international campaigns against soy and beef purchased from deforested lands in the Amazon, Brazil's major soy exporters and slaughterhouses were pushed to declare a moratorium on the purchase of soy and beef from illegally cleared forests. Originally passed in 2006 and renewed annually, Brazil's Soy Moratorium, which prevents the sale of soy linked to deforested Amazon crops, was renewed indefinitely – or until it is no longer needed – on May 9, 2016[108]. More soy farmers were found to have violated the Forest Code than the soy moratorium, demonstrating greater willingness to violate government policy than the private sector[109]. The success of the Amazon soy and beef moratorium made it quite clear that traders and retailers associated with deforestation faced a major reputational risk. Should another global campaign be launched highlighting Brazil's top soy and livestock producing states ultimate impact on the nation's water supply, market response has proven swift and effective.

107 Side Note: Currently, irrigation for Brazil's soybean crop only covers 0.05 % of the cultivated area (Sentelhas et al, 2015)
108 http://www.greenpeace.org/usa/news/brazilian-soy-moratorium-renewed-indefinitely/
109 http://imazon.org.br/imprensa/study-shows-brazils-soy-moratorium-still-needed-to-preserve-amazon/?lang=en#updateOnce

Land-cover change in uplands and riparian zones increases erosion, surface runoff, and the delivery of sediments and pollutants to adjacent freshwaters

Conflicts over water use occur in regions of high population density and industrialization, where water demand exceeds supply. Conflicts over water use by animal production have occurred in many of Brazil's top cattle and soy producing regions (northern Mato Grosso, southern Goias and Mato Grosso do Sul, the coastal region of the Northeast, Rio Grande do Sul, and, more recently, the region encompassed by the Amazon Biome). In some river basins, the percentage of water used for livestock is relatively high: 32 % in the Amazon basin, 18 % in the North West basin, and 16 % in the Tocantins-Araguaia basin (Doreau et al, 2013).

7 Textiles and Apparel

In 2014, global textiles and clothing[110] exports accounted for CHF 791 billion, representing 4.3 % of world trade in merchandise and 6.5 % of world trade in manufactured goods (WTO, 2015). According to the World Trade Organization, compound annual growth in apparel and textiles exports averaged 5.5 % worldwide for the decade ending in 2010. Viet Nam, China, Bangladesh, Turkey, and India were among the fastest growing nations during this period (WTO, 2012).

Top countries of import to Switzerland and their water risk

Regarding volume and value, China is the main source of textiles and apparel imported to Switzerland, followed by Germany, Bangladesh, Italy, Turkey, and India (see Table 11)[111]. For Germany's role in this statistic, see Methodological limitations about re-exports. Switzerland is also a re-exporter of textiles and apparel, most notably to Italy and Germany.

Sector Water Risk and Water Intensity

Water-related risks are substantial in textiles and apparel production (see Table 12 for a general overview of the textiles and apparel sector's water-related risks). There are strong links to the agriculture (natural fibres – mainly cotton production) and petrochemical (synthetic fibres, for example polyester) industries, both of which are significant water users and polluters (see chapters 5 Chemicals and 6 Agriculture, respectively).

Cotton production is the most water-intensive segment of the textiles and apparel sector's value chain and is also the segment most vulnerable to climate-induced physical water risks. The impacts of unsustainable cotton production are dramatically demonstrated by the continuing decline of the Aral Sea, 90 % of which has vanished over the past 50 years as a direct result of water used for intensive cotton production (Varis, 2014; EJF, 2012). One study calculated that by buying products made with cotton from Uzbekistan, consumers in the EU25 countries are indirectly contributing about 20 % to the drying-up of the Aral Sea (Chapagain et al., 2006). Large quantities of freshwater are also needed for wet processing of textiles, like dyeing.

110 A note on terminology: "Apparel" includes clothing and footwear while "clothing" does not include footwear.

111 Swiss Impex, accessed on April 2016, tariff head 58 – Special woven fabrics; tufted textile fabrics; lace; tapestries; trimmings; embroidery, tariff head 60 – K nitted or crocheted fabrics, tariff head 61 – A rticles of apparel and clothing accessories, knitted or crocheted, tariff head 62 – A rticles of apparel and clothing accessories, not knitted or crocheted, tariff head 63 – O ther made-up textile articles; sets; worn clothing and worn textile articles; rags, tariff head 64 – Footwear, gaiters and the like; parts of such articles, tariff head 65 – Headgear and parts thereof

	Import Quantity (kg)	Import Value (CHF)	Percentage of Import Quantity	Physical Risk	Regulatory Risk	Reputational Risk
China	55,428,019	1,966,438,308	30 %	🔴	🔴	🔴
Germany	20,884,616	778,376,666	11 %	🟠	🟢	🟠
Bangladesh	15,184,677	341,789,893	8 %	🔴	🔴	🟠
Italy	12,292,999	1,049,105,891	7 %	🔴	🟢	🟠
Turkey	11,948,423	416,946,266	7 %	🔴	🟠	🟠
India	8,768,475	292,178,286	5 %	🔴	🟠	🟠
Viet Nam	6,992,423	310,635,370	4 %	🔴	🟠	🟠
France	4,289,901	196,821,491	2 %	🔴	🟢	🟠
Portugal	4,137,671	151,914,858	2 %	🔴	🟠	🟠
Pakistan	4,049,412	67,699,728	2 %	🔴	🔴	🟠

Table 11 *– Top ten countries from which Switzerland imports textiles and apparel and their water risk (based on import quantity)*

The textile industry is second only to agriculture as the world's biggest water polluter. Each year, mills discharge millions of litres of wastewater containing toxic chemicals, such as formaldehyde, chlorine, and heavy metals, like lead and mercury. Many of these chemicals cannot be filtered or removed and cause both environmental damage and human disease[112].

The impacts of water risk on a textile company's performance can be illustrated through H&M's lower profits after having to absorb skyrocketed cotton prices due to flooding in major cotton growing areas in Pakistan, Australia, and China that limited supply in 2011 (Ward, 2011; White, 2011). The drought California experienced in 2015 also forced cotton farmers to reduce their production, which in turn affected local clothing companies such as American Apparel, Agave Denim, or Guess (Daniels, 2015).

Regulation is becoming stricter in many countries, such as in China and India, due to growing public awareness and pressure. Thus the regulatory risk for this industry is considerable.

