Water Risk Filter Research Series

TACKLING GROWING WATER RISKS IN THE FOOD SECTOR

HOW SCENARIO ANALYSIS CAN HELP FOOD RETAILERS UNDERSTAND FUTURE RISK AND BUILD RESILIENCE

ACKNOWLEDGEMENTS

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FOREWORD EDEKA

Among Germany's top retailers, EDEKA has long been one of the most engaged in improving the sustainability of our operations on every level.

In 2012, EDEKA established a long-term strategic partnership with WWF with the aim to reduce our ecological footprint by improving our environmental performance with a focus on eight core areas: fish and seafood, wood/paper/tissue, palm oil, soya/more sustainable livestock feed, climate, freshwater, packaging, and managing the procurement of critical agricultural commodities.

Globally, freshwater resources are under increasing pressure. In consequence, the food retail sector is one of the key sectors with high dependence and exposure to water risks through its variety of products and agricultural supply chains.

Therefore, when EDEKA's water stewardship work with WWF started in 2012, the WWF Water Risk Filter tool was used to assess current water risks across our global supply chain. More specifically, the physical, regulatory and reputational water risks for over 2,300 of our own brand products were analysed.

With the new Water Risk Filter scenarios now available, we aim to gain a better understanding of future water risks related to climate and socio-economic changes, which will help build resilience across our agricultural supply chain.

We are pleased that WWF is sharing main findings from the application of new water risk scenarios with this report, in order to identify future water risks of some popular agricultural products, as well as to present water stewardship projects that we are implementing with WWF to protect the world's precious water resources.

"As the largest German food retailer, EDEKA is using the new WWF Water Risk Filter scenarios to better understand future water risks to key agricultural commodities, which will help inform our long-term plans and strategy for climate and water resilience."

Rolf Lange, Head of Corporate Communications
EDEKA Headquarters

FOREWORD WWF

Freshwater is foundational to human wellbeing, economic prosperity and a thriving planet. Yet, water security is under threat from over-abstraction and pollution as well as climate change impacts and the continuing rapid loss of freshwater ecosystems and biodiversity. 84 per cent of freshwater species populations have been lost since 1970; much faster than terrestrial or marine species.

With agriculture alone responsible for 70 per cent of global freshwater withdrawals, water features as one of the highest business risk factors with food retailers. Identifying major water risks linked to sourcing and production is the first step in a responsible supply chain management for any food retail company. Such awareness, and a strong response, is also central to positioning brands in an era where consumers are increasingly turning to purposeful companies.

To help companies assess and respond to current water-related risks facing their operations and supply chains, in 2012, WWF launched the Water Risk Filter. It has since become a leading and trusted source of water risk data with over 6,000 users assessing over 400,000 sites so far.

As climate and socio-economic changes will affect how water risks evolve in the long-term, the WWF Water Risk Filter harnessed new data to inform forward-looking scenarios of water risks for 2030 and 2050. We are pleased to present this new feature, together with our strategic partner EDEKA, to provide a practical example of how food retail companies can better understand and prepare for future water risks in their agricultural supply chains in order to build together a sustainable future for all.

"With almost half of global GDP potentially coming from high water risk areas by 2050, the new Water Risk Filter Scenarios will help companies turn risk into resilience."

Philipp Wagnitz, Director Ecosystems and Resources
WWF Germany

1. INTRODUCTION

Water is essential to all people and economic activities, but this precious resource is under increasing pressure. Already today, 17 per cent of the global population and 10 per cent of the world's GDP come from regions of high-water risk – and by 2050 this could increase to 51 per cent and 46 per cent respectively.

Future changes in climate and socio-economic systems will impact both the use and availability of freshwater resources. On the one hand, socio-economic aspects related to population growth, economic development, governance and technological advancements will affect freshwater demands and use. On the other hand, the impacts of climate change will affect regional and seasonal water availability and supply in different ways across the world, primarily by altering precipitation patterns, increasing temperatures and more frequent extreme weather events (e.g., floods and droughts). As highlighted in the Global Commission on Adaptation's *Adapt Now Report*, climate change impacts will *"most immediately and acutely be expressed through water"*.

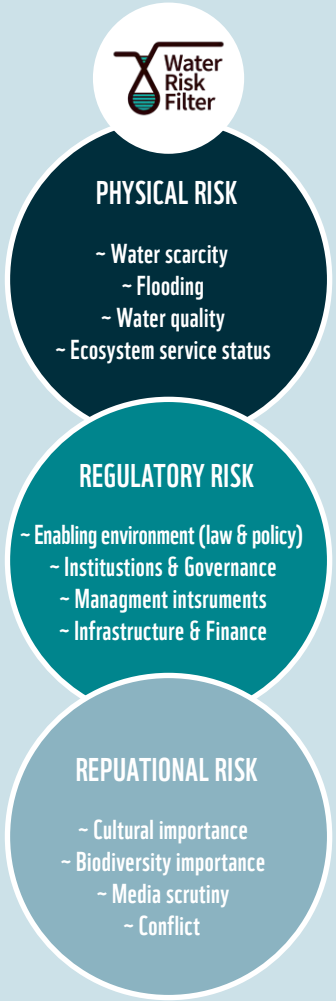
With worsening water security across the globe, water risks are already rapidly materializing for businesses and in turn impacting their bottom line, with a combined value at risk of US$425 billion reported by companies via CDP in 2019. As agriculture accounts for 70 per cent of global freshwater withdrawals and represents one of the biggest causes of water pollution worldwide, the food sector is at the forefront when it comes to water challenges. Key economic sectors with water-intensive agricultural supply chains such as the food retail sector are highly exposed to water risks now and in the future as described in Box 1. In particular climate change is predicted to cause raised variability and extremes in temperature and rainfall, which will affect the viability of agricultural operations, resulting in increased food prices and volatility, supply chain disruptions, and decrease in supply.

Given the high level of uncertainty regarding when and how the effects of climate change and socio-economic factors will manifest in the future, it is challenging for companies to understand how water risks may evolve and potentially impact their operations and agricultural supply chains in the future. Within this context of high uncertainty, the Task Force on Climate-related Financial Disclosure (TCFD) recommends that companies perform scenario analyses as an approach to assessing future risks and opportunities, which in turn will help to evaluate business resilience to a range of possible future states.

In collaboration with the German food retailer EDEKA, the new WWF Water Risk Filter scenarios were applied to explore the future water risks of five food products sourced by EDEKA from different cultivation regions across the world. Through this applied case study analysis, the report aims to highlight how the use of scenarios can help companies in the food sector understand future water risks across their agricultural supply chains. Furthermore, the report provides a set of recommendations to help companies develop and implement water stewardship responses and strategies for resilient agricultural supply chains.

Future changes in climate and socio-economic systems will impact both the use and availability of freshwater resources.

WWF WATER RISK FILTER
RISK ASSESSMENT FRAMEWORK



WATER RISKS IN THE FOOD SECTOR

Water risk for businesses refers to the ways in which water-related challenges potentially undermine business viability. A company can be exposed to physical, regulatory and reputational water risks through its agricultural operations and supply chains, which can manifest themselves in different financial impacts. Water risks can be further divided into two categories that shed light on the source of that risk: 1) water risk due to basin context (basin risk) and 2) water risk due to how water is being used and managed (operational risk).

Physical risks in agricultural supply chains can occur when there is insufficient water for crop production, poor water quality for irrigation or flood events devastate cropland areas.

- In developing countries, more than 80 per cent of the damage and losses caused by droughts are incurred by agriculture. But even in relatively water-secure Germany, harvests of various crops were reduced in 2018 and 2019 due to unusually dry growing seasons. Potato prices rose by up to one third due to increased costs of irrigation and reduced supply.
- Throughout the spring of 2019, severe flooding in the Mississippi River basin caused millions of acres of corn and soybeans to go unplanted, driving up futures prices of the primary ingredients for livestock feed and inflicting billions of dollars in damages — shares of Tyson Foods fell 4.8 per cent and shares of Sanderson Farms Inc. and Pilgrim's Pride Corp. fell more than 11 per cent over the same period.

Regulatory risks are caused from changing, ineffective, or poorly implemented water policy and/or regulations.

- Extended drought conditions may require governments to impose reductions in water withdrawals. For example, companies like Conagra Foods, General Mills, J.M. Smucker Co., Kellogg Co. and Kraft Heinz Co. Commodities sourcing a variety of commodities in the drought-hit Colorado River basin were impacted by imposed water abstraction regulations.
- In 2019, Diageo reported via CDP that the potential for increased regulation to restrict withdrawal volume is a key risk consideration for their brewery in Uganda, impacting potential for business growth.

Reputational risks occur when companies, including their supply chains, are associated with the negative impacts of poor water management affecting ecosystems and people.

- Following public pressure, Nestlé reduced their water abstraction in the French town of Vittel by 30 per cent in order to work towards a long-term stability of the groundwater level.
- Danone reported via CDP that water-intensive food solutions are increasingly under scrutiny of customers (end consumers and retailers), NGOs, public authorities and investors.

2. FROM RISK TO RESILIENCE: WWF WATER RISK FILTER SCENARIOS

Since its launch in 2012, the WWF Water Risk Filter has been a leading online tool used by companies to assess current water risk exposure. With the new WWF Water Risk Filter scenarios, companies are now able to better understand future water risks which will help inform resilience planning and strategy.

For companies in the food sector reliant on a diversity of agricultural products and activities, conducting a water risk assessment across the entire value chain poses challenges. As a first step, WWF recommends focusing on key agricultural commodities and manufacturing/processing activities of greatest strategic importance to the business (i.e., highest procurement volume/value) and with high dependencies and/or impact on water (i.e., high water footprint).

Establishing a baseline of current water risk exposure is a critical first step to then be able to explore how water risks are likely to evolve over the medium to long-term due to various climate and socio-economic factors. With the integration of new scenarios in the WWF Water Risk Filter, the tool now allows companies to build on assessments of current water risks to explore future water risks under different scenarios over a 10- and 30-year time frame (2030 and 2050).

In line with TCFD recommendations, the Water Risk Filter scenarios are based on a combination of the most relevant climate scenarios (IPCC Representative Concentration Pathways – RCP) and socio-economic scenarios (IIASA Shared Socioeconomic Pathways – SSP). More specifically, these scenarios are based on climate impact ensemble projections that account for climate (e.g., temperature, precipitation) and socio-economic variables (e.g., population, GDP), and represent the consequences and effects of climate and socio-economic changes on water resources. Accordingly, the pathways for the Water Risk Filter scenarios follow the respective narratives described in Table 1.

