



Umwelt
Bundesamt

LINKING WATER RISK AND FINANCIAL VALUE - PART II

REVIEW OF WATER RISK VALUATION TOOLS

Support WWF

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Why we are here

To stop the degradation of the planet's natural environment and
to build a future in which humans live in harmony with nature.

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1 Summary

Freshwater is a scarce resource that is under increasing pressure due to competition and variability driven by growing climate instability. As outlined in Part I of this series, droughts, floods, and other basin water risk drivers are increasingly impacting company's financial statements and in turn, becoming a growing concern for financial institutions.

To date, much of the focus has been on the development and provision of water risk tools for corporate users. Furthermore, most of the work has focused on water risks and not connected how such risks manifest as financial impacts. While some tools already exist that are explicitly tailored to the financial sector's information needs and have begun to link water risk and financial impact, no systematic review of these tools has been completed to date.

This report aims to help fill this gap and offer guidance and recommendations for improved water risk management in terms of available tools.

More specifically, this report provides a review of several tools in the water valuation space, including the Water Risk Monetizer and the Water Risk Valuation Tool, which are primarily tailored to the needs of investors, as well as the Corporate Bonds Water Credit Risk Tool and the Drought Stress Testing Tool, which are geared to bond and credit valuation. The Investor Water Toolkit is also introduced, which – while not a tool in the strict sense of the word – is a comprehensive online resource that gives investors essential information on water risks.

The analysis of available tools shows that existing tools need to be further developed or supplemented, in order to fully and adequately capture the impact of water risks on investment and loan portfolios. In addition to droughts, based on both experience and the input of financial institutions in Germany, WWF suggests that future tools address the impacts of floods and pollution and provide information for as many relevant countries and industries as possible to ensure the broadest possible coverage of financial institutions' portfolios. These tools should also supply information for financial institutions focusing on both the short- and long-term and enable users to replace the assumptions underlying the calculation with their own assumptions or to apply different scenarios.

Tools can help financial institutions better account for their water risk exposure.

As water risks grow, more extensive knowledge and capabilities will be needed in all departments involved in risk assessment or that make decisions about what action to take on the basis of these assessments.

As tools are strengthened, WWF believes it will become more feasible for financial institutions to better take into consideration both an investment's risk exposure and response. In doing so, investors will be better able to identify opportunities, and in turn, drive capital into companies who are accounting for the financial value tied to water risks.



2 Measuring the impact of water risks

“You can’t manage what you can’t measure.”

Peter Drucker

There is no question that assessing the financial impact of water risks is a complex process. Droughts and floods can be quantified in terms of their physical scope and severity, but the consequences on a business are less easily attributable.

Failed harvests can be due to general water scarcity, a drought, or to unfavourable weather conditions in the relevant year. While the financial loss from a poor harvest can be calculated, attributing it to one or more of the water risks noted is less easy.

Rising costs for raw materials and intermediate products can be caused by water risks, inefficiencies, or higher supplier margins. Suppliers are seldom transparent about why prices rise. And even if water data availability is improving for more and more companies, there will continue to be gaps in the data pool over the next few years, which will have to be gradually eliminated.

Tools aimed at identifying water risks and measuring their impact on manufacturing companies or even the financial market players financing them will have to deal with these gaps. Some of the tools described in more detail in section 4.2 are already dedicated to solving this problem. However, before these tools are considered in more depth, it is important to take a closer look at various indicators that can be used to measure water risks in manufacturing companies and in the financial sector.

2.1 Indicators in production

The water risk exposure at company level can be attributed to the combination of external (basin water risk) and internal (operational water risk) factors of a company’s operations and value chain.¹



¹ Orr, S. & Pegram, G. C. (2014)

Basin water risk factors:

Basin water risk factors are the result of events and developments outside a company's own production facilities, which in turn can affect an operation through that operation's dependencies upon water. Examples of external water risk factors are:

- Widespread drought that affects availability in the short term;
- Increasing consumption or pollution of water resources by other up-stream actors, which affects the amount/quality of water available for a site;
- Flooding, which can interrupt operations;
- Weak or shifting water regulations that make business planning unpredictable and therefore difficult;
- Long-term supply/demand trends that drive scarcity, such as population growth and economic situation, which create changes in demand, or potential changes in climate, which create changes in supply; and
- Deteriorating water infrastructure.

Operational water risk factors:

These factors look at how water-dependent a company's operation is and the extent to which it manages:

- Allocated water resources in its operations/supply chain, notably by decreasing water quantity-related dependencies and impacts;
- Incoming and/or outgoing water quality, with a view to the level with which it decreases its water quality-related dependencies and impacts;
- Its provision of access to safe drinking water, sanitation, and hygiene for workers; and
- Its relationship with other users in the basin (i.e., quality of stakeholder engagement).