112 http://www.sustainablecommunication.org/eco360/what-is-eco360s-causes/water-pollution

Some key figures

- Water footprint of fabric made with cotton from (Chapagain et al. 2006):
  - India – 22,500 litres/kg (*India produces cotton under high evaporative water demand, short-falling effective rainfall, and partial irrigation, resulting in relatively lower cotton yields)
  - Pakistan – 9,600 litres/kg
  - Uzbekistan – 9,200 litres/kg
  - China – 6,000 litres/kg
- Conventional cotton accounts for 24 % and 11 % of global sales of insecticides and pesticides, respectively[113].
- The World Bank estimates that 20 % of industrial water pollution comes from textile dyeing and treatment[114].
- On cotton farms operating under the WWF-initiated "Better Cotton Initiative", water use has been reduced by up to 23 % and pesticide use by as much as 55 %. Drip irrigation can reduce cotton's water use by up to 60 % (CottonConnect, 2014;[115]).
- A study of cotton farms in India showed that the grey water footprint (water contaminated, see also 2. Switzerland's Water Risk: Water Footprint vs. Water Stewardship) of conventional cotton was 5.5 times higher than the grey water footprint of organic cotton (Franke & Mathews, 2013).

113 http://wwf.panda.org/about_our_earth/about_freshwater/freshwater_problems/thirsty_crops/cotton/
114 http://www.sustainablecommunication.org/eco360/what-is-eco360s-causes/water-pollution
115 http://bettercotton.org/wp-content/uploads/2015/02/BCI-A5-leaflet-web2015.pdf

Physical risks	**Basin**	Freshwater availability is under pressure due to increasing demand from other basin users. • Large need for water is depleting surface and / or groundwater reserves. • Textile industry is often geographically concentrated. Basin is often so polluted that water is insufficiently cleaned for use. Soil erosion is common where cotton is grown.
	Company	High reliance on large freshwater volumes, especially for agricultural suppliers, petrochemical suppliers, and wet processing of textile (dyeing and bleaching). Large amounts of often very polluted wastewater are discharged directly, often without treatment. • High amounts of pesticides and insecticides are used for agricultural supplies, especially cotton. • High amounts of chemicals are needed to process agricultural inputs, produce regenerated and synthetic fibres, and for textile wet processing.
Regulatory risks	**Basin**	Regulation should be strict to avoid negative impact on the competitive position. • No or limited regulation or no or limited enforcement by local governments can impact water quantity and quality in the basin. • If operating in a multi-national basin, differences in regulations and enforcement per country can have greater impact on water quantity and quality downstream.
	Company	Regulators are well aware of environmental and public health issues of textile processing and regulation is often strict. • Enforcement is often very limited, but this is likely to increase. • Many companies have been forced out of business by local governments. • Regulation of agricultural production is often less strict, while water depletion and pollution is common.
Reputational risks	**Basin**	As textile suppliers tend to be concentrated, the reputation of every company operating in the same basin is under pressure if the basin is under threat.
	Company	Local residents are well aware of the industry's negative impact on ecosystems and public health. • Often, freshwater sources are polluted or depleted, which results in a lack of clean drinking water. • Emerging health issues cannot be ignored. • Locals sometimes keep track of abuses. Customers and NGOs are paying more attention to water risk. • Focus is mainly on well-known international brands. These brands will define more standards and policies that suppliers need to follow.

***Table 12** – A general overview of water-related risks for the textiles and apparel sector*

Country Case: Textiles and apparel from Bangladesh

	Textiles	Clothing
Share of global production (WTO, 2015)	> 0.8 %	5.1 %
Share of imports to Switzerland[116]	8.28 %[117]	

In 2014, Bangladesh was the world's third largest exporter of clothing, after China and the EU (WTO, 2015). The ready-made-garment (RMG) sector contributes over 81 % of export earnings and employs 4.2 million people[118] (Akter, 2015). Over the past six years, the textiles and clothing sector has grown by an average of 13.9 % annually; in 2015, industry associations presented an export target of CHF 49.6 billion (US$ 50 billion) by 2021 (Leahey, 2015).

Water Situation

Bangladesh lies in the world's largest estuary delta made up of the Ganges, Brahmaputra, and Meghna (GBM) rivers. Only 7 % of the GBM system's total catchment lies in Bangladesh. Most rivers in Bangladesh are tributaries or distributaries to the GBM river systems. The water regime of the GBM river systems is marked by a great disparity between the monsoon floods and the low flow during the dry season. Periodic and devastating floods can cover up to 60 % of the country; water scarcity during the dry season is another big challenge[119]. Climate change has altered the frequency and intensity of the monsoons and is causing rapid snowmelt in the Himalayas, the source of two of Bangladesh's three major waterways. This will also entail freshwater shortages in the future, as India and China will increase damming upstream in response to their own water and energy shortages[120].

Bangladesh is faced with groundwater contamination due to naturally occurring arsenic, resulting in unsafe drinking water, and permanent depletion of groundwater levels, particularly in the Dhaka metropolitan area and in the northwest[121,122]. The district of Dhaka also faces a water deficit due to an imbalance between water demand and supply, which is causing conflict between water users (Akter et al., 2012).

116 Swiss Impex, accessed on April 2016
117 Combined share textiles and apparel
118 http://www.garmentsmerchandising.com/readymade-garments-industry-of-bangladesh/
119 http://chinawaterrisk.org/opinions/sinking-reputations-lessons-from-bangladesh/
120 ibid
121 ibid
122 Water Risk Filter: Bangladesh

With over 1,700 washing, dyeing, and finishing units consuming 1,500 billion litres of groundwater annually and discharging wastewater, the sector impacts the lives of more than 12 million of Dhaka's inhabitants

Physical Risks

The textiles and clothing industries are contributing heavily to what experts describe as Bangladesh's "water pollution disaster", particularly in the large industrial areas of the capital, Dhaka (Yardley, 2013). With over 1,700 washing, dyeing, and finishing units consuming 1,500 billion litres of groundwater annually and discharging wastewater, the sector impacts the lives of more than 12 million of Dhaka's inhabitants (World Bank, 2014). Each of the four major rivers near the capital is substantially degraded by untreated industrial discharges. The textile industry's wet processors are one of the biggest culprits as they dump used dyes and chemicals directly into the surface waters[123]. In addition to polluting the city's drinking water sources, toxic wastewater inundates rice paddies and is causing fish stocks to die (Yardley, 2013).

Over 87% of Dhaka's water supply is extracted from groundwater (Khan & Ahmad, 2014). Heavy water usage by the textile and clothing industry is contributing to groundwater over-exploitation. Recent research has shown a worrying water table decline of almost 3 metres per year (World Bank, 2014). Estimates suggest that the textile industry may be consuming almost as much groundwater as the capital's 12 million inhabitants (World Bank, 2014). Growing water scarcity and conflicts over water as a consequence pose tangible physical risks to the textiles and apparel industry.

123 http://citiscope.org/story/2015/textile-plants-are-dhakas-water-problem-and-also-its-solution#sthash.Ovm254og.dpuf

Regulatory Risks

While the World Bank found Bangladesh's existing legislative and regulatory environment management framework to be "acceptable" in 2014, it also found it insufficient to address growing industrial pollution concerns. With the textiles and apparel sector representing the backbone of the country's economy, it is proving difficult to balance environmental needs with those of this valuable and politically powerful industry (World Bank, 2014; Yardley, 2013).