To tackle the complexity of water risks, the Water Risk Filter scenarios comprehensively cover all types of water risks, ranging from TCFD-focused acute physical risks (e.g., flooding) and chronic physical risks (e.g., scarcity, water quality, and ecosystem services status) to the less commonly explored regulatory and reputational water risks, which can cause significant potential impacts if overlooked. For more information on the underlying datasets and framework of the scenarios, read the tool's methodology documentation which is available online.

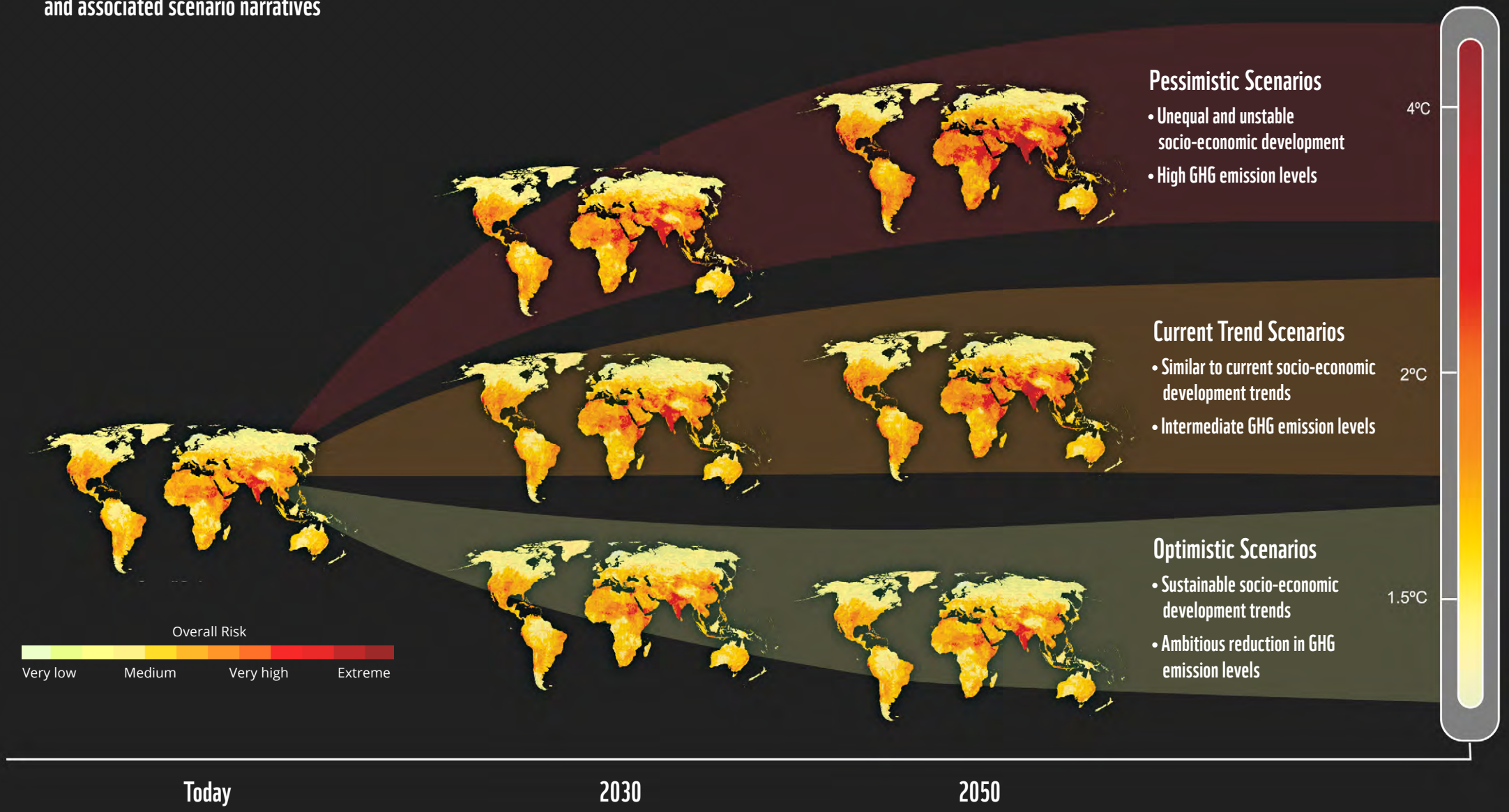
Table 1: Narratives of the WWF Water Risk Filter scenarios

Optimistic scenarios	Current trend scenarios	Pessimistic scenarios
The optimistic scenarios represent a world with sustainable socio-economic development (SSP1) and ambitious reduction of GHG emissions (RCP2.6/RCP4.5), leading to an increase of global mean surface temperature of approximately 1.5°C by the end of the 21st century.*	The current trend scenarios represent a world similar to current socio-economic development trends (SSP2) and intermediate GHG emission levels (RCP4.5 /RCP6.0), leading to an increase of global mean surface temperature of approximately 2°C by the end of the 21st century.*	The pessimistic scenarios represent a world with unequal and unstable socio-economic development (SSP3) and high GHG emission levels (RCP6.0 / RCP8.5), leading to an increase of global mean surface temperature of approximately 3.5°C by the end of the 21st century.*

*Changes calculated with respect to the 1986-2005 reference period, and based on the Coupled Model Intercomparison Project Phase 5 (CMIP5) ensembles

SCENARIOS OF OVERALL WATER RISK

The Water Risk Filter overall water risk maps for 2030 and 2050 and associated scenario narratives



For the food sector, it is critical to identify the most materially exposed parts of the agricultural supply chain that are projected to face the greatest change in water risk (i.e., the difference between today and future risk) to focus resilient water stewardship responses. In all cases, water stewardship actions and strategies should be contextually appropriate — water resilience does not work with a "one size fits all" approach.

Whilst the WWF Water Risk Filter's Respond section provides recommended response actions to address identified current water risks, it can also be used to help users evaluate potential responses to different scenarios and thus explore whether proposed responses are resilient to different futures. If a response action works well under different climate scenarios, it is likely better-suited to work, no matter what the future holds (i.e., "future-fit"). WWF is also beginning to explore the integration of sector-specific recommendations linked to agricultural commodity standards, which will help ensure that the right issues are being tackled given the water risk resilience issues in play.

Box 2: Linking Water Stewardship and Resilience

Water Stewardship is defined as the use of water, which is socially and culturally equitable, environmentally sustainable and economically beneficial, achieved through a stakeholder-inclusive process that includes both site and catchment-based actions.

Long-term resilience for companies can be defined as the ability to achieve and maintain long-term goals in the face of shocks and stresses. In this sense, water insecurity represents one potential form of shock and disturbance, while stewardship, by incorporating climate resilience principles, represents a central response mechanism to adapt and transform as needed.

Water is inherently variable: freshwater systems have variable flow rates with shifting water quality driven by seasonal changes, weather events, and water-use decisions by others. The dynamic nature of water challenges means that even without climate change, businesses and communities have always needed to develop strategies to help manage this variability to ensure water security. Too much water (extreme flooding) is problematic, as is too little water (prolonged drought), and climate change is amplifying these extremes with greater frequency. With climate change exacerbating water risks, businesses find it beneficial to enhance their water stewardship strategy as a means of building climate resilience.

WWF's 2020 report on *Rising to Resilience* outlines a four-step approach to help companies embed climate resilience thinking into their water stewardship programs, and in the process, better secure water for people and nature under a changing climate. In summary, the four-step approach is:

1) Assess water risks and opportunities using climate scenarios
2) Develop water-risk responses and water stewardship strategy
3) Implement smart basin resilience responses
4) Monitor, evaluate, report and adaptively manage for climate-water risks with water stewardship responses.

3. SCENARIO ANALYSIS OF AGRICULTURAL COMMODITIES

This chapter presents the key findings from the application of the WWF Water Risk Filter scenarios to understand future water risk exposure for a selection of key agricultural commodities and main sourcing regions for the German market.

The WWF Water Risk Filter scenarios were applied to understand future water risk exposure of five key agricultural products for the German food market: avocados, bananas, citrus fruit, grapes and potatoes (see map page 14). These agricultural products were selected because:

1) they account for a large share of Germany's fruit and vegetable imports and
2) these agricultural commodities have both high impacts and dependencies on water resources in their growing area.

The WWF Water Risk Filter contains three pathways (Optimistic, Current Trend, Pessimistic) for 2030 and 2050 covering all aspects of water risks. For the purpose of this report, the results presented focus primarily on how physical water risks in the main sourcing regions for each agricultural product will evolve by 2050 under a pessimistic scenario. Whilst it is important to understand exposure to water risk under different scenarios, being aware of and prepared for the 'worst case' pessimistic pathway is imperative. Moreover, physical water risk exposure is of particularly high concern to agricultural activities given the high dependence and impact on water, which in turn can enhance regulatory and reputational water risk to manifest.

The five sub-sections below outline the results from the analysis of each selected commodity including some background information on the commodity, the growing region as well as key findings on the most critical aspects of water risk today, the change over time, and the main drivers of risk change.

The WWF Water Risk Filter scenario risk scores are classified into 6 risk levels as illustrated in Figure 1.

In addition, some examples of best practices are highlighted where water stewardship measures have been adopted for climate change adaptation and resilience.