Operational water risk factors, therefore, also relate to a company's response and potential actions for risk avoidance, mitigation, acceptance, or transfer.

Water risk exposure can be attributed to external and internal factors.

Assessing basin and operational water risk factors:

To be able to assess an individual company's water risk factors, three main issues need to be examined in more detail:

- (1) the basin status at the company's respective operational/sourcing locations;
- (2) the company's operational dependence on water (quantity/quality); and
- (3) the level of sophistication in terms of the uptake of water stewardship response actions.

A single indicator of water use intensity – the amount of water used to generate one dollar of revenue, or the amount of wastewater produced per product unit – can offer some insights into a company's potential water dependency. However, this only provides an incomplete and often misleading picture, as calculation methods vary heavily by uptake of technology. Furthermore, water use intensity does not capture many external basin water risks, such as the dependence on inland shipping and the vulnerability of the local electricity grid to water risks. The amount of wastewater and how it is managed should also be considered. It should ultimately be possible to use all indicators related to water dependency to assess the influence of different water risks on a company's financial performance.

When assessing basin water risk, the general aim is to capture the probability that individual water risks will occur. Indicators typically include:

- a) Physical water risks, which include: water stress/scarcity and/or drought, water quality, and flooding;
- b) Regulatory water risks: these range from laws and policies to enforcement and even information on the water infrastructure's condition; and
- c) Reputational water risks: these cover local water conflicts, and issues such as negative media stories.

In theory, by multiplying the potential financial impacts of each basin water risk event of a given severity by its probability of occurrence and aggregating these products, it is possible to calculate a potential financial loss expected from companies as a result of water risks. However, basin water data is limited, and probabilistic data even more so, making this sort of a calculation a key challenge.

Furthermore, several water risks (such as 1-in-100 year flooding) are heavy tail risks, which occur only very rarely but then cause serious damage, so the expected average financial loss should not be the only factor included in the risk assessment.

The question also arises as to whether, in the event that a water risk occurs, companies will be able to cope with very high financial losses and what action they can take in this situation to mitigate financial losses with appropriate countermeasures (or controls). This includes controls both around water stewardship responses to avoid or mitigate water risks, in addition to responses that transfer risks of financial impacts (e.g., flood insurance for asset impairment). A company's ability to handle water risk is therefore a function of the quality or sophistication of its water stewardship responses. This is, in turn, heavily linked to its management competences. Accordingly, the following aspects can be used as indicators for good management of a company's water risks:

- Disclosure of water-related information, including water risk exposure of operations and suppliers, as part of corporate reporting;
- The management's ability to provide information on material water-related risks;
- Existence of company-specific water goals or targets, especially where they account for context (i.e., focus on the right water issues in the right places);
- Existence of water stewardship guidelines and/or policies including use of credible, third party certification systems² in operations and supply chains;
- Cooperation with environmental organisations, especially those working on water stewardship; and
- Evidence of participation in shared basin activities to mitigate water risks (i.e., collective action on water challenges).

Only once a company's risk exposure and response quality has been evaluated, can a final assessment of the water risks' impact on a company's financial performance be made.

However, as noted earlier, measuring the financial impacts of water risks on corporate earnings is a challenging process. Not only is it difficult to model risks to financial impacts, but the local nature of water combined with global operations, makes for a complicated exercise. For large, diversified conglomerates operating across multiple sectors, it requires separate evaluations of the various assets across business segments. Furthermore, challenges exist for investors who rely on published company information to assess water risks, as not only does the availability of relevant data at the business unit level usually decline significantly, but self-reporting is often limited to select water risks, which may miss material risk exposure. For example, many companies assess and report on water stress exposure, but not systematically on other types of water risks, such as flood risk exposure, thus potentially underestimating their risk exposure. The result of this is that current mainstream approaches from ESG data providers to evaluate water risk exposure are flawed.

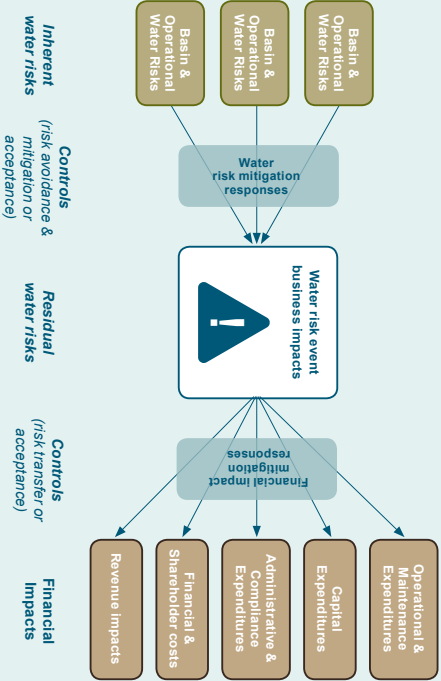


Figure 1: Factors influencing the level of water-risk exposure and financial impact

2 E.g.: Alliance for Water Stewardship (AWS), case study of EDEKA

2.2 Indicators in the financial sector

In order to integrate water-related risks into their analysis, investors and lenders need to understand the relationship between water dependency and future water security with the company's future forecasts. Some events may only affect companies for a short time (e.g., floods). Other events can last for several years (e.g., droughts) or even much longer (e.g., decades-old regulations).