After tragic accidents in Bangladeshi textile factories in 2012 and 2013, the European Union threatened sanctions if working conditions for labourers were not improved in Bangladesh (Spiegel & Wilson, 2013). Although these sanctions were never imposed, importing countries such as Switzerland may find the environmental price for goods too high to pay and impose trade restrictions, especially if pushed by public concern, in the future (see "reputational risks").

Reputational Risks

1,129 people were killed in a devastating collapse of a garment factory building in Savar in April 2013

Reputational risks for the textiles and apparel industry are substantial. The sector in Bangladesh has been under close public scrutiny since serious regulatory lapses were confirmed after a fire in a textile factory in Dhaka that killed 117 people in November 2012 and the devastating collapse of a garment factory building in Savar in April 2013 in which 1,129 people were killed. Unfortunately, it is common practice for textile brands to change suppliers when they see their sources under scrutiny in order to avoid reputational damage. These suppliers may not be under international focus while still operating under precarious conditions for both humans and the environment. On a positive note, the disasters have prompted some industry representatives from global brands and local producers to engage in a collective effort to upgrade working conditions and building safety in garment factories in Bangladesh (Curran & Nadvi, 2015; Nieuwenkamp, 2014).

Initiatives such as Greenpeace's Detox Campaign have already mobilized global fashion leaders to commit to the elimination of hazardous chemicals from their clothing and are important triggers for a paradigm shift in the textile industry. It remains to be seen if this shift will take place before an environmental disaster brings the severe environmental issues of this sector into international focus (see Pulp and Paper on page 38 for another example of a sector's reputational risk regarding toxic chemicals). Given the present state of Bangladesh's water resources, the human health implications, and the textile sector's involvement with these issues, it is likely only a matter of time until they become a target of global public awareness.

Introduction
Retail and Financial Services

Indirect Water Risks

The water risks for the retail and financial sectors are mostly indirect since they are often connected to suppliers (retail sector, especially from agriculture) and investments and/or in the countries they invest in (financial services sector) rather than direct operations. Retailers rarely own the farms and processing plants that are supplying them. The same applies for a bank's investment portfolio. Though all economic sectors are represented in the financial services sector, water risk is more easily identifiable among some sectors.

Depending on the supplier or investment, simply shifting to other opportunities might not be an option. Thus, the relationship between the retail sector and its suppliers and the financial services sector and its investments requires new ways of risk mitigation.

8 Retail

The retail industry has been transformed by globalization. Water is no longer a local concern but rather a global one. Vast quantities of water flow into the production of retail goods. The retail industry has been transformed by globalization. Water is no longer a local concern but rather a global one. Vast quantities of water flow into the production of retail goods. In fact, the amount of water used for the production of everyday items like a glass of orange juice (200 litres for 200 ml) or a new cotton T-shirt (2,500 litres of water) far exceeds Switzerland's daily per capita water use of 142 litres[124, 125]. Often, the so-called 'virtual water' used to produce these commodities comes from regions with water deficits. This is why one of the looming questions involving water consumption in retail is not about 'internal' water resources, but 'external' resources (WWF-Switzerland, 2012).

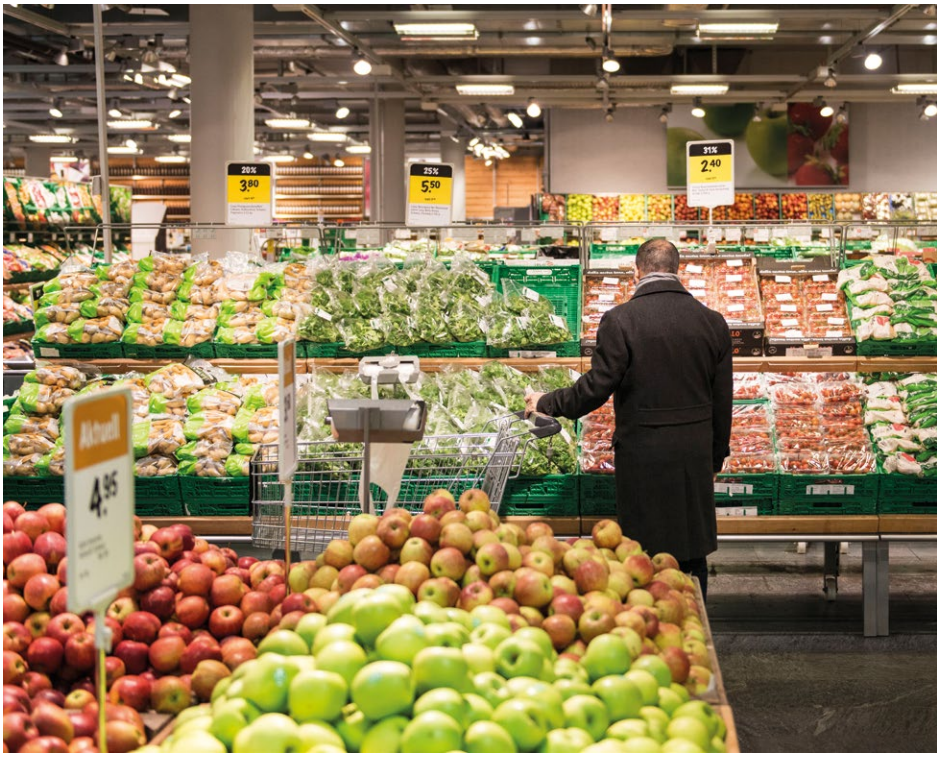
Sector water risk and water intensity

Switzerland's water footprint – the volume of water used to produce all goods and services consumed by a country's inhabitants – is 11 million m^3/year or 30 billion litres/day. This correlates to an annual average footprint of 1,500 m^3/year/capita, which exceeds the global average of 1,385 m^3/year/capita. More importantly, 82 % of this figure comes from 'external' water sources (WWF-Switzerland, 2012). This is no surprise as Switzerland is the 18th largest global importer[126], while being only the 97th largest country based on population size[127].

Switzerland's indirect exposure to water-related risks through suppliers can be very high, especially for food and apparel retailers (see also sector description in 6 Agriculture and 7 Textiles and Apparel and Table 13 for a general overview of the retail sector's water-related risks). Agricultural products are particularly dependent on water for irrigation, cleaning, processing, power generation, and transportation. A supplier's water use (like agriculture) may ultimately impact overall water availability in a significant way, especially when located in a threatened water basin.

According to a 2010 survey by CDP, few retailers were able to identify which of their operations were located in water-stressed areas (CDP, 2010). While some retailers feel that their suppliers' water-related issues are not their concern, others have established good relationships with reliable suppliers that provide good quality, quantity, and well-priced products. If water risks – caused by for example the unavailability of sufficient amounts of unpolluted freshwater, stricter regulations, or community conflicts – interrupt supplies, retailers often change suppliers.