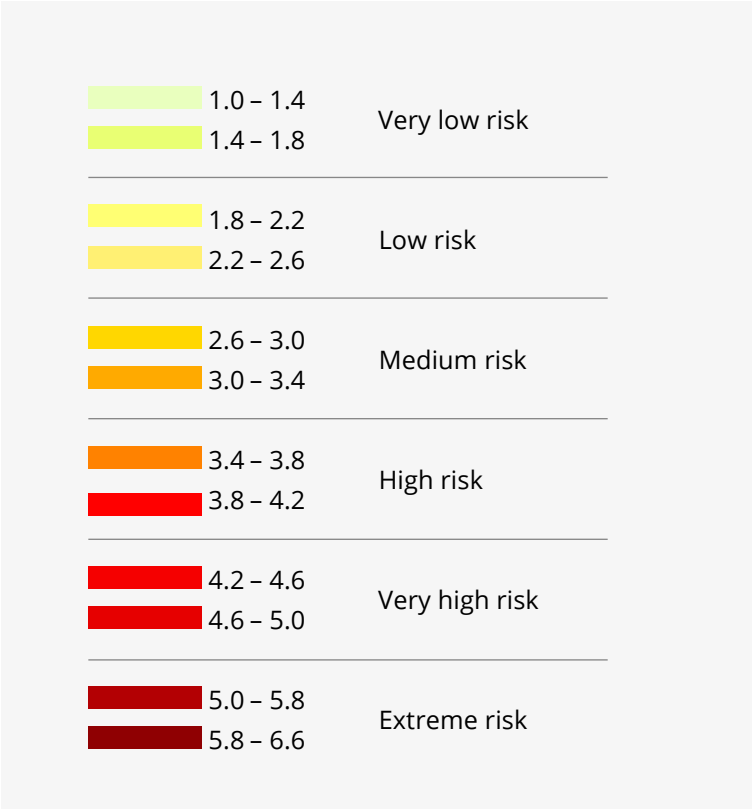
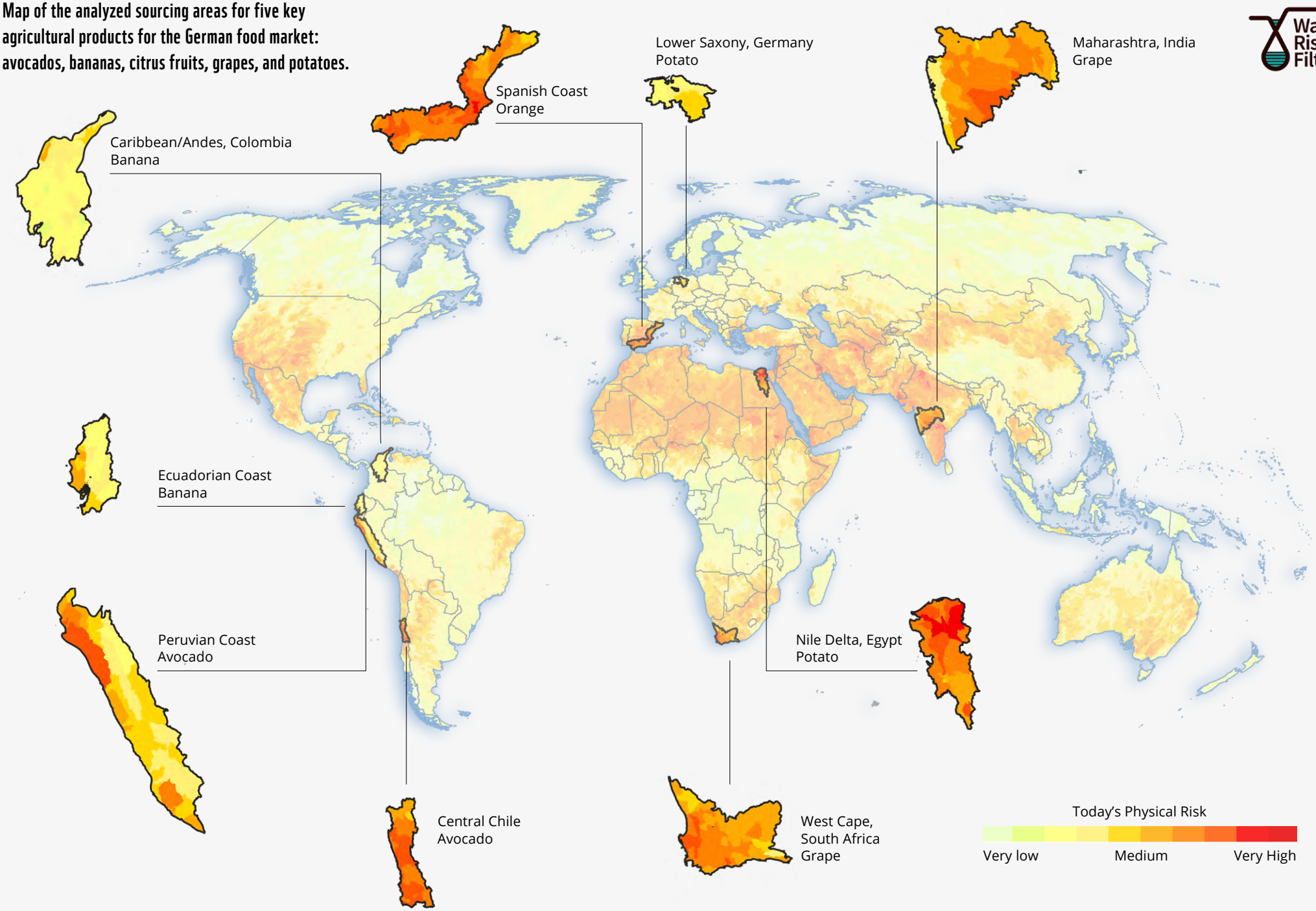


Figure 1: WWF Water Risk Filter 6 risk levels with associated risk score range

Map of the analyzed sourcing areas for five key agricultural products for the German food market: avocados, bananas, citrus fruits, grapes, and potatoes.



I. AVOCADOS

The avocado, hailed as a superfood, has certainly become one of the trendiest fruits over the last two decades. The rising value of the commodity has created a strong incentive for avocado growers to expand their production. In 2000, Germany imported a mere 4.9 tonnes of avocados worth US$ 6,000. By 2019, this number had risen to an astounding 95,321 tonnes worth US$ 343,489,540. In particular, avocados from the coastal region of Peru and central Chile contribute almost 47 per cent of avocados for the German market.

However, as indicated by the Water Risk Filter, the growing regions in central Chile and on the Peruvian coast are currently exposed to high water scarcity risk. More specifically, both growing regions are located on the semi-arid, western slopes of the Andes with a snowmelt-fed water regime, which is already suffering from reduced water availability due to decreased runoff owing to glacier recession. Based on the Water Risk Filter pessimistic scenario, the combination of socio-economic changes and a warmer climate is expected to result in a physical water risk increase of up to 11 per cent and 9 per cent by 2050 in the growing regions in Peru and Chile respectively. This predicted increase in physical water risk is primarily due to an increase in water scarcity, nutrient loadings in water bodies (water quality risk), and pressure on freshwater ecosystem services. However, climate change will manifest in several ways. Dry and wet season patterns are being altered and while runoff is generally projected to decrease, the warmer climate will also induce more extreme floods, especially on the Peruvian coast which is predicted to face a very high flood risk by 2050 under the Water Risk Filter pessimistic scenario.

Furthermore, higher levels of physical water risks in turn increase the likelihood of conflicts and disputes. Already the expansion of large-scale, industrial avocado farming has caused rivers and wells to run dry in some growing regions. Local residents, who in the past sourced their water from once abundant rivers and streams, are now receiving rationed water in trucks. With predicted increases in physical water risk under a pessimistic scenario, water risk conflict is also expected to increase over the course of the next 30 years, which could ultimately result in reputational risk for food retailers sourcing from these regions.

AVOCADOS

Physical risk in 2050 pessimistic scenario
The maps show future physical risk exposure in key avocado sourcing regions for the German food market (analysis focus area).

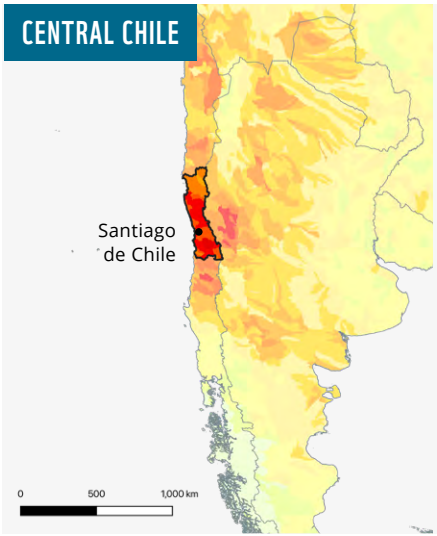
Physical risk change under 3 scenarios
The graphics show general trends of physical risk change across 3 different scenarios.

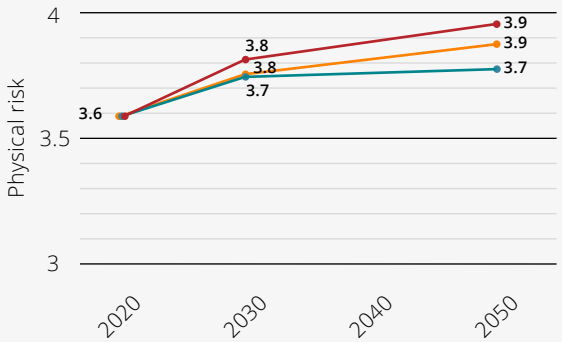
- Optimistic
- Current trend
- Pessimistic

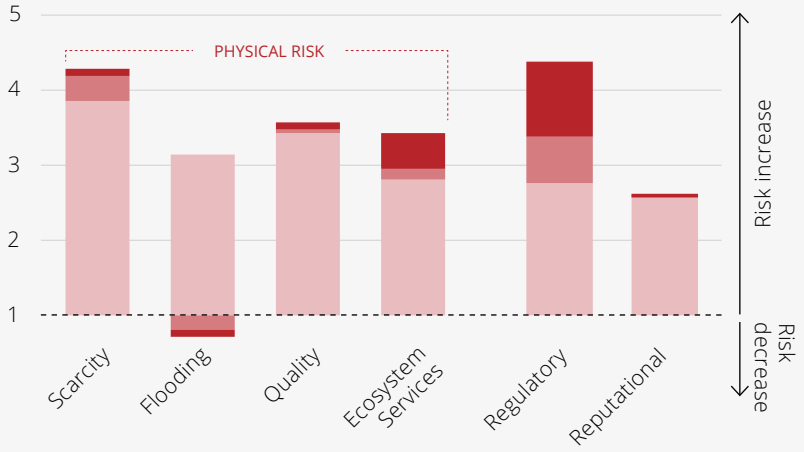
Pessimistic scenario: Drivers of risk change
The graphics show how different physical risks as well as regulatory and reputational risks will evolve under a pessimistic scenario.