Banks are most likely to be affected by the consequences of water-related events through increased credit default risks. The level of credit default risk is calculated by multiplying the probability of default by the expected level of default. While the expected level of credit default depends primarily on the amount and nature of the loan (e.g., senior unsecured loans vs. subordinated loans), the probability of credit default can be estimated using various company financial metrics.

As already described in Part I of this series, water risks can lead to both falling revenues and rising costs, thus lowering EBIT and EBITDA. This has a direct impact on various key metrics relevant to the assessment of default probability, such as:

- Interest coverage ratio;
- Net debt ratio; and
- Total return on investment.

In the event of unexpected additional write-downs, key ratios based on the balance sheet to assess the credit default risk are also affected.

Water risks, therefore, have the potential to be very important for rating agencies as the credit ratings are also based on the financial ratios mentioned. In particular, permanent events can have a significant impact on credit ratings.

For investors, the main focus is on changes in a company's expected cash flows, which are used to calculate a company's fair value. While one-off effects are generally likely to have a relatively minor impact on the total discounted cash flows, influences on the company's expected future growth rate are extremely important.

In addition to affecting cash flows, water risks can negatively affect profit margins, return on equity, and equity ratios. If individual plants can no longer be operated as before, they may have to be partially or, in extreme cases, completely depreciated, which reduces a company's value.

Water valuation tools are needed to convert risk scores into financial metrics.

2.3 Interim conclusion of measuring impact of water risk

Water risks can have a direct or indirect impact on companies in several ways via internal and external risk factors. Indeed, water risk assessments are particularly advisable for companies and financial institutions with a high level of exposure to particularly vulnerable industries or regions.

For an investor to properly account for water risk, it is necessary to assess a client's:

(1) basin water risk exposure for material operations, (2) operational water risk exposure, based on the nature of how water is used, and (3) water stewardship responses, including the site's ability to adapt to risks. Based on an analysis of these indicators, it is possible to derive a better understanding of various water risks' impact on a company's financial performance. However, translating an understanding into quantified values that can be used to calculate water-related changes in the financial performance of companies is more challenging. Since water risks can impact a company's income statements and balance sheets, and this in turn affects its financial ratios, which lead to changes in credit ratings and the company's value, converting water risks to financial impact numbers is important to influence lending and investment decisions.

One of the key challenges, accordingly, is to convert water risk scores into financial metrics, which is where there is a need for water valuation tools.



3 Evaluation of available water risk and valuation tools

In recent years, a number of tools have been developed to measure not only water status (‘water status tools’), which tell you about the physical status of water in a basin (e.g., WBCSD India Water Tool), but also water risk (‘water risk tools’), which convert levels into risk categories (e.g., WWF’s Water Risk Filter, WRI’s Aqueduct). The former category offers ratio level data on water but lacks interpretation, while the same could be argued in reverse of the latter (water risk tools offer ordinal level data but with interpreted meaning). In addition to these water risk tools, tools calculating the financial impact of water risks (‘water valuation tools’) have also emerged. There is no doubt that the development of this category of tools is only just beginning and will continue as the financial industry pays more attention to this issue. Nevertheless, it is important for users to distinguish between these different types of tools. The remainder of this section will focus on water risk tools and water valuation tools.

3.1 Water risk tools: a brief overview

There are many challenges when it comes to building water risk and water valuation tools. Water risk assessments need to be both comprehensive, geographically and topically, as well as sufficiently detailed in time and space (i.e., up to date and accurate). The tools need to cover all countries as fully as possible (and at a minimum, the most relevant markets) for them to be applied to the vast majority of the investment and loan portfolios of internationally active financial institutions. Furthermore, for investors, there is the need to cover not just a company’s operations (requiring asset-level data for a company’s value chain), but for thousands of companies across all sectors. The lack of asset-level data for operations and supply chains has, to date, limited the ability of investors to tap into existing water risk tools.

Today, the available data on global water risk is primarily provided by two water risk tools, both of which are freely available. These are WWF’s Water Risk Filter and World Resources Institute (WRI)’s Aqueduct Water Risk Atlas. Due to their significance for many different derivative water risk and finance tools, an overview of these two water risk assessment tools is provided below.