124 http://waterfootprint.org/en/resources/interactive-tools/product-gallery/
125 http://www.bafu.admin.ch/umwelt/indikatoren/08605/12306/index.html?lang=en
126 http://atlas.media.mit.edu/en/profile/country/che/
127 http://esa.un.org/unpd/wpp/



Retailers face direct and indirect water risks related to their product supply chains. For food retailers these risks are often connected to agricultural production

For certain commodities (tropical fruits, vegetables in winter, cotton, etc.), simply shifting supply chains will no longer be a sustainable option. Limited land, a growing population, changing global consumption patterns, and climate change will have huge effects on availability, quantity, quality, and ultimately the price of these goods. There will be increasing competition between national and international retailers especially for commodities produced in water scarce regions. Furthermore, consumers are becoming increasingly conscious of the social and environmental costs associated with the products they buy, including water. A growing trend in the retail industry has been the introduction of various labels and certifications.

In order to sustainably handle water risks related to suppliers and producers, retailers have to start analysing their product-related risks at the farm, factory, and river basin-level. Depending on the commodity, they will have to find ways to support their suppliers and producers efforts towards the sustainable development of water resources beyond a given farm or factory. It is essential that products from water scarce regions not be avoided. These areas are often impoverished and shunning their goods would only exacerbate their situation. By managing water risks responsibly, the threat to local water resources can be diminished. It is the responsibility of Swiss retailers to tackle this challenge (WWF-Switzerland, 2012).

Physical risks	**Basin**	Relatively low due to low direct consumption and opportunity to switch suppliers in case of supplier interruption. • Freshwater availability (quantity) for suppliers might be under pressure due to increasing demand from other basin users. • Other basin users may pollute freshwater sources (quality).
	Company	Indirect water usage; therefore risk is limited. Water scarcity or contamination of water sources may interrupt retail suppliers. • Indirect water usage, especially from agricultural suppliers, is significant. • Changes in precipitation patterns, severe drought, and flooding due to climate change may interrupt supplies since the most significant water use is embedded in crop or livestock production, and potable water is a non-substitutable ingredient for beverage products.
Regulatory risks	**Basin**	Some potential risk for suppliers, which may impact competitive position of retailer: • No or limited regulation or no or limited enforcement by local government can impact water quantity and quality in basin. • If operating in a multi-national basin, differences in regulations and enforcement per country can have greater impact on water quantity and quality downstream.
	Company	Direct risk is expected to be limited. However, the risks may be significant for suppliers. • Increasing competition with other water users in the basin may lead to withdrawal of water rights. • Tighter regulations and increased governmental enforcement may increase cost for freshwater and wastewater treatment and discharge, which would lead to price increases.
Reputational risks	**Basin**	Reputation may be damaged by selling products that require a lot of water and are produced in risky water basins. Decline in economic, social, and physical well-being of consumers due to lack of access to clean water may affect market growth for retailers located in that area.
	Company	Most significant for retailers as consumers become more sensitive to the impact of their purchases on the environment and local populations. • Depending on the situation, consumers may decide to refrain from buying certain products in the store or not to shop in the store at all. Potential causes of brand and reputation damage are: • Agricultural runoff and wastewater, which may have negative impacts on local water sources and ecosystems. • High water usage in areas where population lacks drinking water.

***Table 13** – A general overview of water-related risks for the retail sector*

9 Financial Services

Over the past 20 years, the Swiss financial sector has grown at an above-average rate relative to the Swiss economy. While GDP grew by a factor of 1.6, the Swiss financial sector's proportion of the GDP almost doubled. In 2014, the Swiss financial services sector contributed 10.2 %, or CHF 66 billion to Swiss GDP (FDF, 2015). The financial services sector encompasses a diverse range of organisations and structures with business models that differ significantly, from commercial to investment banks, institutional investors to insurance companies and the insurance business, as well as a range of intermediaries. As a financial centre of global relevance, asset and wealth management play a prominent role. The Swiss insurance sector is growing much faster than the banking sector, yet both contribute equally to the GDP (SIF, 2015).

Many "real economy sectors" are linked to and influenced by the financial services sector and thus, their water risks are embedded in any investment and financing portfolio that includes them. Consequently, strategies to mitigate water risk have to be tailored towards the relevant and subsequent business models of the specific financial institution. Interaction between financial institutions and companies found in the real economy is essential to setting the right criteria, dealing with information requests, and ultimately reducing relevant water risks. Sectoral and company specific water-related risks impact financial institutions variously – from business risks increasing probability of default, to value impairment to investments and assets, or to new business opportunities[128].

Water is a more material risk than, for example, climate change risks, though both of course are inter-related. Water-driven hazards can have more direct impact and are harder to predict than before as a result of growing water demand due to the growing world population, unpredictable impacts of climate change, ongoing urbanisation, and a change in consumption patterns. Impacts of a changing climate are expected to lead to further increased risks related to water.

Financial service providers consider water risk to be the next emerging issue

This explains why financial service providers consider water risk to be the next emerging issue beyond climate change related risks and are starting to pay attention to their client's exposure to water-related risks and inter-dependencies. If these risks materialise, the effects will most likely have direct consequences for portfolios, financing and investment activities, and the business performance of financial service companies. Beyond the increasing awareness of water as a material risk issue, reputation is another driver for financial institutions to better understand the issue[129]. Due to intensified public and shareholder awareness, a financial institution's reputational risk will increase if a client demonstrates insufficient water risk management. In the past few years, the number of environmental and social policy resolutions filed by investors has strongly increased, especially in the USA (CDP, 2013).

128 Findings / Assessments based on WWF-Finance sector experts
129 Findings / Assessments based on expert interviews with Swiss banks and asset managers

Financial institutions can make a positive difference by taking into account aspects like sustainable water management, efficient water use, alternate approaches to water supply, water pollution minimisation, and water resource recycling

As financial institutions are a key enabler of economic development, they can also be key enablers of sustainable development. They can make a positive difference by taking into account aspects like sustainable water management, efficient water use, alternate approaches to water supply, water pollution minimisation, and water resource recycling – all put into the perspective of the given river basin's specific circumstances.

Sectoral water risk

Seasonal droughts and floods, bad water quality, and changes in water-related regulations are risks faced by financial institutions through their investment, financing, or insurance portfolios (see Table 15 for a general overview of the financial sector's water-related risks). Insurance companies should be aware of their client's resilience to water-related risks and management strategies because they can be simultaneously affected as insurers and investors.

Strategies to understand, capture, and measure potential and actual water-related risks for financial institutions can vary greatly, from actively hedging against weather-related effects to properly understanding, engaging, and cooperating with companies to become resilient or adjusting their business models to the causes and effects of water-related risks. Some development banks have made good strides in reducing the water risk in their portfolios by providing technical assistance to their clients (UNEP FI & UNEP GPA, 2006). It is becoming increasingly more commonplace for public and private decision-makers to develop and implement mitigation strategies and new technologies to address future challenges, increasing water demand, and climate change impacts (World Economic Forum, 2016).

