WATER RISK MODELING:
A Framework and Guidance for the Financial Sector

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EXECUTIVE SUMMARY

In recent years, water risk has become a major threat to society and business viability. Exacerbated by climate change, water risk events have increased in frequency and magnitude, thus endangering water security for households, industries, and ecosystems. The consequences of water risk are multifold, affecting society and the economy alike. Yet, because water risk is an emerging risk, it remains poorly understood and lacks visibility and inclusion in risk management processes.

Well-developed tools that allow risk managers and investors to understand, assess, and mitigate water-related challenges are crucially important to address this emerging risk. Many organizations have created water risk assessment tools in recent years, but are the available models exhaustive and/or holistic enough to guide the financial sector towards enlightened decision-making? Because water risk presents various investment, management, and modeling opportunities, it is important from both a risk management and investment opportunity perspective for the Global Risk Institute (GRI) and its constituents to understand the current state of research and model development in this area. It is in this context that we present this report to the GRI and offer detailed insights into the current state-of-the-art of water risk modeling.

Water Risk Framework

Our water risk framework demonstrates two key elements for the understanding and modeling of water risk:

1. Water risk often emerges as a physical threat (e.g., water scarcity, water stress, etc.) in a specific location. However, it can quickly transmit and expand to a variety of entities whose livelihood or business interests are directly or indirectly connected to that region. We illustrate this transmission and expansion process in Figure 1. Physical water risk engenders impacts at the socio-economic level, and ultimately on the financial system. In turn, a stressed financial system will reciprocally affect society and the economy. Therefore, water risk represents a complex challenge, and any tools designed to assess it must consider these wide-ranging impacts.

2. The abovementioned loop generates physical, regulatory, and reputational risks for companies. We employ three case studies to illustrate these challenges and ground our discussion: Nestlé Water Bottling, the Fort McMurray Wildfire, and the Drought of the Rhine and the Danube (Tables 2, 3, and 4). Each of these case studies highlights the systematic and wide-ranging repercussions water risk can entail.

Based on these examples, we create a financial water risk framework (Figure 2), which specifically looks at the ways in which water risk affects the financial system.

Overview of Socio-Economic Water Risk Models

We discuss four of the leading and best-established models that have been designed to assess water risk from both socio-economic perspective:

- The World Resources Institute (WRI) Aqueduct model allows companies and investors to assess and measure their geographic exposure to water risk. The model considers the physical, regulatory, and reputational aspects of water for specific geographic areas and has served as a foundation for various other models.
- The Ceres Aqua Gauge model allows financial investors to assess the relative water risk exposure of their portfolios and adjust them accordingly. The qualitative information provides a basis for further quantitative modeling.
- The World Business Council for Sustainable Development (WBCSD) CEO Guide to Water identifies seven ways in which water can affect a company's bottom line and guides managers on how to incorporate water risk assessments in their managerial decisions. It does not quantify the effects of water risk.
- The World Wide Fund for Nature (WWF) Water Filter considers basin and operational risks. Companies can assess their vulnerability to water risk with this tool at the country and industry level and evaluate potential responses.

These models provide an excellent foundation to assess a company's exposure to water risk. However, their investment-specific guidance capabilities remain limited, suggesting that further work is warranted in this emerging field.

Overview of Financial Water Risk Models

Financial managers and investors need financial water risk models tailored to various aspects of financial performance. Some established models include:

- The German Association for International Cooperation (GIZ) tool integrates the geographic shadow price of water, thereby allowing accountants and financial mangers to explore the effects of water stress on income statements and their companies' financial performance. The tool does not provide bond-specific information such as the impact of water risk on the price or yield to maturity of a given bond.
- Water And ValuE (WAVE) calculates the effects of physical water risk and operational water risk on a set of variables measuring the direct and indirect costs and revenues linked to water risk. It considers the effects on financial assets and portfolios and aims to become a stress-testing tool in the future.
- South Pole focuses on equities in portfolios. It assesses water risk vulnerabilities with respect to industries and regions. By attributing risk scores, the model portrays the impacts of water risk on single equities and their presence in equity portfolios.

Recommendations

There are opportunities to develop models alongside those already in existence, especially financial water risk models. Some of the elements to consider either in modeling or for model users are:

3. Elements considered in the model (e.g., the role of water in production or transportation)
4. Types of risks considered in the model (e.g., physical, regulatory, and/or reputational)
5. Aggregation (holistic versus specific)
6. Time perspective (expected changes)
7. Integrated modeling of threats and opportunities
8. Data

Most models currently focus on equity, and new models should target the effect of water risk on bonds and loans. In terms of management, we suggest that financial investors consider opportunities as much as threats, their asset mix and diversification, and the direct and indirect consequences water risk imposes on them.

More financial models are needed for transparent decision making. Future models should have modules or should work in combination with others to answer the specific needs of financial investors. The models should be location and industry specific, with a clear understanding of the interplay of various risks, especially reputational risks.

In terms of portfolio management, a long-term outlook is preferable as water risk challenges will increase in the future. Additionally, models should take into account mitigation and adaptation measures related to specific investments. Finally, a useful, complementary approach would be to employ a multivariate (e.g., regression) analysis as it would assess water risk exposed entities and financial assets.

With the right tools, risk managers, investors, and stakeholders can make decisions that benefit their business and the society towards a more sustainable world.