3.1.1 WWF Water Risk Filter

The WWF Water Risk Filter, initially released in 2012, was developed in cooperation with the German Development Finance Institution DEG to meet the needs of the financial industry with the aim of understanding and analysing the water risks in its portfolios. Designed to be easy to use by non-water experts, the Water Risk Filter is a free online tool that enables companies and financial institutions to assess, respond, and value water-related risks worldwide.

Following a comprehensive upgrade in 2018, the latest version of the Water Risk Filter (version 5.0) offers in-depth analysis across the following areas:

- Assessing basin risks: physical, regulatory, and reputational risks associated with a company’s geographical location are assessed using 32 risk indicators (for 57,645 basins) and higher resolution data sets for 12 relevant countries.
- Assessing operational risks: physical, regulatory, and reputational risks associated with the company’s operations are assessed either using a short questionnaire (10 drop-down questions for all company locations) or with a more detailed questionnaire (45 questions for each location separately).
- Recommending water stewardship responses: based on a company’s potential water risks (basin and operational risks), the tool provides various recommendations for risk mitigation or prevention that account for basin risk context. Financial institutions can compare corporate risk mitigation measures with those recommended by WWF to assess the appropriateness of the company’s response to water risks.

The Water Risk Filter can also be applied by financial institutions in the following areas:

- Use of the country profiles as a rapid analysis of water risk exposure where asset-level data are unavailable, but national operational footprint is available.
- Analysis of investment opportunities: as part of WWF’s emergent work on Bankable Water Solutions, financial institutions can use the Water Risk Filter to identify not only regions with a high need for investment in water infrastructure (e.g. high water risk regions), but also those that may have a favourable investment environment (e.g. low risk of corruption).

Furthermore, the WWF Water Risk Filter is continually enhanced. The latest upgrade (as of this report’s publication) includes the launch of the Valuing Water Database, which covers over 100 tools and approaches that can be used to help find the right way to value water.

Lastly, WWF is in the process of integrating climate and socio-economic pathway-based scenarios into the tool to support scenario evaluation of water risks in line with the Task Force for Climate-related Financial Disclosure (TCFD) recommendations.

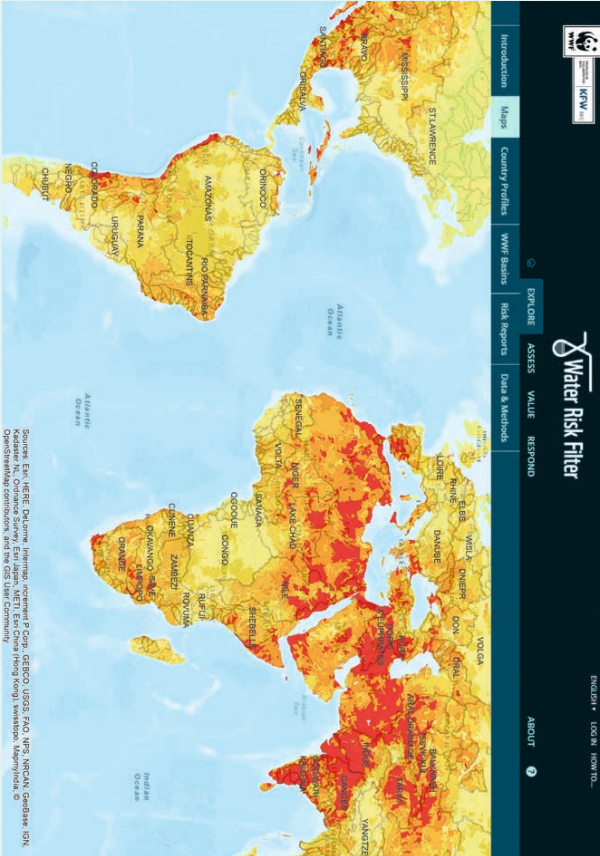


Figure 2: WWF Water Risk Filter³

3 WWF (2019a)

3.1.2 WRI Aqueduct

Since its inception in 2011, the WRI’s Aqueduct Water Risk Atlas is a freely accessible global water risk mapping tool, which can be used by companies and investors to assess water-related risks around the world.

In August 2019, WRI released an updated version of the Aqueduct Water Risk Atlas (version 3.0.) which includes higher spatial and temporal variation, news indicators, and a more holistic hydrological model. In this latest version, water risks associated with a company’s geographical location are assessed using 13 risk indicators (for 16,396 basins) organized into three categories: physical risk quantity, physical risk quality, and regulatory & reputational risk.

The WRI Aqueduct Water Risk Atlas also provides information on projected water risks in 2030 and 2040 based on optimistic, pessimistic, or business-as-usual climate and economic growth scenarios. Therefore, companies and financial institutions can use the tool to evaluate and disclose on current and future geographic water risks, as recommended by the Task Force for Climate-related Financial Disclosure (TCFD).