The exposure towards water risks highly depends on the specific business model of the actors in the financial sector. According to the different business models, the actors in the financial sector need to develop their own understanding of where water risks are materially relevant for their portfolio and/or performance and how to best integrate them into decision making processes (see Table 14 for a selection of some of the most important).

In recent years, the financial services sector has become increasingly aware of water-related risks and the need to establish adequate mitigation strategies. Access to reliable data regarding water risk exposure remains a challenge for financial institutions to better integrate water-related risks into their decision making. Similarly to climate change risks, water risks require cross-sectoral thinking; however, the financial industry is usually organised in a sector-specific structure. To properly understand water risks, detailed regional and even basin-related information relevant to the specific company is required. Unfortunately, information availability is limited and/or cost intensive.

Information on water risks is increasingly more accessible also for mainstream analysts

Initiatives like the Equator Principles and the UN Principles for Responsible Investment have contributed to raising awareness and prioritising water risks. Another initiative is the CDP Water Program, which has contributed to more transparency related to companies' water-risk. It was recently announced that a group of global banks, including UBS Switzerland, are working with the Natural Capital Declaration and the German Government's Emerging Markets Dialogue on Green Finance to include the economic impact of drought in bank stress testing scenarios. The Natural Capital Declaration has been working on a tool for corporate bond credit analysis on integrating water stress factors into credit assessments of bond issuers in the beverages, mining, and power utilities sectors. It can be observed that information on water risks is increasingly more accessible also for mainstream analysts. A Water Risk Valuation Tool[130] released by Bloomberg LP enables analysts to incorporate water risks into company valuations for copper and gold mining companies.

130 https://www.bloomberg.com/bcause/new-tool-integrates-water-risk-considerations-in-equity-valuation-process

Financial services sector	Relevance of water risks based on	Example of processes relevant to water risks	Trends and observations
Commercial and universal banks	Lend money directly to customers / companies	Risk of default and credit risk deterioration if companies/ debtors are affected by water risks (e.g. water scarcity threatens agribusiness profits leading to default).	Global banks are more likely to be exposed to increasing water related risks compared to domestic Swiss banks. Due to this, global banks have progressed in assessing water risks as part of their environmental-risk processes on a transaction basis. However, the majority of banks have not yet started to analyse water-related risks systematically on either a transaction or a portfolio basis (WWF/KPMG, 2012; KPMG, 2015.
Investment banks and corporate finance	Help businesses raise money from other firms in the form of bonds (debt) or stock (equity)	Water risks related to commodity trading (e.g. palm oil, cereals) impact the business directly, as well as future prices on commodity markets (see also chapter 6 Agriculture). This can impact the ability to pay interest or repay debt.	Recently, banks have started to develop "water-stress-testing-approaches" to understand their exposure towards water risks also on a portfolio-perspective.
Development banks and other government-sponsored enterprises	Government-sponsored organisations (e.g. World Bank) invest in and provide credit to companies and infrastructure in developing countries	Similar to retail and universal banks, but with even greater reputational pressure for sustainable financing.	Government banks and other government-sponsored enterprises, which are particularly sensitive towards reputational risk, have been leading in assessing and integrating water-risks.
Asset-/ and Wealth management	Offer a conglomerate of financial services from more than one sector; mostly manage third party funding	The value of investments made in asset management processes (buying of shares, property, etc.) can significantly decrease due to water risks connected to the asset.	Leading asset managers in sustainable investment are analysing the exposure to water risks of companies within their sustainable investment process. Most recently, some have also begun analysing their own exposure to water risks also on a portfolio level. However, the market share of sustainable investments is still small (at the end of 2014, approximately 1 % of assets managed in Switzerland were invested sustainably (FNG, 2015)). Assessing and integrating water risks into mainstream investment processes is still in its infancy.

***Table 14** – Some of the most important branches in the financial services sector and examples of associated water risks*[131]

131 WWF market knowledge and expert interviews

Financial services sector	Relevance of water risks based on	Example of processes relevant to water risks	Trends and observations
Investors and Asset Owners	Institutional investors, such as pension funds invest on behalf of their beneficiaries and according to their fiduciary duty. Some institutional investors such as life insurances, pension funds, trusts or churches have rather long-term investment horizons.	The value of investments made in asset management processes (buying of shares, property, etc.) can significantly decrease due to water risks connected to the asset. Investors also bear a high reputational risk as the real or perceived impacts of a company's operations on communities and environmental habitats may negatively impact the investing company's reputation.	Asset Managers describe an increasing demand for transparency regarding water risk exposure from certain ethical investors, namely from Scandinavia. Compared to other European countries, institutional investors in Switzerland have been more reluctant concerning sustainable investments and water risks are not yet high on the agenda. Recently, some state-related institutional investors in Switzerland (e.g. PUBLICA or Suva) have started to integrate ESG (Environmental, Social and Governance) criteria into their investment decisions, which may lead to more awareness about water risk in investments.
Insurance companies	Provide cover for selected risks and transfer those risks to capital markets in other forms	Underestimating water-related risks caused by hydrological changes in water basins, regulation, and reputation can cause additional risks for clients and lead to an increased number of claims.	As managing risks is the key function of their business model, insurance and re-insurance companies have been early movers in assessing water risks in underwriting. However, they also see freshwater shortages as an opportunity to grow their business. As companies become more concerned about potential water supply shortfalls, they will likely seek insurance against business interruption.
Re-insurance companies	Take primary insurance cover policies and restructure them to market to other investors or insurance companies, allowing primary insurers to reduce their risks and protect themselves from very large losses	Claims are caused because of business interruption due to natural disasters like droughts or flooding or regulatory changes. House/property insurance (damage of flooding, fire) and liability/indemnity (claims of reduction in water quality/quantity through pollution/over-abstraction) are particularly affected.	

Physical risks	**Basin**	Most financial institutions and insurance companies still seem to ignore the importance of knowing the freshwater context that their clients or suppliers are operating in. • Freshwater availability (quantity) may be under pressure due to increasing demand from other basin users, and other basin users may be polluting freshwater sources (quality).
	Company	Underestimation of water- related risks for assets, debtors, commodity suppliers and clients, resulting in financial risk. • Due to lack of understating of water-related risks. • Due to lack of information or water-related risk evaluation methodologies. • Water-related risks are different for each of the clients and suppliers, due to different industries and basin contexts.
Regulatory risks	**Basin**	No or limited regulation or no or limited enforcement by local government can impact water quantity and quality in basin and therefore increase financial risks. • E.g. If governments sold more water than available, if there is a large difference in regulation and enforcement in different countries in the same basin, or if enforcement is insufficient.
	Company	Stricter regulation and increased enforcement by government may increase costs for freshwater and wastewater treatment and discharge and therefore the bottom line performance of assets, debtors, and commodity suppliers. • Regulation to force companies to use innovative production technologies to reduce impact on water. • Potential price increase or changes in pricing structures. Regulators may force insurance companies to cover more water risks. • This can result in higher uncertainties and potential claims, which in turn may impact prices and even presence in certain countries.
Reputational risks	**Basin**	Assets, debtors, or commodity suppliers in high water risk geographies (basins) may negatively impact reputation. • This can be the case even though the specific investment is highly efficient and not polluting water.
	Company	Assets, debtors, or commodity suppliers in high water risk industries may negatively impact reputation. • In general, the public and insurance company clients are becoming increasingly sensitive to impacts on local environments and populations. Risk that claims are partially covered by insurance companies, while general public is expecting full coverage, • Ensure clients understand their water-related insurance policies.