- Today's Risk
- Change by 2030
- Change by 2050

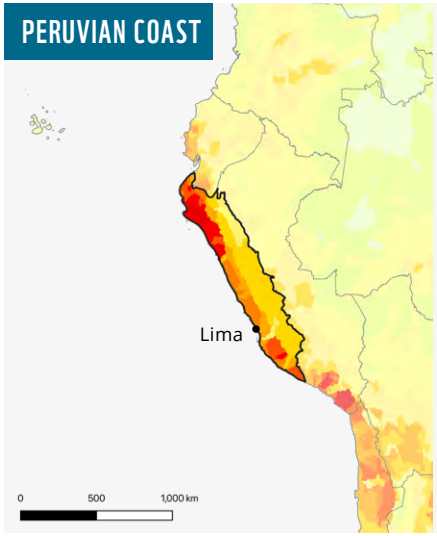
CENTRAL CHILE

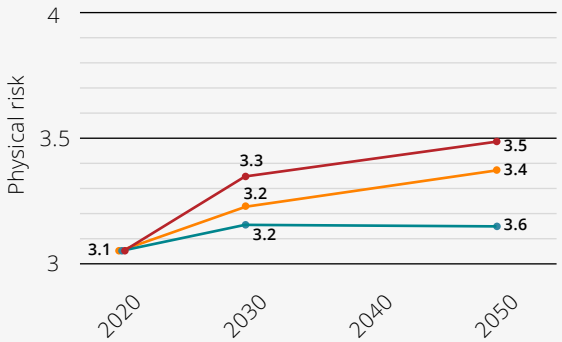


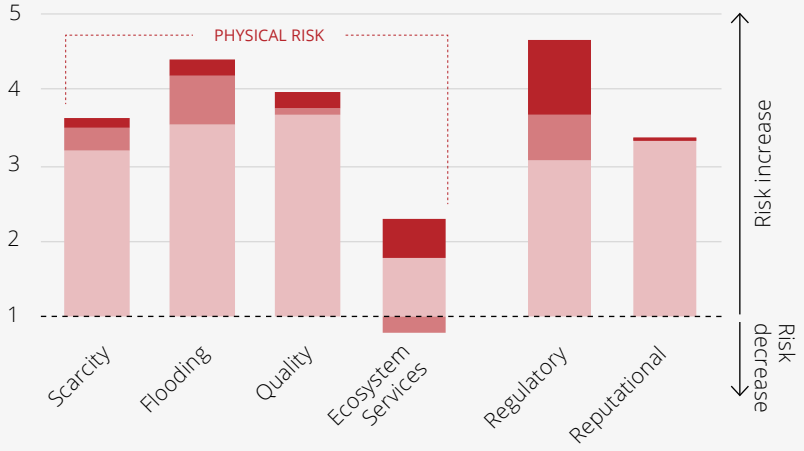




PERUVIAN COAST







Physical Risk under Pessimistic 2050 Scenario

Very low Medium Very High Extreme

II. BANANAS

Banana is a staple food in many tropical countries, but it is also the most traded fruit in the world. Globally, 116 million tonnes of bananas were produced in 2018. In addition, Germans love bananas so much that it is the second-most consumed fruit by German households, following hard on the heels of apples (in 2019, an average household consumed 17.1 kg of apples and 16.2 kg of bananas). Nearly half of the bananas imported by Germany in 2019 came from Ecuador and Colombia.

Banana plantations require rich, humid, well-drained soils and are quite specific in their temperature spectrum. They grow best between 26°C and 30°C and do not tolerate extreme heat or cold. Scientific studies have come to the conclusion that the rising temperatures due to climate change have been favorable for banana producers for the most part since 1961, and that further global warming may have beneficial effects in Africa and some South American countries, while being detrimental to other producing regions, especially in the tropics.

Based on the Water Risk Filter risk analysis, the banana cultivation regions in Ecuador and Colombia share similar water risk profiles. Although the changing water regime due to Andean glacier retreat adds a water management challenge for the irrigation-dependent banana industry, flooding is the most critical water risk in these two regions. More specifically, today's high flood risk levels in both regions are expected to increase to very high flood risk levels by 2050, with flood events projected to be 5 times more frequent by 2050.

Flooding can have a devastating impact on banana plantations. Already in 2011, flooding linked to La Niña[1] led to the loss of 4,000 hectares of banana plantations in Colombia. In addition to the direct impact on plantations, flood events can also cause major supply chain disruptions due to the destruction of infrastructures, such as roads, bridges and warehouses, which are crucial for logistics and transportation of products.

At least 97 per cent of internationally traded bananas are of the Cavendish variety. They are mainly produced in monoculture systems, which make them highly susceptible to pests, fungi and diseases. With a lack of biodiversity and with global warming, such diseases will find advantageous circumstances, as they thrive in wet and warm conditions. Already today, diseases threatening the Cavendish variety like the banana leaf disease called Black Sigatokahas or the Fusarium Wilt (also known as Panama disease caused by the Fusarium mutant Tropical Race 4 (TR4) have spread to banana plantations all over the world and are having a considerable economic impact by reducing yields. The preventive application of large quantities of pesticides pollute waterbodies and thereby adds to existing and future water challenges. According to the WWF Water Risk Filter pessimistic scenario, water quality risks are expected to rise considerably by 2050 in both the Ecuadorian coast and the Colombian Andes/Caribbean. In particular, nutrient loadings are projected to increase due to the excessive use of fertilizers in monocultures.

1 La Niña is a weather event that usually occurs following an El Niño event. La Niña is associated with above-average differences in air pressure between South America and Indonesia. Unlike an El Niño, which usually lasts a maximum of one year, a La Niña can last one to three years and occurs in two- to seven-year cycles.

BANANAS

Physical risk in 2050 pessimistic scenario
The maps show future physical risk exposure in key banana sourcing regions for the German food market (analysis focus area).

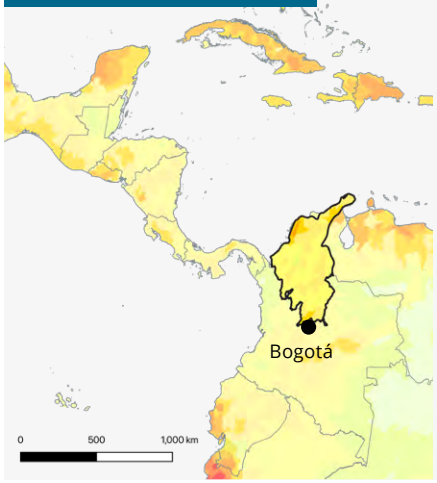
Physical risk change under 3 scenarios
The graphics show general trends of physical risk change across 3 different scenarios.

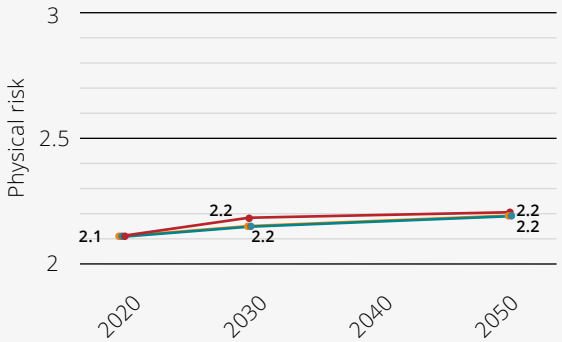
- Optimistic
- Current trend
- Pessimistic

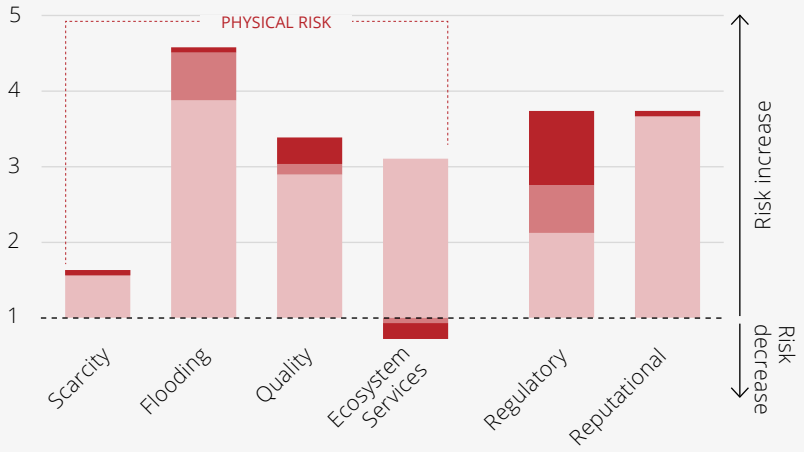
Pessimistic scenario: Drivers of risk change
The graphics show how different physical risks as well as regulatory and reputational risks will evolve under a pessimistic scenario.

- Today's Risk
- Change by 2030
- Change by 2050

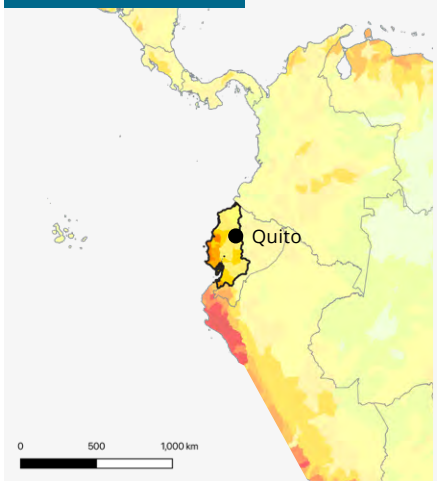
CARIBE/ANDES, COLOMBIA

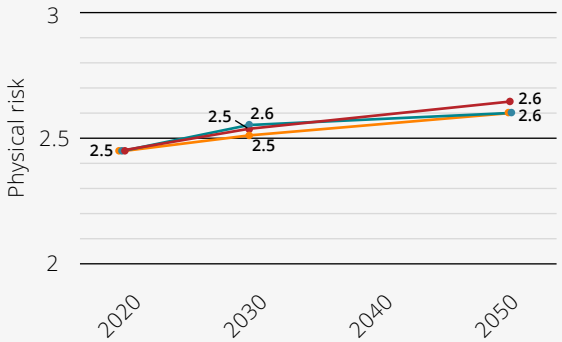


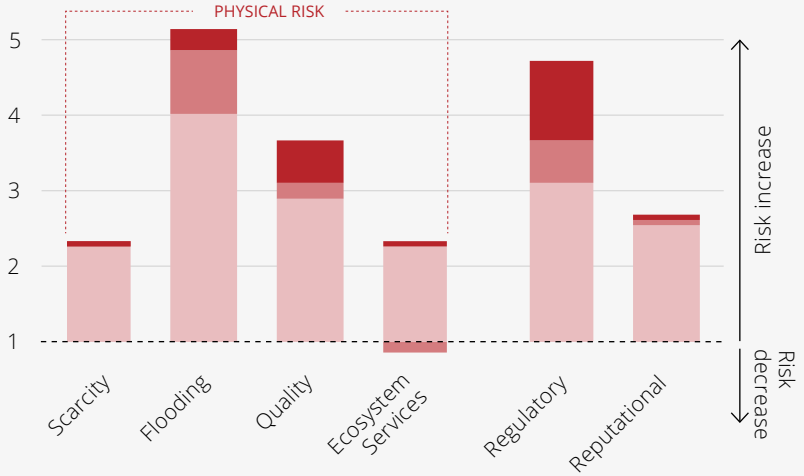




ECUADORIAN COAST







Physical Risk under Pessimistic 2050 Scenario

Very low | Medium | Very High | Extreme

Box 3: EDEKA-WWF Banana Project

Since 2014, EDEKA, WWF and Dole, a global leader in the production and distribution of bananas, have been implementing a banana project together with conventional banana producers in Ecuador and Colombia on a total of 4,000 hectares of land. The banana project focuses inter alia on protecting water resources by consumption monitoring and improved management, as well as improving ground-water quality by responsible and reduced pesticide and herbicide use.