In addition to the Aqueduct Water Risk Atlas, the WRI Aqueduct information platform also contains an online Country Rankings tool. For three risk indicators (Baseline Water Stress, Drought Risk, and Coastal Flood Risk), financial institutions can analyse and compare national water risk exposure, especially when there is a lack of asset-level location data available.

Furthermore, two new tools will be launched soon on the WRI Aqueduct information platform, which specialize in providing additional, detailed information on flood and food related water risks.

- Aqueduct Floods: a new tool to better identify coastal and riverine flood risks as well as analyze the costs and benefits of investing in flood protection.
- Aqueduct Food: a new tool to understand and identify current and future water risks to agriculture and food security.

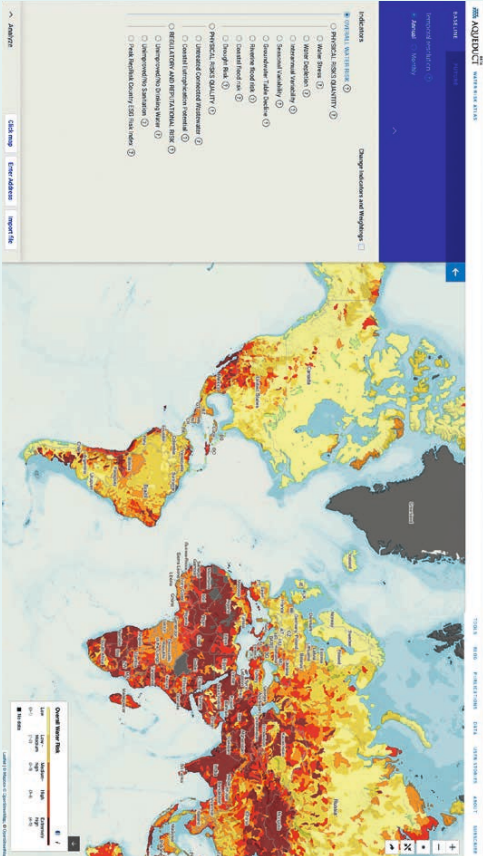


Figure 3: WRI Aqueduct Water Risk Atlas⁴

3.2 Water valuation tools: evaluation criteria

The two most comprehensive water risk tools (described above) are used by a number of water valuation tools as a starting point to model the impact of water risks on investment and loan portfolios of financial institutions.

However, these tools often differ considerably (since their methods and outputs vary significantly) and so it is helpful to evaluate them across a range of criteria. Table 1 summarises the different criteria used to distinguish the tools and what were seen as the most important requirements for individual tools.

While there are dozens of potential tools to evaluate (see Water Risk Filter's Valuing Water Database), five tools were selected due to their specific aim of providing financial valuation of water risks: the Water Risk Monetizer, the Water Risk Valuation Tool, the Corporate Bonds Water Credit Risk Tool, the Drought Stress Testing Tool, and lastly, a toolbox – the Investor Water Toolkit.

Criterion	Description
Industries and countries covered	<ul style="list-style-type: none">As many mechanisms of water risk action as possible (see section 2.1 and section 2.2)
Asset classes covered	<ul style="list-style-type: none">Impact of water risks varies depending on asset class, so tools therefore work with different input indicators and calculate different metrics
Relevance of the metrics	<ul style="list-style-type: none">As complete a picture as possible of the key ratios for banks and investors discussed in sections 3.2Calculation of discounted cash flows is the minimum requirement for tools that focus on investments
Timeline	<ul style="list-style-type: none">Timeline of at least 20 years to create value for long-term financial institutionsRepresentation of risks on an annual basis for the first five years to create value for short-term financial institutions
Data required	<ul style="list-style-type: none">Due to low data availability, the probability that the tool can be applied is greater when less data is neededData input should be supported by import functionsTool should close data gaps with estimates
Data credible and up-to-date	<ul style="list-style-type: none">Databases used by the tool should be highly credible and high qualityData must be up-to-date
Adjustability	<ul style="list-style-type: none">High transparency with regard to the assumptions on which the tool is basedUsers should be able to integrate their own assumptions and data
Scenario analysis	<ul style="list-style-type: none">It should be possible to map several scenarios for the future development of water risksThe user should be able to adjust the scenario assumptions
Costs	<ul style="list-style-type: none">Low costs/licence fees have a positive impact on the number of potential users of the tool

Table 1: Evaluation criteria for water risk tools in the financial sector

⁴ WRI (2017)

3.3 Water valuation tools in detail

In this section, the various water valuation tools designed to translate water risks into financial impacts for the financial sector are described and evaluated on the basis of the above criteria.

It is worth noting that in addition to these valuation tools, a comprehensive array of tools and approaches may be found in the WWF Water Risk Filter's Valuing Water Database.⁵

3.3.1 Water Risk Monetizer

The Water Risk Monetizer (WRM)⁶ was developed by Ecolab in cooperation with Trucost and Microsoft. This free online tool calculates how a company's operating costs and revenues would change when the "full" water value is quantified, i.e., select externalities are internalised. The tool employs a shadow pricing approach to account for the value of water (Box 1).