***Table 15** – A general overview of water-related risks for the financial services sector*

10 Water Stewardship – From Risk to Opportunity

As presented in the previous chapters, water risks vary from country to country and from sector to sector. Certain risks, typically those related directly to the production, such as water consumption or pollution, can be relatively easily addressed by producing companies themselves. However, depending on a company's operation and supply chain, the company may only be affected indirectly by these risks. A retailer shares the risk of its entire supply chain, be it coffee from Viet Nam, oranges from South Africa, or t-shirts made in China.

Many risks only emerge because various stakeholders use the same water source. Thus, the root cause of water risk is often not the availability or use of water, but governance; unless an entire river basin is managed in a sustainable way, one company's improved efficiency will likely be overshadowed by increased use from a competitor or a neighbouring community. This makes water the ultimate shared resource – and everyone's responsibility (WWF, 2013).

Because of these reasons, shared water risks cannot be addressed by one stakeholder alone. Collective action is needed at the local and basin level. This typically involves some degree of cooperation with other stakeholders and governments, a sometime difficult process (Lloyd's, 2010). Water stewardship can help to facilitate this process and to implement collective actions at both the local and basin level.

Water Stewardship

Water stewardship means contributing to the responsible and sustainable management of freshwater resources and finding solutions for shared risks in a specific river basin

Water stewardship goes beyond being an efficient water user. It means contributing to the responsible and sustainable management of freshwater resources and finding solutions for shared risks in a specific river basin. Consistent with this idea, sustainable business engagement should not simply be a matter of corporate social responsibility (CSR) or public relations. There is an essential business case for achieving sustainable flows – access to clean water in order to sustain production and profitability. It is important for companies to understand that if they undertake water-related activities from a CSR perspective alone, it is unlikely that they can address the underlying water risks they face or leverage the potential opportunities. Companies and investors that evolve from understanding their portfolio's water risks towards implementing water risk management strategies decrease their risk exposure. Becoming a good water steward requires shifting from ad hoc and philanthropic initiatives to recognizing water as a strategic and core business issue that is material to profits and long-term opportunities for growth.

The Alliance for Water Stewardship defines water stewardship as:

"The use of water that is socially equitable, environmentally sustainable and economically beneficial, achieved through a stakeholder-inclusive process that involves site and catchment-based actions. Good water stewards understand their own water use, catchment context and shared risk in terms of water governance, water balance, water quality and important water-related areas; and then engage in meaningful individual and collective actions that benefit people and nature." [132]

Notes:

- Socially equitable water use recognizes and implements the human right to water and sanitation and helps to ensure human wellbeing and equity.
- Environmentally sustainable water use maintains or improves biodiversity, ecological, and hydrological processes at the catchment level.
- Economically beneficial water use contributes to long-term sustainable economic growth and development and poverty alleviation for water users, local communities, and society at large.
- Internal actions: within the site and under the responsibility of the site management.
- External actions: in collaboration with others in the catchment and including actions in the supply chain and the catchment as a whole.
- Water stewardship is intended to support and contribute to Integrated Water Resource Management by all actors.

The following steps (Figure 1) help define WWF's concept of water stewardship. The steps were designed to better understand the various water-related activities that companies can engage in, but not to be a comprehensive description of action for every company. While they are simple in definition, there is a lot of depth and detail to each step. There is also overlap between steps, meaning that they should not be seen as prescriptive and contained, but rather fluid and iterative. The local nature of water will dictate where some companies will have to prioritise, as will the level of risk as dictated by the business sector and geography (WWF, 2013).

132 http://www.allianceforwaterstewardship.org/about-aws.html#what-is-water-stewardship