Since its inception, multiple aspects of the project have generated successes:

- The use of pesticides is continuously optimised and watercourses on the farms are successfully protected from chemicals by an erected plant cover.
- Water consumption has fallen with the use of treatment plants, making it possible to reuse water up to five times in post-harvest processing (i.e. washing). Today, all farms in Colombia and Ecuador have water treatment plants. The installation of more efficient irrigation technology has also contributed to improved water management.
- All banana farms in Colombia and currently two in Ecuador have achieved the world's first AWS certification in the banana sector according to the International Water Stewardship Standard for taking water management to a higher level. All other farms in Ecuador will follow and be certified this year.

The EDEKA-WWF partnership has motivated local stakeholders, in the Rio-Frío and Rio Sevilla basins in the province of Magdalena in northern Colombia, to participate in the "water stewardship platform" (Plataforma de Cooperación y Custodia del Agua, PCCA) to help the region improve water management equitably for all stakeholders. The platform is facilitated by WWF Colombia with support from the consulting firm Good Stuff International. The aim is for project farms to control and reduce their water consumption, preserve ecosystems and ensure good water quality. Since its foundation, the PCCA has made progress and can account for many successes within the region:

- Established a dialogue among watershed stakeholders, continuously engaging 14 public, private and civil society entities in meetings and collective actions;
- Shared understanding of the territory and its water situation through establishing an up-to-date and open-access Watershed Information System;
- Provide environmental education in communities;
- Conducted collective reforestation activities;
- Obtained legal advisory for inter-institutional actions and agreements;
- Included indigenous people living in Sierra Nevada; and
- Produced four project concepts reflecting the interests of stakeholders and communities.

III. CITRUS FRUIT

In 2018, 152 million tonnes of citrus fruit were produced globally, with Spain being the 6th largest producer, after China, Brazil, India, Mexico and the USA. With about 6.8 million tonnes, Spain produces roughly 4.45 per cent of global citrus fruits. In terms of export value, Spain ranks as the top country for oranges globally and is also Germany's most important supplier of citrus fruit. In 2019, 79 per cent of Germany's citrus fruit imports came from Spain. In the same year 26 per cent of Spain's orange exports went to Germany, making Germany Spain's largest buyer of oranges, followed by France.

Citrus fruits need a warm climate to grow in as they are not resistant to prolonged frost. In Spain, citrus fruit cultivation areas are concentrated around the southern region and eastern Mediterranean coast.

As shown by the Water Risk Filter, these main growing regions in Spain are already exposed today to high water scarcity risk. Irrigation is crucial to citrus fruit production in the region, and water management in citrus fruit production has dramatically improved water efficiency by the introduction of drip irrigation. However, water efficiency measures alone do not necessarily result in absolute water savings. Efficiency measures in many cases lead to an increase in production. In other words, the water saved is used to irrigate new plantations. This "rebound effect" (known from many instances spanning all economic sectors) has been observed in citrus fruit production sites in Spain.

Within the European Union, Spain is one of the countries expected to be most affected by climate change, which will manifest as a decrease in rainfall and sharp temperature increases. Based on the WWF Water Risk Filter, today's high physical risk in southern Spain will further increase within the next 30 years, especially water scarcity, which is projected to increase by up to 10 per cent. In addition, water quality risk (e.g., increase in nutrient loadings) and ecosystem service degradation are also projected to increase considerably by 2050, contributing to overall physical risks.

CITRUS FRUIT

Physical risk in 2050 pessimistic scenario
The maps show future physical risk exposure in key citrus fruit sourcing regions for the German food market (analysis focus area).

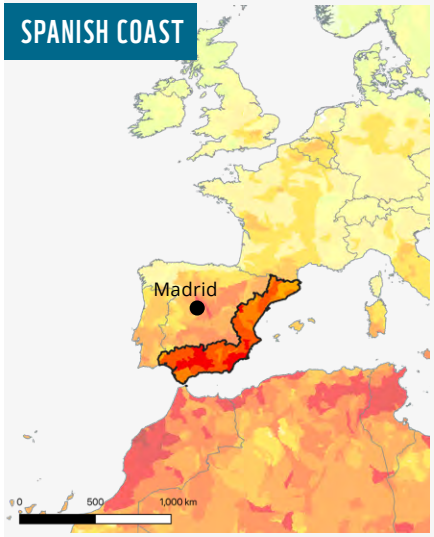
Physical risk change under 3 scenarios
The graphics show general trends of physical risk change across 3 different scenarios.

- Optimistic
- Current trend
- Pessimistic

Pessimistic scenario: Drivers of risk change
The graphics show how different physical risks as well as regulatory and reputational risks will evolve under a pessimistic scenario.

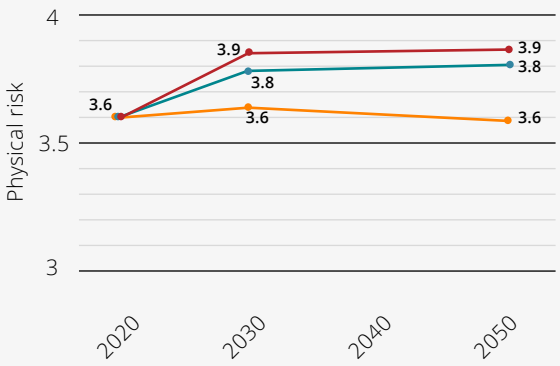
- Today's Risk
- Change by 2030
- Change by 2050

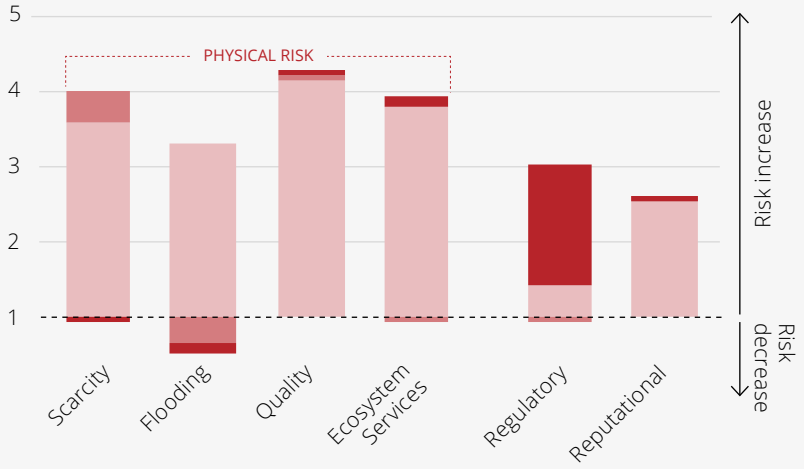
SPANISH COAST



Physical Risk under Pessimistic 2050 Scenario

Very low | Medium | Very High | Extreme





Box 4: EDEKA-WWF Citrus Project

With about 4.4 million hectares of agricultural land, the Spanish province of Andalusia is one of Europe's food production centres. Oranges and mandarins are particularly popular in Germany during the winter. Around 80% of the oranges and mandarins sold at EDEKA come from the Spanish region. Almost every fifth Spanish orange sold by EDEKA in 2018/2019 came from the EDEKA-WWF citrus project in Andalusia: "Together for a better orange and mandarin".

In 2015, the citrus project was launched by EDEKA, WWF and a distributor in the Guadalquivir river basin. Through this project, measures were implemented on nine citrus farms with a total cultivation area of 716 hectares, making their conventional farming more sustainable by:

- Implementing sustainable water use (on the farm and in the river basin);
- Reducing pesticide application;
- Improving soil fertility and efficient fertilization; and
- Protecting and enhancing biodiversity.

As a result of these measures, 806 million litres of water were saved in 2018, while the amount of pesticides applied has been reduced by one fifth, and so far 23 different ladybird species (project's biodiversity indicator) have been spotted on the project farms (compared to the start of the project).

In 2018, the pilot farm, Iberesparragal, became the first agricultural enterprise in Europe to achieve AWS certification with Gold status. Drip irrigation and soil moisture probes are used to make water management on the farm more efficient. Furthermore, as part of the certification process, a joint workshop was held with relevant regional stakeholders such as the local irrigation community. This community is responsible for the allocation and quantity of water use rights. Among other things, the workshop addressed the need for a change in sustainable regional water use. Pessimistic scenarios assume a decrease in available water in the Guadalquivir river basin by 8-10% by 2030. The Citrus Project, together with its producers, aims to adapt irrigation to these same regional climate projections and to use at least 8% less water than the respective individual water use rights of individual farms would allow.
Following the Water Stewardship approach, the project not only considers efficient use of water at farm level, but also aims to initiate positive changes in the river basin. Since 2019, together with EDEKA and WWF, producers have also been increasingly promoting the responsible use of water beyond their farms fence line through collective actions. At the end of 2019, a joint waste collection campaign was carried out on a bank of the Guadalquivir River together with project participants. In order to raise awareness among producers beyond the project boundaries, a video was produced that focused on the need for a re-orientation of conventional agriculture and the associated resource-intensive habits in dealing with water, but also pesticides or biodiversity.

IV. GRAPES

In 2019, Germany imported 843,165 tonnes of table and wine grapes from various countries, of which South Africa and India rank in the top 5 countries. The South African grapes usually come from the Western Cape with its Mediterranean-like climate and good soils, meanwhile the Indian grapes come from Maharashtra, which has a tropical climate.

South Africa has been experiencing a series of droughts, with associated crop losses, water restrictions, and impacts on food and water security since 2015. In 2018, Cape Town came to the brink of 'Day Zero', when the city would have run out of water. To address this water crisis, strict water rationing for private households and agricultural water quotas were put in place. Whilst Cape Town managed to avert its worst water crisis so far, the risk of future shortages remains. Climate change is expected to cause higher temperatures and a reduction in rainfall, which would put even more pressure on water resources in the region. This is in line with the results from the Water Risk Filter pessimistic scenario, in which today's high physical risk in Western Cape is expected to increase even more within the next 30 years, with water scarcity being the main risk driver and projected to increase by up to 10 per cent.