Box 1: The limitations with Shadow Pricing approaches

Per Investopedia, shadow pricing is "the assignment of dollar values to non-marketed goods such as production costs and intangible assets". While it emerged into the mainstream in the carbon realm, its use has extended to water in recent years. While logical in the sense that water is undervalued (and therefore well suited to shadow pricing), the approach should be treated with caution for several reasons:

1. Calculating a viable shadow price of water is fraught with assumptions around externalities and drivers of water pricing. Furthermore, a static value often does not account for the time value of money.
2. Shadow pricing water works reasonably well for water procurement (where the additional price can be added), but fails in most other areas.
3. Building off the previous point, the most financially material impacts from water are not due to water procurement, but on issues like operational interruption (e.g., due to flooding). Shadow pricing fails to capture this aspect of water risk.

In the first step, higher water prices per m3 are multiplied by the water consumption per site, which makes it possible to quantify the additional costs in the event that water risks occur. In the second step, the tool estimates the likelihood of a "water risk [price] premium" for periods of three, five, and ten years. The likelihood factors for price increases include historical water price increases, water stress forecasts, and regulatory and reputational risks. An assessment of these risk categories specific to a location ultimately produces an estimate of the likelihood that the higher water costs will actually occur. This process is used for both the incoming and outgoing wastewater of a company. The expected additional production costs attributable to water risks are aggregated across all locations.

A fair share approach is then used to quantify potential revenue losses. The model assumes, for better or worse, that in regions where water is scarce, water is available to the company proportional to its share in the region's added value. If a company needs more water to generate revenues than it is "entitled to" in terms of added value, then its revenues, generated by additional water consumption, are at risk. The likelihood factors for the loss of revenues include, for example, water stress at the location, the industry's importance, the industry's water intensity, and regulations – as is the case with production cost calculations.

In addition to supplementary production costs and potential revenue losses, the Water Risk Monetizer also calculates a reputational risk value based on RepRisk data. Both water stress and pollution are considered to be potential water risks.

The tool is not limited to any one particular sector or country. As the tool does not calculate any other financial metrics (except changes in revenues and costs), there is no focus on asset classes.

Some company-specific information needs to be entered to be able to use the tool. In addition to information on water use, water price information and production data is also required. The preset assumptions in the tool can be overridden, particularly when estimating the likelihood that individual risks will occur. Users can thus also test the company's sensitivity to water risks in different scenarios using different risk likelihoods. The tool is available to users online for free.⁷

The tool was originally developed for manufacturing companies and is intended to help users better manage their own water risks. The tool is not suitable for banks and investors that assess large portfolios and only have externally available information on the company to be valued. In the case of larger private equity acquisitions (where the investor has access to better information), however, the tool offers an approach to illustrate how select water risks may affect some aspects of the water use costs for the company being valued.

⁵ WWF (2019b)

⁶ Ecolab (2019a)

⁷ Ecolab (2019b)

The tool is based on water risk data from the Aqueduct Water Risk Atlas, the Water Risk Filter, Global Water Intelligence, and Trucost's population data, water quality standards, and environmental impact data based on selected ecosystem service calculations. In that sense, it is one of the few tools that attempts to account for freshwater externalities.

However, given the shadow pricing approach and assumptions around the relationship of water pricing, fair shares for revenue, and ecosystem service valuation methods, the WRM has several limitations. Conversely, the WRF is potentially suitable for companies that use water as an input factor for production.

3.3.2 Water Risk Valuation Tool

The Water Risk Valuation Tool (WRVT) was developed by Bloomberg LP and the Natural Capital Declaration to quantify financial water risks facing a set of 23 listed gold and copper mine operators for the investor community.⁸

Specifically, the WRVT calculates declines in revenue caused by water scarcity at mine sites because certain production volumes can no longer be produced when water is scarce. It also calculates how high additional production costs could be based on rising shadow prices for water. The tool obtains data on a singular data layer (water stress at production sites from the Aqueduct Water Risk Atlas). Information on mine location data and the company's key financial ratios is taken from the Bloomberg terminal. The Water Risk Valuation Tool models potential stranded assets based on assumptions about future physical water scarcity and estimates the impact of this water risk factor on the financial performance and share price of the operating companies on an annual basis until 2021. The tool determines the change in the "fair" share price of a company on the basis of the discounted cash flow approach, both with and without water risk considerations. The tool also captures changes in the rate of investment as a reaction on the part of the companies affected by water shortages. Tool users can view and adjust assumptions, e.g., for preset shadow prices for water, and thus also apply different shadow price-based scenarios. No prior knowledge or data input is required to use the tool. The WRVT is a restricted-access tool, available only to users on the Bloomberg platform for a fee.