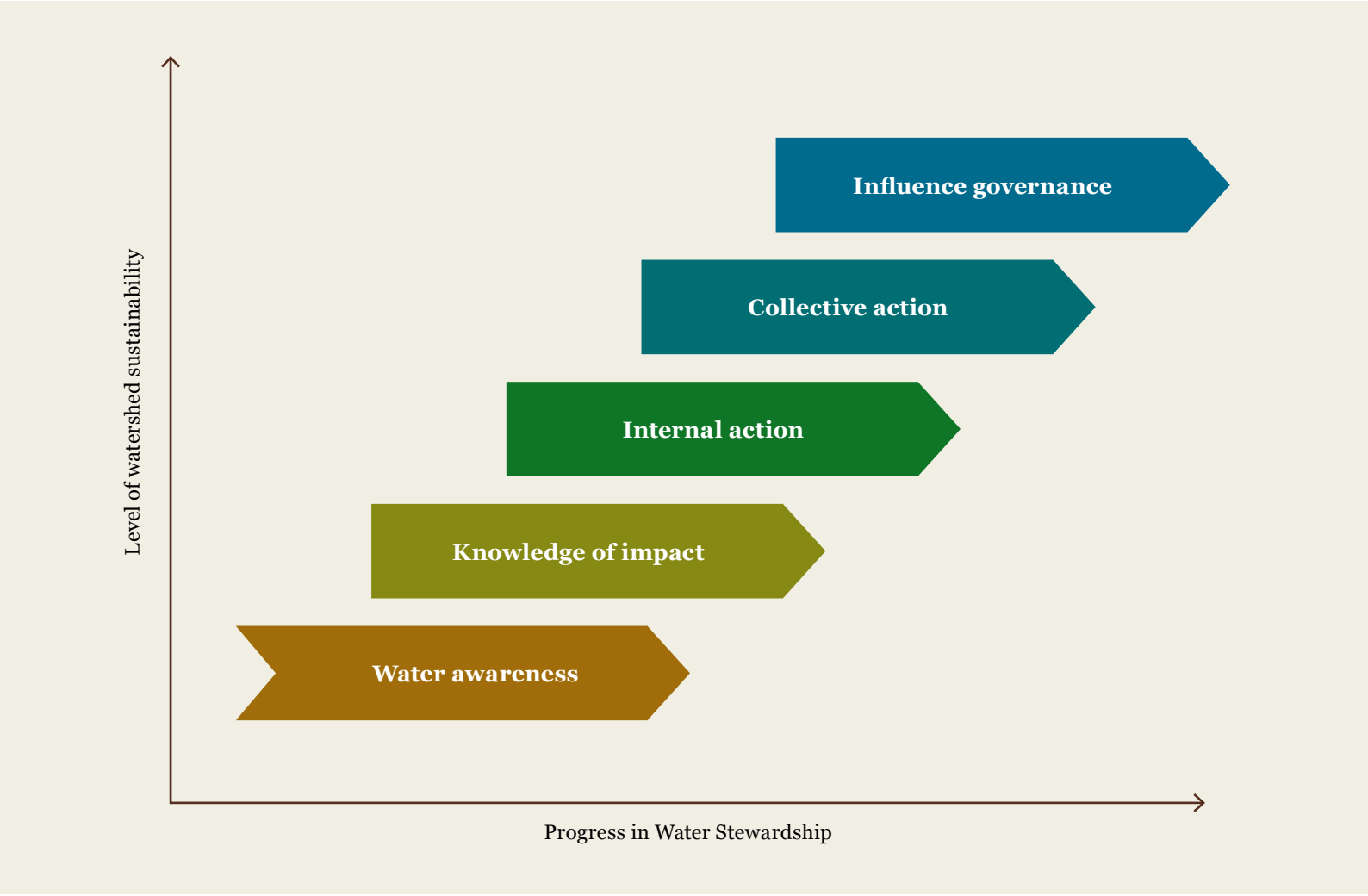


Figure 1 *– The five steps of WWF's concept of water stewardship*

Collective action and influence of governance is where a company shifts from management to stewardship

The first three steps in Figure 1 are materially distinct from the next two. Water awareness, knowledge of impacts and internal action are under direct control of a company. They concern internal impacts on water resources, efficiency of water use, and private goods. On the other hand, step four and five – collective action and influence of governance – are outside the direct sphere of influence and concern impact of others on the company, allocation of resources and public goods. This is where a company shifts from management to stewardship – where the rules, measures, focus, engagement, control and complexity change considerably – and where traditional notions of business sustainability are most challenged by the resource.

Influence governance

- Advocacy, influencing or lobbying, partnerships, financial support, facilitation or institutional strengthening at the local, watershed, state or national level.

Collective action

- Engaging with stakeholders at various levels (global forums to local water groups). This can include participation in public forums to address water management issues; support for freshwater conservation projects; partnerships to pool technical, human, and financial resources to conserve freshwater resources; participation in collective actions to improve water management.

Internal action

- Putting a strategy in place with goals and measures: launching water efficiency projects; engaging with employees, consumers and marketing to address opportunities and risks; improving water quantity and quality reporting; preventing pollution.
- Engaging suppliers and assessing options such as alternative sourcing, product innovation, or improved management of water in raw materials production.

Knowledge of impact

- Understanding the company's water footprint: direct (company operations) and indirect (supply chain) water dependencies.
- Analysing water risks (e.g. with WWF Water Risk Filter) and estimating impact on water resources. Risks should cover physical (e.g. quantity, quality), regulatory (e.g. legislation, enforcement) and reputational (e.g. media attention, community conflicts).

Water awareness

- High-level understanding of global water challenges, the company's dependence on freshwater, and its exposure to water-related risks.
- Internal commitment from the CEO to plant managers, suppliers, and employees.
- Understanding of how the company is perceived by others, including basin stakeholders, the press, and consumers.

11 Call to Action

WWF believes that now is a perfect moment for business to anticipate the trends and search for long-term, smart water strategies that benefit more than just the bottom line.

Water risk situations around the globe will worsen in the future. Rising populations, changing consumption patterns, and climate change will directly affect water availability and quality. Water stewardship allows stakeholders to mitigate risks that they have traditionally not been able to address. Still, the concept is fairly new and there is a lot of room for development.

WWF has been actively involved with water stewardship since its inception – be it through local projects or international discussions – and has thus seen approaches succeed and fail. WWF is convinced that the challenges ahead can only be faced if all parties are engaged in the dialogue, adopt working and develop new strategies, and act together. Depending on the scale of work, there will be champions and followers. No matter how a company decides to engage, every action counts.

Companies – be water conscious!

Ultimately, companies bear the consequences of water-related risks. However, it is in their power to mitigate these risks in their direct operations or by defining standards within their supply chains. Many companies already recognise the value of water as a strategic resource for corporate success. Accordingly, they have begun developing and implementing strategies for its responsible and sustainable use.

Swiss companies can become model water stewards by:

- **Identifying risks, impacts, and responsibilities** related to water. Water risks affecting Swiss companies are primarily external. Therefore, the first step towards risk mitigation is understanding the entire supply chain and the concrete risks. Managing risks without full knowledge of a commodity's origin and processing is difficult, if not impossible.

- **Going beyond water management.** Companies need to unite with scientists, NGOs, government agencies, and other stakeholders to develop and implement company-specific water stewardship strategies. By using the collective insight of local governments and civil society, companies can more comprehensively consider risks. Companies can also help reduce water risks by investing in long term supply relationships. This will provide their supply partners with the means to engage in sustainable production and – if applicable – to invest in the latest technologies (i.e. TCF technology for pulp and paper) or obtain certification.

- **Engaging in collective action** for sustainable water management together with regional and local stakeholders in river basins at risk. This means direct communication with local food and textile producers as well as retailers with an aim towards developing sustainable sourcing solutions. Also, if the extractives sector were to engage with mining operators, together they could reduce the impact on local water resources and quality (e.g. spills in mines and along pipelines, toxic wastewater leakages). Companies need to combine efforts and good practices with those of allies who share their values and vision and involve them in internal processes.

- **Applying available sector-specific solutions.** Some industries have already developed sector-specific guidelines on water stewardship, like the IPIECA Water Management Frameworks standards (IPIECA, 2013) for oil and gas companies or the International Council on Mining&Metal's Water Stewardship Framework (ICMM, 2014). For the agriculture sector, solutions need to be both site-specific and commodity-oriented. There are already a number of standards that provide guidance for certain commodity/site combinations (WWF-Germany, 2015).

- **Daring to innovate.** Development of new sector-specific solutions (e.g. guidelines, tools) where none exist and continue developing existing standards. Companies should take into account standards that provide specific guidance on water stewardship, such as AWS[133].

- **Driving transparency and disclosing its actions** through organisations, such as CDP[134]. Sharing knowledge about local water problems with other stakeholders, such as indigenous communities, NGOs, and governments will help safeguard water resources.

- **Ensuring compliance with legislation, including by suppliers.** Companies need to advocate for strong governance and consistent, predictable legislation.

Investors and financial institutions – don't turn a blind eye to risky clients!