Similar to South Africa, the grape growing region of Maharashtra, India, is already exposed to high physical risk. With strong seasonal climatic variations already being experienced today, droughts in the dry season and floods in the wet season are common occurrences. Following years of drought in the region, Maharashtra faced a water emergency of unprecedented proportions: rivers were drying up, water in dams and reservoirs was being depleted and over-exploitation of groundwater was raising concerns about the long-term availability of water resources, potential regulatory risks in the form of restricted access and water use conflicts.

Based on the Water Risk Filter pessimistic scenario, the combination of climate and socio-economic changes will cause the region of Maharashtra to experience even greater physical risks by 2050 — a risk increase of up to 12 per cent. Water scarcity is only one of the main drivers of physical risks in the region, flooding and water quality risk are also expected to increase dramatically in the region to very high and extreme risk levels respectively. Along with the high increase in these multiple physical water risks, it is important to consider potential regulatory and reputational risks, which are likely to increase over the next 30 years.

GRAPES

Physical risk in 2050 pessimistic scenario
The maps show future physical risk exposure in key grape sourcing regions for the German food market (analysis focus area).

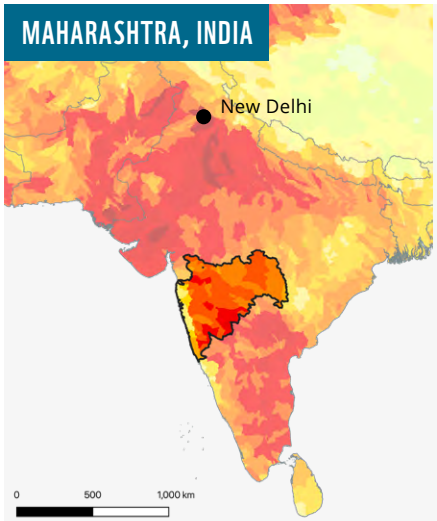
Physical risk change under 3 scenarios
The graphics show general trends of physical risk change across 3 different scenarios.

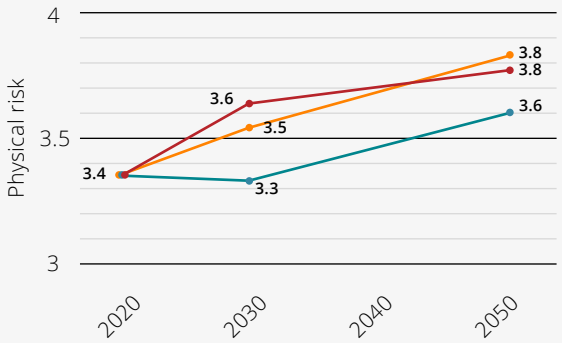
- Optimistic
- Current trend
- Pessimistic

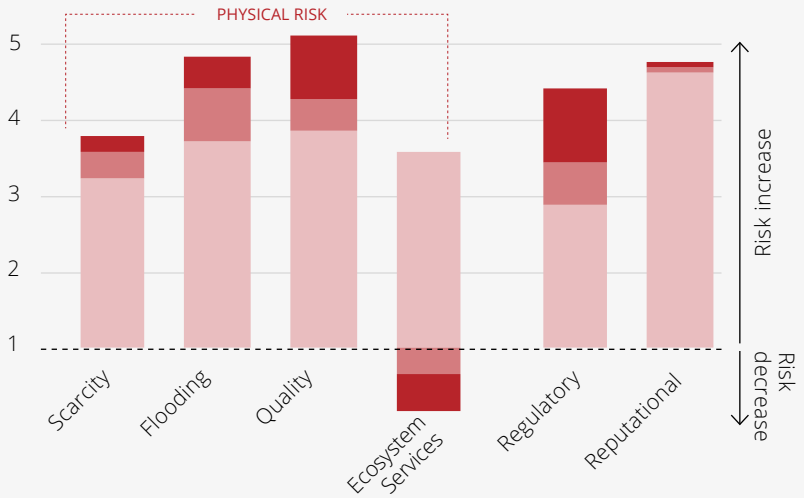
Pessimistic scenario: Drivers of risk change
The graphics show how different physical risks as well as regulatory and reputational risks will evolve under a pessimistic scenario.

- Today's Risk
- Change by 2030
- Change by 2050

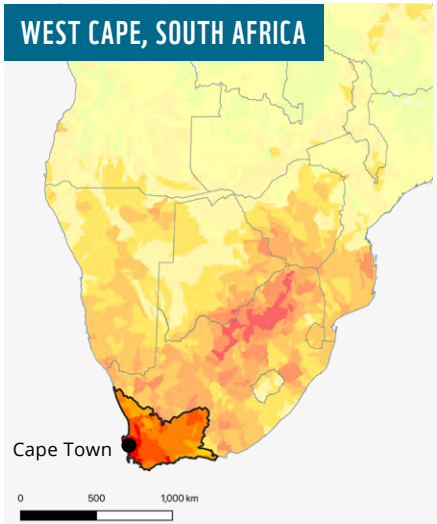
MAHARASHTRA, INDIA

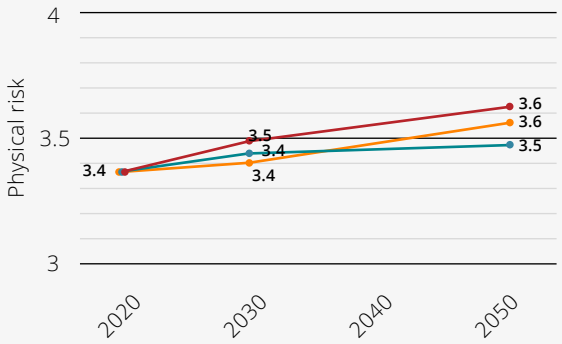


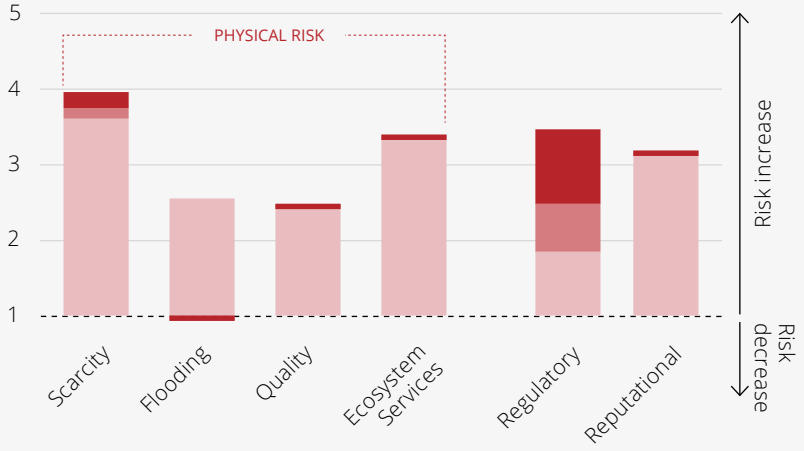




WEST CAPE, SOUTH AFRICA







Physical Risk under Pessimistic 2050 Scenario

Very low | Medium | Very High | Extreme

Box 5: The fruit basket of the Western Cape

WWF South Africa has been involved in stewardship programmes in the Western Cape area since 2013. A variety of water stewardship initiatives have been implemented in various landscapes in the Breede River catchment to the northeast of Cape Town, one of the Western Cape's epicentres of fruit and grape production. The region has seen rapid urbanisation and population growth with the incursion of job seekers. Coupled with repeated drought situations, pressures on natural resources are growing. This in turn is affecting the agricultural sector, which relies on surface and groundwater resources for irrigating fruit farms. For retailers buying fruit from the area, added pressure is placed on the supply chain. Losing business would be devastating for farmers, farm workers, local residents, retailers, exporters and importers alike.

WWF South Africa has been working with several stakeholders, including farming communities, to improve water stewardship on farms, while also engaging with residents to address water quality issues in and around the urban and peri-urban settlements.

Initial efforts in 2013 focused on on-site actions and data generation, as well as trialling the Alliance for Water Stewardship standard with volunteer farmers. At the onset of the drought in 2016 cooperating farmers implemented multiple water use efficiency steps in order to survive the drought. A key lesson learnt was the value of mulching orchards, a practice that reduced irrigation needs by up to 30 per cent. This lesson has grown into a common practice in the farming community of the Ceres valley. Subsequently, water stewardship efforts focussed on involving local governance bodies, local municipalities, other NGOs and a large contingent of farmers and engaging them in broader water issues through collective action and influencing governance. One of many collective actions is to clear alien trees that have overtaken the river course and natural areas around the orchards. These trees are using far greater amounts of water than the natural vegetation. To date invasive alien plant[2] control has led to the clearing of alien plants from the land of over 100 participating farmers, the clearing of over 75 kilometres of river and over 400 hectares of endangered wetland. This translates into a saving of more than 75 million litres of water annually, while also creating jobs for over 100 people and leading to the rise of several small and medium enterprises that specialize in clearing and selling off the felled biomass for firewood, biochar and woodchips. The woodchips in turn are sought after by farmers who seek to mulch their orchards in order to keep their irrigation levels down. By using biomass from the felling of invasive trees, primary resources of native trees could thus also be preserved.

The WWF water stewardship project in the Breede catchment has pioneered water stewardship in agriculture in South Africa and aims to further scale the work at various levels. On a local scale, it has taken steps to create a more resilient upper Breede catchment by activating pockets of initiatives among various stakeholders.

2 Invasive alien species are a major threat to biodiversity, as they can locally displace native species and thus change the nature and functioning of entire ecosystems. They can also cause considerable economic damage by reducing yields in agriculture, forestry and fisheries.

V. POTATOES

Germans consume on average 60 kg of the tuber every year. German potato production covers most of the country's demand, even surpassing it by 37 per cent in 2017/18. In 2018, Germany produced 8.9 million tonnes of potatoes, ranking it as the world's 7th most significant potato producer and globally the top exporter of fresh potatoes. More specifically, the federal state of Lower Saxony accounts for 45 per cent of Germany's potato production, as the favorable (i.e. rainy) climate offers the most reliable growing conditions.

Whilst climate change is expected to regionally change water regimes (e.g., higher summer temperatures and wetter winters), agronomists seem to be in agreement that overall potato yields are expected to remain stable over the next decades. As reflected by the Water Risk Filter results, water scarcity risk in Lower Saxony is projected to maintain low risk levels in the coming decades. On the other hand, water quality risk is the main driver of physical risk change, with very high water quality risk levels already seen today likely to rise even further as nutrient loadings are projected to increase significantly.