The WRVT has similar shadow pricing limitations to the WRM and also relies on limited water risk layers.

3.3.3 Corporate Bonds Water Credit Risk Tool

Developed by the Natural Capital Finance Alliance, GIZ, and VTI, the Corporate Bonds Water Credit Risk tool (CBWCRT) can be used to integrate water stress into the credit analysis of and evaluate corporate bonds in water-intensive industries such as mining, energy, and beverages. It was developed and tested together with seven financial institutions. The free Excel model can be obtained from the Natural Capital Finance Alliance.

The tool factors in water risks using a shadow pricing approach. This makes it possible to pass on external costs not previously included in the water price to the company to be valued. The higher assumed water price at the company's various production sites and the company's water consumption produce a hypothetical additional production cost. The tool calculates the impacts of the additional production costs on the profits to be expected in the future, which in turn influence the associated financial indicators. Users can change the data and assumptions used in the tool. It is also possible to apply scenarios by adjusting shadow prices for water.

The CBWCRT calculates the impact of the shadow price on EBITDA margins, the debt ratio, and the ratio of operating profit to gross and net debt for the next four years in advance. Data is already preset for 24 enterprises (8 from each of the three sectors covered). If more companies are to be added, company data must be entered in the corresponding spreadsheet. The tool obtains water stress data for specific sites from the Aqueduct Water Risk Atlas. Location data for the 24 companies included in the tool was supplied from the Bloomberg terminal. The tool automatically calculates the water shadow prices for the years 2010, 2020, 2030, and 2040 once the location data is entered. The application of shadow prices is particularly suitable when valuing companies that use water as an essential input factor for product manufacturing. Risk type coverage is therefore limited.

3.3.4 Drought Stress Testing Tool

The Drought Stress Testing Tool (DSTT)⁹ was developed by the Natural Capital Finance Alliance, GIZ, the Emerging Markets Sustainability Dialogues (EMSD) network, UNEP FI, the Global Canopy Programme, and Risk Management Solutions (RMS). Publicly accessible on the website of the Natural Capital Finance Alliance, this tool incorporates five drought scenarios for each of four countries (Brazil, China, Mexico, and the United States) to account for direct and indirect impacts of drought on 19 industry sectors.

The Drought Stress Testing Tool determines how a drought can change revenues and operating costs for individual companies. These changes filter through the financial statements of the companies in a loan portfolio, translating into a revised credit rating, and implying a new default probability, as well as an updated expected loss for both the company and portfolio as a whole.

The insights provided by the tool inform banks as to how a company's profit and loss statement could be affected by a drought (scenario), and how their likelihood of defaulting on their loans would change. All of the tool's components and the associated assumptions and calculations are visible, and users can adjust them to incorporate their own assumptions into the analysis.

Three different risk types that can potentially arise for companies from droughts are analysed in more detail. The tool identifies the implications of drought-induced water scarcity for production and assesses the possible impacts on energy supply and material/labour supply.

Revenues and production costs from the companies' annual reports serve as the starting point. These costs are allocated to the different company sites. The expected effects of droughts on the two metrics are then calculated for each destination and aggregated at the company level. The tool provides information on expected changes in financial metrics for the next five years on an annual basis. The user has to enter the debtor's annual accounts, locations, and operating information into the model.

The change in revenues and production costs leads to changes in financial metrics. In addition to the logarithm of total assets, the model also calculates the net debt ratio, the return on total assets, the interest coverage ratio, and the liabilities to assets ratio.

In a separate module, S&P credit ratings are correlated to historical default rates for each rating score. At the same time, the typical (average) values of the five financial ratios mentioned above for a specific credit rating are determined. The change in a company's financial ratios triggered by a drought scenario thus leads to a revised credit rating and also to a changed probability of default.

The loss-given-default amount is 45% for senior unsecured loans and 75% for all sub-ordinated loans. Multiplying the changed credit default probability and the expected credit defaults in the event of occurrence yields the expected value of the drought-related credit defaults. This value can then be aggregated across all companies in a loan portfolio to form a portfolio ratio.

Users have to import financial ratios from the annual financial statements of the companies to be valued into the tool. They also need to enter location-specific information for production facilities and information about all outstanding loans in the model.

3.3.5 Investor Water Toolkit

The Investor Water Toolkit[®] was developed by Ceres in collaboration with over 40 institutional investors. While not a tool in the strictest sense, as there is no stand-alone calculation model available to quantify the impact of water risks on individual assets or portfolios, the IWT is a valuable online resource to help investors lay the ground-work for integrating water risks into their decision-making process. The IWT contains extensive information and analyses that help investors better understand water risks. It also outlines a process for establishing water-related goals and guidelines for investors. Proposals are formulated for how to incorporate water risks into purchase or sale decisions for private equity investments and into portfolio and asset class analysis. It also provides information on how to integrate water risk issues into investor engagement activities. The online platform provides links to relevant data sources as well as overviews of available tools and case studies from other investors. A materiality analysis for various industries is also available.