It is essential for investors and other financial institutions to assess, manage, and mitigate water-related risks for individual transactions, clients, or investments as well as across their overall portfolio. As described in chapter 3 Methodology, the financial services sector is very diverse and adequate responses to dealing with water risk analysis and mitigation must still be developed in many branches. Such strategies include assessing own water risk exposure, embedding water risk in the risk assessment processes, defining appropriate risk integration measures as a cornerstone of the decision-making process, as well as embracing engagement strategies with their clients. Pushing portfolio companies or clients to mitigate water-related risks and associated impacts is of great importance for ensuring the financial performance of those investment portfolios, loan books, and other forms of related financial service. It may also trigger companies to behave more responsibly.

Investors and financial institutions can become model water stewards by:

- **Developing standards and policies for water risk analysis and impacts** in their internal decision-making processes.

- **Systematically assessing investments, clients, transactions, and portfolios** for water-related risks.

133 http://www.allianceforwaterstewardship.org/about-aws.html#what-is-water-stewardship
134 https://www.cdp.net

- **Developing and agreeing on standardised water risk disclosures at different levels** (company / asset, financial product, portfolio).
- **Disclosing water risk exposure** and openly demonstrating water risk mitigation actions.
- **Engaging with company management boards** to ensure water risk management policies are in place.
- **Including water-related risks in decision-making processes,** such as environmental and social risk frameworks for underwriting or credit business or the investment processes in asset management.
- **Developing sector-specific sustainable water risk reduction strategies** to address and provide technical assistance for risky clients and/or investments. Aiming towards mitigating risks alongside local strategic stakeholders.
- **Adhering to initiatives** such as the Equator Principles[135], UNEP Financial Initiative's[136] water stewardship scheme, or CDP water program and developing industry-specific codes of practice.
- **Excluding clients** that do not appropriately address and manage water-related risks regardless of active and regular attempts to engage with them on their portfolios.
- **Proactively supporting companies** that are seeking to reduce water-related risks (i. e. reward water stewardship in the market place).

Government – initiate and collaborate!

Although there is room for improvement when it comes to water governance and some water protection regulations, the current Swiss Water Protection Act and its corresponding ordinance lay out a firm and tangible framework for the restoration of rivers, water engineering, and the refurbishment of hydropower stations. However, this does not address the issue of the high water-related risks facing the countries and water basins whose resources are used to produce the many foreign goods consumed in Switzerland. Outdated or poorly enforced public policy in these countries along with weak water management institutions often increase water-related risks for everyone. Therefore, the Swiss government has a responsibility to mitigate water risks, in particular in countries from which Switzerland imports its goods.

135 http://www.equator-principles.com/
136 http://www.unepfi.org/

The Swiss government can become a model water steward by:

- **Establishing a comprehensive understanding of the international water risks** the Swiss economy is exposed to.

- **Introducing water stewardship targets** into the strategies of relevant Federal Offices in order to ensure the responsible and efficient use of natural resources consumed by the Swiss economy.

- **Developing mandatory sustainable water criteria** for sourcing in countries with high water-related risks. This process includes engaging with companies and requesting them to disclose their supply chains. Shining a light on potentially problematic suppliers will ultimately also benefit the companies themselves.

- **Introducing the same criteria to public procurement processes.**

- **Ensuring the inclusion of all relevant stakeholders** of the economy, civil society (including indigenous people), and NGOs in the implementation of basin management plans. Implementing traditional knowledge into management solutions ensures the active involvement of local stakeholders and sustained success.

- **Collaborating with key businesses** on shared risk and collective action for at-risk water basins that are important to the Swiss economy.

- **Engaging with governments** (also beyond development aid) in selected high water risk countries and river basins that are important to Swiss trade and consumption, and developing a deeper understanding of the economic importance of water in local river basins. Supporting the development and implementation of meaningful basin management plans will secure economically vital water resources.

- **Delivering on Switzerland's international commitment to the 2030 Agenda for Sustainable Development (SDG),** including those linked to water risk mitigation[137]:
  - Ensure availability and sustainable management of water (Goal 6)
  - Ensure sustainable consumption and production patterns (Goal 12)
  - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (Goal 15)

- **Delivering on Switzerland's international commitment as a Party to the UN Convention on Biological Diversity (CBD)** and ensuring that the Aichi Targets addressing water risks are met by 2020[138]:
  - Sustainable production and consumption (Target 4)
  - Sustainable management in agriculture, aquaculture, and forestry (Target 7)
  - Pollution (Target 8)
  - Ecosystem services (Target 14)
  - Ecosystem resilience (Target 15)

137 https://sustainabledevelopment.un.org/sdgs
138 https://www.cbd.int/sp/targets/

Consumers – demand better!

Globalization has made it increasingly difficult for consumers to know whether their purchases are environmentally sustainable. However, consumers have the power to wield change by demanding sustainable choices from companies. They are in a position to push companies to work with socially responsible suppliers, to invest in sustainable solutions, and to take water resources seriously. Consumers must be attentive to the sustainability of their purchases and force companies to be responsible.

Consumers can become model water stewards by:

- **Buying quality products that stand the test of time.** High quality products last longer and buying less ultimately has the highest impact on protecting water.
- **Buying goods produced in an environmentally friendly manner** (e.g. certified products like organic for food or FSC for forestry and paper products).
- **Consuming a diet higher in plant-based proteins** (e.g. legumes, nuts, beans and soy instead of meat, sausages, dairy and eggs).
- **Choosing seasonal and locally-produced fruits and vegetables** that do not involve additional irrigation.
- **Informing themselves about the origin of products** and their associated water issues. Request that companies disclose their supply chains.
- **Demanding transparency** from companies through various channels (including at point-of-sale) and reconsidering purchases that are not sustainable.
- **Demanding companies only source sustainable goods** rather than forcing consumers to choose what is sustainable.
- **Supporting government and company action on water stewardship** as citizens.

Annexe I

	Import Quantity (kg)	Import Value (CHF)	Percentage of Import Quantity	Physical Risk	Regulatory Risk	Reputational Risk
Germany	6,018,217,492	3,444,395,615	44 %	🟠	🟢	🟠
France	1,311,934,288	1,838,806,054	10 %	🔴	🟢	🟠
Netherlands	1,238,565,437	608,977,827	9 %	🟠	🟢	🟠
Nigeria	1,143,015,000	456,694,213	8 %	🔴	🔴	🟠
Italy	1,006,901,107	579,391,202	7 %	🔴	🟢	🟠
Belgium	928,592,971	502,608,833	7 %	🔴	🟢	🟠
Mexico	510,490,049	203,823,227	4 %	🔴	🔴	🟠
USA	359,540,215	139,535,895	3 %	🔴	🟢	🟠
Kazakhstan	247,251,385	104,982,863	2 %	🔴	🔴	🟢
Austria	203,312,116	339,264,861	1 %	🔴	🟢	🔴

Table I *– Top ten countries from which Switzerland imports oil and fuels and their water risk (based on import quantity). For the role of Germany, France, or the Netherlands in oil imports, see Methodological limitations*

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