Between December and May, when fresh potatoes from the German harvest become harder to come by, Germany imports early potatoes to satisfy demand. Most of these come from Egypt, Spain and Israel. In 2018/19, almost 44 per cent of the 152,868 tonnes of imported early potatoes came from Egypt.

Egypt, despite being mostly a desert, has a flourishing agricultural production regionally concentrated in the Nile Valley and the Nile Delta, which is 98 per cent equipped with irrigation. Egypt's climate is characterized by hot dry summers and mild winters. Rainfall is very low, irregular and unpredictable. The Nile River supplies nearly all water in Egypt, and it is almost entirely controlled by the High Aswan Dam, which forms Lake Nasser. Therefore, warmer temperatures are likely to have a greater effect on agricultural production, as higher temperatures increase evapotranspiration, especially on reservoirs.

Based on the Water Risk Filter results, potatoes coming from the Nile Delta are exposed to very high physical water risks. The Nile is both exposed to high levels of physical risks today and it is projected to have a risk increase of up to 20 per cent by 2050. The main physical risk driver is water scarcity, which is projected to increase up to 30 per cent by 2050, reaching very high risk levels, followed after by increased risk in water quality and flooding. Therefore, ensuring geopolitical stability through the implementation of international water agreements such as the Cooperative Framework Agreement (CFA) for the Nile Basin, is crucial for a country almost entirely dependent on external water resources.

POTATOES

Physical risk in 2050 pessimistic scenario
The maps show future physical risk exposure in key potato sourcing regions for the German food market (analysis focus area).

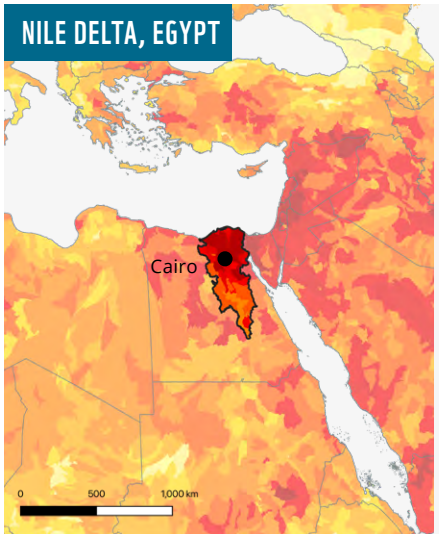
Physical risk change under 3 scenarios
The graphics show general trends of physical risk change across 3 different scenarios.

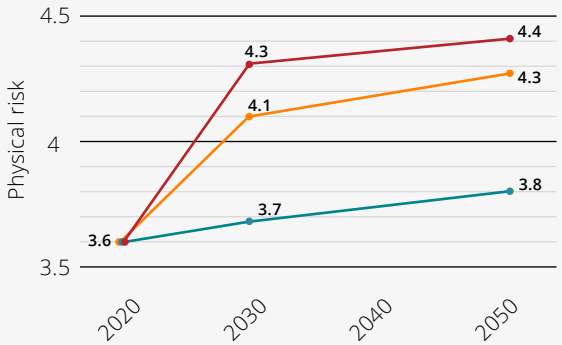
- Optimistic
- Current trend
- Pessimistic

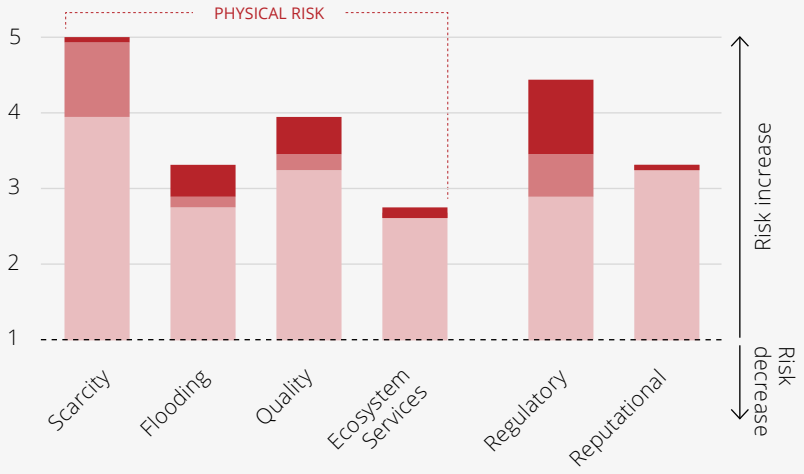
Pessimistic scenario: Drivers of risk change
The graphics show how different physical risks as well as regulatory and reputational risks will evolve under a pessimistic scenario.

- Today's Risk
- Change by 2030
- Change by 2050

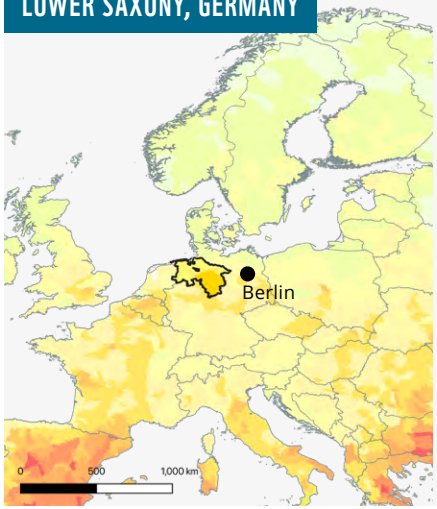
NILE DELTA, EGYPT

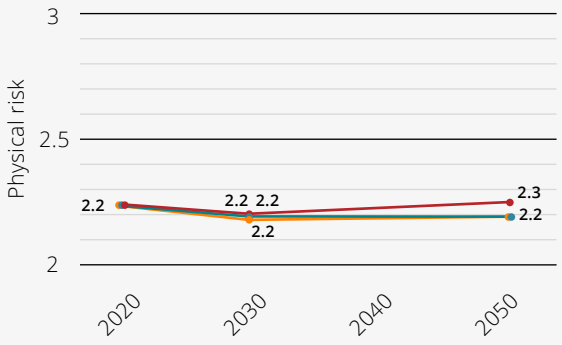


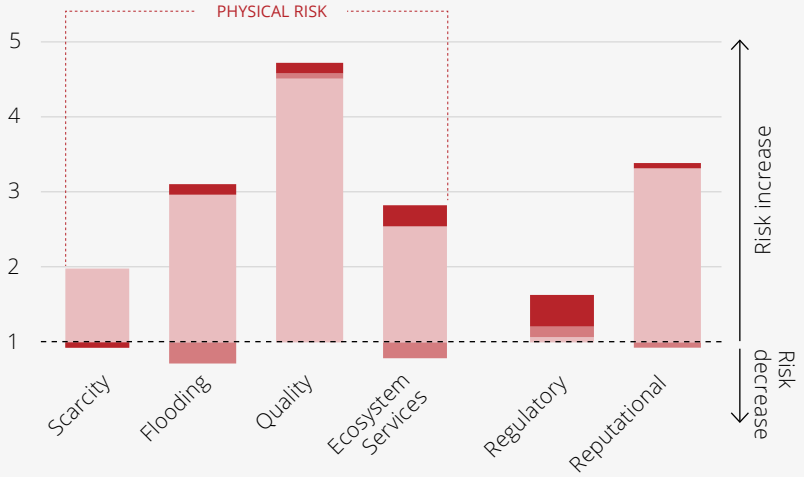




LOWER SAXONY, GERMANY







Physical Risk under Pessimistic 2050 Scenario

Very low | Medium | Very High | Extreme

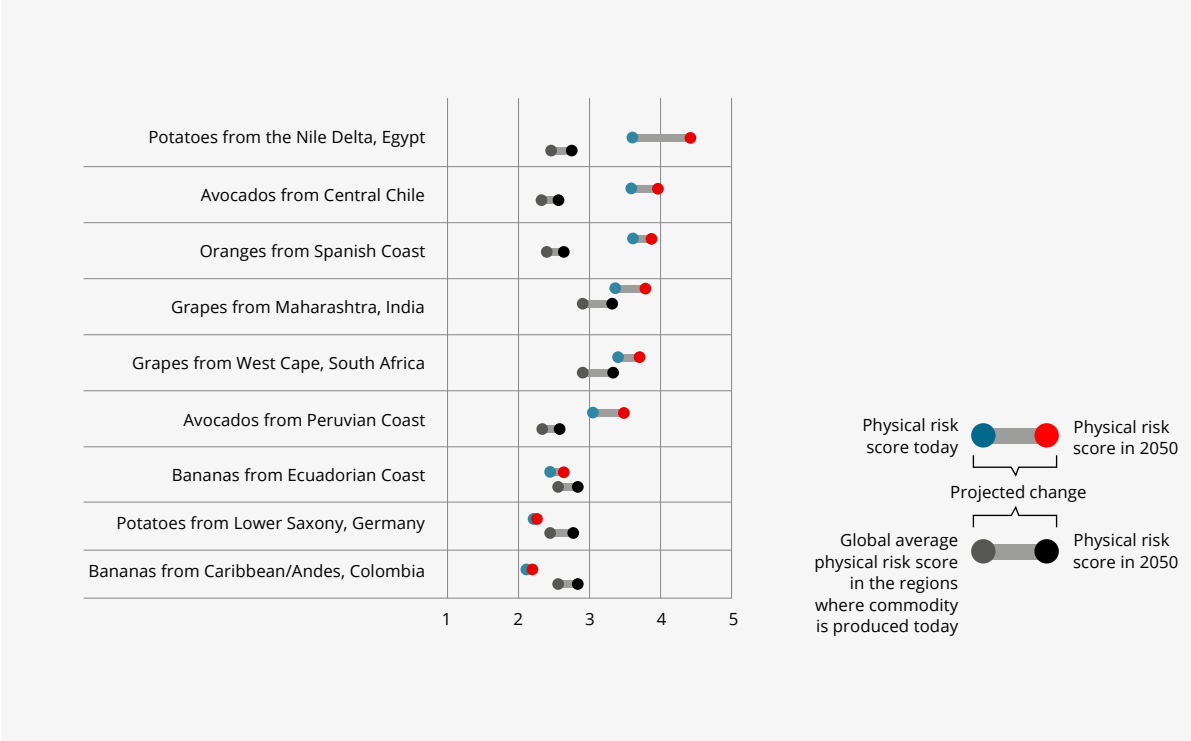
4. SUMMARY RESULTS ON FUTURE WATER RISKS

The aim of this analysis was to provide a practical case study of how the Water Risk Filter scenarios can help food retail companies understand future water risks in key sourcing areas for their agricultural commodities. Amongst all analyzed key commodities, potatoes coming from the Nile Delta in Egypt stand out as the most critical commodity exposed to greatest levels of future water risks. The Nile Delta region is both exposed to the highest levels of physical water risks today and it is projected to have a risk increase of 20 per cent by 2050 based on the Water Risk Filter pessimistic scenario.