3.4 Interim conclusion of existing water valuation tools

Overall, the range of water valuation tools is limited. Existing tools are restricted in their scope and/or target audience.

For example, the Water Risk Monetizer and the Water Risk Valuation Tool are primarily tailored to the needs of companies and/or equity investors due to their respective focus on cash flows (revenues/costs). The Water Risk Valuation Tool calculates not only modified discounted cash flows but also direct implications for a fair share price, taking water risks into account. However, it is subject to a fee, accessible only via the Bloomberg terminal, and applicable only to selected mining companies. The Corporate Bonds Water Credit Risk Tool and the Drought Stress Testing Tool are primarily geared to bond and credit valuation. Both tools calculate key financial ratios relevant to lending. While the Corporate Bonds Water Credit Risk Tool uses a water shadow price to measure the impact on companies that need water as an important raw material for production, the Drought Stress Testing Tool also considers the effects of droughts on energy supply and on the supply of materials and labour.

The Investor Water Toolkit is not a tool in the true sense of the word, but a comprehensive online resource that gives investors essential information on water risks. It was therefore listed here as another tool.

All of the tools focus on the effects of droughts. Water risks due to flooding or pollution are scarcely covered. No tool covers water risks across a large number of countries and sectors. Accordingly, these tools only allow for isolated valuation assessments, which will only be able to cover a small part of most loan and investment portfolios. Lastly, it is worth noting that the majority of the tools heavily rely on the use of shadow pricing as a methodology, which biases water intensive sectors and may not reflect how water risks affect financial value (e.g., flooding is independent of water use). Table 2 provides an overview of this evaluation's findings of the four model-based tools.

The above conclusions, which are summarized in the table, were also the basis for WWF developing a new valuation tool back in 2018 – the Water And Value (WAVE) tool. This new tool is intended to fill some of the gaps in the water valuation tools space and build on recent innovation. WAVE is the focus of Part III of this series and includes a comparison against Table 2.

	Water Risk Monetizer	Water Risk Valuation Tool	Corporate Bond Water Credit Risk Tool	Drought Stress Testing Tool
Primary Audience	Corporations	Equity investors	Bond issuers	Banks
Industries covered	Unlimited	Mining	Mining, energy, beverages	19 industries in four countries
Risk types covered	Physical (scarcity & quality)	Physical (scarcity)	Physical (scarcity)	Physical (drought)
Asset classes covered	Investments	Investments	Corporate bonds	Loans
Relevance of the financial ratios	Medium	High	High	High
Timeline	3, 5 and 10 years	Every year until 2021	2010, 2020, 2030, 2040	Every year for 5 years
Data required (for users)	Location; water use; water price; production data	Production impacts; company action; shadow price	Financial data, location, water use	Financial data, location, production data
Data credible and up-to-date	Uses data from WWF and WRI As of: 2016	Uses data from WRI and Bloomberg As of: 2015	Uses data from WRI and Bloomberg As of: 2015	Uses data from RMS As of: 2017
Adjustability	Yes	Yes	Yes	Yes
Scenario analysis	1 drought scenario	WRI-based scenarios	WRI-based scenarios	5 drought scenarios
Approach output	Shadow price	Shadow price	Shadow price	Credit rating adjustment
Costs	Free of charge	Bloomberg access required	Free of charge	Free of charge

Table 2.: Overview of tools to measure water risks

4 Conclusions and recommendations

Investors and financiers play an important role in the transition to sustainable water management. As investors in companies, financial institutions are exposed to the water-related risks that companies themselves face, which affect corporate expenses, revenues, assets, and liabilities. Water risks can, in turn, manifest themselves in financial institutions through devaluation and default risks. A financial institution's reputation is also affected by a risk that may result from unethical, unfair, or manipulative customer practices.

Investors and financiers play an important role in the transition to sustainable water management.

Tools in the water valuation space have only emerged in the past few years. Their current risk focus will ultimately be supplemented by the fact that risks are also accompanied by opportunities to create economic value. Asset-level data will be necessary to fully develop next-generation approaches that account for both risk and opportunity across an investment portfolio.

Additional resources – both guidance in the form of supporting tools like the Investor Water Toolkit, as well as additional tools, such as WWF & Water Foundry's Water And Value (WAVE) tool – are important to continue to build tangible pathways for investors to incorporate water risk into financial decision making.

Ongoing evolution, through tools like WAVE, will continue to help build a much stronger understanding of how water risks affect financial value. This, in turn, will lay the foundation for water risks to be more explicitly incorporated into investment and lending decisions.



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