As illustrated by Figure 2, avocados from central Chile, oranges from the South and East coast of Spain, grapes from Maharashtra in India and from West Cape in South Africa and avocados from the Peruvian coast are next on the list of risky commodities. Moreover, these five sourcing regions face greater physical water risk exposure than the global average (considering all regions where each of these commodities are produced globally) and they are all projected to face risk levels around 10 per cent greater than today.

As highlighted in the previous chapter, physical water risks vary considerably between sourcing regions of different commodities – from scarcity to floods and water quality. In most cases, water scarcity was identified as one of the greatest physical water risks experienced already now and expected to increase in the future, especially for potatoes from Egypt, avocados from Chile and Peru, citrus fruit from Spain and grapes from South Africa and India. However as shown from this analysis, water scarcity is not the only physical water risk of concern. For example, flooding was identified as the most critical physical water risk for banana plantations from Colombia and Ecuador meanwhile water quality risk was extremely high for potatoes from Germany, citrus fruit from Spain and grapes from India. Lastly, whilst this analysis focused primarily on physical water risks, it is important to also account for potential greater regulatory and reputational risks as they are likely to increase along with physical risk.

Figure 2: Change in physical water risk between today and 2050 under a pessimistic scenario for the selected commodities and sourcing regions compared to global averages.



5. WWF RECOMMENDATIONS FOR RESILIENCE

Once a company has a comprehensive understanding of how different types of water risk affecting each commodity and sourcing region will evolve over time, it is then well positioned to consider the next step to implement contextual responses and strategies for resilient agricultural supply chains.
It is important to emphasize from the outset that the findings on water risk hotpots should not be interpreted in any case as a hint to shift to other sourcing regions with lower risk levels. The latter case could end up costly as even regions with low risk today are certain to quickly become high risk if demand suddenly increases and sustainable practices are not put in place. Resilience is about better preparing good growing regions to ensure their future sustainability – not about fleeing a region in trouble, as no regions are likely to fully escape the impacts of climate change.

Based on key recommendations outlined in WWF 2020 Reports 'Rising to Resilience', this chapter provides guidance to food retail companies on how to build resilient water stewardship responses and strategies for long-term resilient agricultural supply chains.

Apply a strategic materiality lens to prioritize and focus efforts

After assessing current and future water risk exposure, it is important to apply a strategic materiality lens to determine how and where to prioritize and focus a company's resilience response and strategy across its value chain. This helps to efficiently mitigate water risks and achieve greater impact with existing budgets and resources. A materiality analysis for food retailers should consider the following aspects to focus on:

Key sourcing regions/ commodities of high procurement relevance and facing current/future high-water risks.

Key current/future sourcing regions and operations accounting for projected business growth.

Geographic clusters of high procurement/value suppliers and operations exposed to high current/ future water risk as effective resilience often depends on systemic landscape solutions.

As materiality is considered, the upcoming WAVE tool, to be embedded in the WWF Water Risk Filter, will also prove useful as it allows users to explore the potential financial impacts of various water risk scenarios at a site level.

Develop resilient water stewardship responses and strategy to manage change

With a better sense of where to focus within the value chain and what, contextually, to focus on, companies should next turn their attention to setting up resilience responses and strategies through water stewardship.

Simply put, implementing contextual water stewardship responses and strategy means *doing the right things in the right places* – water resilience does not work with a "one size fits all" approach. Whilst context matters, it is also important to take into account that context changes, as highlighted by the Water Risk Filter scenario analysis results, described in the previous sections. Therefore, it is important that any response plans and strategies are responsive to a changing context.

In an uncertain and changing climate context, scenario analysis is a useful approach to evaluate the resilience of a business response plan and strategy in terms of a range of future states. If a response action works well under different scenarios, it is likely well-suited to change and therefore future-fit. Moreover, the application of scenarios can be used to identify "least regrets" response plans that account for a "worst case" changing context under a pessimistic scenario.

When developing resilience responses and strategies through a water stewardship approach, there are two overarching levels to consider: the site operational level (internal action) and the river basin level (collective action).

Both levels should be implemented to mitigate water risks effectively. Typically, implementing internal actions at a site operational level is the first step as there is greater control, flexibility, and short-term benefits. However, internal actions tend to be limited in scope and can be insufficient to build systemic basin resilience, thereby inherently calling for action beyond the fence line through collective action responses at a river basin level as described in the next paragraphs.[3]

3 For more information see also the Guide for Context-based Water Management by WWF and German Global Compact Network

Implement collective action for basin level resilience

Like resilience, water risks cannot be effectively reduced in isolation on individual farms or sites. For companies to address their water risks in deep and meaningful ways to build systemic basin resilience, they will need to engage in collective action approaches with other stakeholders in the river basin to solve shared challenges. Engaging beyond one's own fence line/ supply chain in collective action with other stakeholders is at the heart of water stewardship and resilience.

However, agriculture and the food industry in general have mostly up to now responded to current water risks with technological progress and increased efficiency at a farm/site level. For example, high levels of irrigation efficiency have been achieved in farming regions such as in southern Spain, but this has not solved the water shortage issues in the area. Even worse, efforts to improve efficiency in farms have in some circumstances exacerbated the problem because the water saved through highly efficient irrigation technology is generally used to expand production or produce even more water intensive raw materials. Thus, it is critical to shift conventional agricultural practices and thinking from increasing water efficiency in agriculture (e.g., "more crop per drop") to sustainable withdrawals of water within the boundaries of a river basin for long-term resilience.

The food retail companies have a critical role to play by engaging with their strategic producers and suppliers facing high current and future water risks to achieve responsible water use beyond the boundaries of individual farms as part of a "collective actions" project. Two projects led jointly by EDEKA and WWF working with banana farmers in northern Colombia (described in page 19) and citrus farmers in southern Spain (described in page 22) are examples of successful collective action projects for addressing shared water risks at a basin level. For both projects, the Alliance for Water Stewardship (AWS) standards framework was used, including the AWS standard's advanced criteria, which provide an array of actions that can enhance water resilience through contextual collective action responses. Whilst there are various agricultural commodity standards for "sustainable sourcing", it is important to ensure that they are contextually relevant when it comes to water and that they tackle the right issues given the risk and resilience issues in play.

When implementing collective action projects for basin level resilience, consideration must be given to investing in Nature-based Solutions (NbS) that use ecosystems' natural benefits to help build resilience and reduce water risk (e.g., flooding, scarcity or drought) as well as provide a diverse range of additional benefits, from carbon sequestration to habitat protection and biodiversity enhancement. When prioritizing and potentially investing in NbS, their effectiveness under a changing climate must also be evaluated. The return on investment of NbS, or the climate resilience benefits they provide, is greater if those solutions are also stress-tested and designed based on an understanding of impacts under different climate and socio-economic pathway-based scenarios.

Monitor, evaluate, report and adaptively manage

One of the weakest areas of water stewardship performance has been around monitoring and evaluation, with most water bodies around the planet still lacking basic monitoring. However, a new era of water data is rapidly evolving with the expansion of new technologies —from remote sensing (RS) and Artificial Intelligence (AI) to Big Data and the Internet of Things (IoT). As relevant data on agriculture and water (e.g., soil moisture, drought and flood risk) become more readily available for monitoring and evaluation, there is the need to also develop stronger systems for adaptive management. Building resilience requires continually reviewing new information and knowledge, re-assessing past assumptions to be able to adaptively manage for change.

Lastly, reporting and disclosure have always been core to the notion of responsible water stewardship. Through reporting initiatives such as CDP Water and GRI 303 (water) standard, WWF encourages companies to report on contextual water risks and responses, particularly as an increasing number of investors are interested in environmental risks. With momentum on TCFD and increasing recognition that climate impacts typically manifest as water impacts, climate reporting is interlinked to water-related disclosure.

Accelerate sector collaboration

Each food retailer has a role to play in communicating to its stakeholders and pushing forward the urgent need for political action for a resilient water-secure future. Common positions and obligations are a practical step towards sectoral cooperation in food retail. Common positions by the food retail sector could help align sector level commitments, guidance and terminology, and strengthen water stewardship and resilience criteria into agricultural standards and certification systems (e.g., the EU organic standard).

Moreover, food retail companies often have similar procurement hotspots and thus also water risk hotspots. Therefore, working collaboratively in critical sourcing regions facing high current and future water risks will be essential for building together a resilient water-secure future for all. Food retailers should aim to leverage synergies to mitigate these shared risks. To this end, it is essential to create a pre-competitive space in which certain information can be shared, which in return can form the basis for collective action in the affected river basins.

6. CONCLUSION

Producing food is the most water-extensive business on earth. Consequently, the food sector is materially exposed to water risks across its agricultural supply chain. With freshwater resources under increasing pressure due to climate and socio-economic changes, it is critical for food retailers to have a comprehensive understanding of both current and future water risk within sourcing regions of their key agricultural products, in order to design and implement future-fit water stewardship response plans and strategies for long-term resilience.

Water stewardship and resilience is a journey. The first step of this journey is to understand the current and future water context, which can be achieved using the WWF Water Risk Filter tool as illustrated in this analysis. The steps outlined above enable companies to embed resilience into their water stewardship responses and strategy, and contribute towards a water secure future for people, nature and business under a changing socio-economic and climate context.

Working collaboratively in critical sourcing regions facing high current and future water risks will be essential for building together a resilient water-secure future for all.

In conclusion, the food sector has a critical role to play in addressing water challenges and should consider the following recommendations to build resilience in their agricultural supply chain:

- Understand current and future water risks of key agricultural product sourcing regions as illustrated through this analysis using the Water Risk Filter scenarios
- Develop and implement water stewardship response plans and strategy to mitigate material water risks
- Engage with strategic producers/suppliers in collective action to build basin resilience, including the implementation of Nature-based Solutions
- Monitor, evaluate, report and adaptively manage water stewardship performance
- Accelerate sector collaboration to push for a political agenda which focuses on water resilience, enhance responsible market work and work together as an industry for collective action in shared water risk hotspots

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A short version of the report as storymap can be found here (arcg.is/14uuDa1).

Why we are here
To stop the degration of the planet’s natural environment and to build a future in which humans live in harmony with nature.

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