

Weather Risk Management Services

White Paper By:

Janani Ravi

Mahek Saxena

Shuvam Ankit Tripathy

Srijan Ghosh

Index

| | |
|---|-----------|
| Introduction | 3 |
| The Link between weather and business | 4 |
| Major Effects on various Sectors on account of Weather Risk: | 5 |
| Economic Impact of bad weather | 9 |
| Impact of bad weather in India | 9 |
| Strategies to Mitigate Weather Risk in the Agricultural Sector: | 10 |
| Traditional Approaches | 10 |
| IoT in Agriculture | 11 |
| Technologies critical for successful weather monitoring and forecasting in agriculture | 13 |
| IoT sensors for weather monitoring | 14 |
| Connected system of IoT sensors for weather monitoring: | 14 |
| Advantages of IoT solutions for weather condition monitoring: | 15 |
| References | 18 |

Introduction

Extreme weather events have always had and will continue to have significant consequences on society and the economy.

The weather affects consumers' behaviour in terms of what products they buy, where they buy them, and in what quantity. Even if a business knows how normal weather affects its earnings, unexpected abnormal weather always poses new risks. Today, weather risk management is still in its early days. The majority of businesses do not hedge against weather risks, nor do they have an accurate view on how much is at risk. Climate change is making severe weather more common, and reporting to investors about how climate affects the business will require companies to estimate and report on the risks they face from the weather.

This document gives an overview on how businesses in various sectors are affected by weather and the strategies adopted to mitigate the risk.

The Link between weather and business

The weather affects consumers' buying decisions. Even if a business knows how normal weather affects its earnings, unexpected abnormal *weather* events present their own risks. Research shows that abnormal weather disrupts the operating and financial performance of 70% of businesses worldwide. When weather conditions are on average adverse over days, weeks, or entire seasons, shortfalls in sales cause reduced cash flows and can lead to financial distress and business failure.

A deviation from normal weather conditions poses as a peril to the business. Recent events around the globe underline the increasing volatility of the weather and the different ways in which they can impair the economy. Although the majority of businesses are exposed to

weather risks, many are still failing to adequately identify and manage the impact changes in climatic conditions can have on their revenue streams.

Weather affects the realisation of the production potential. Hot weather may slow down workers, frost may damage crops, floods may disrupt transport and manufacturing. Research shows that over the last decade, global economic losses from extreme weather events have grown more costly

Sectors such as energy, retail, food, clothing, tourism, distribution, transport and construction are just as sensitive to minor changes in the weather as they are to movements in interest and foreign exchange rates in terms of the impact this can have on profits.

Major Effects on various Sectors on account of Weather Risk:

Airlines: The adverse weather leads to delay in flights. The impact of sudden and slow-onset weather shocks results in delays of departure. 84% of all delays occur on the ground (gate, taxi-out, tax) out of which 76% are prior to take off.



Construction: Weather is a crucial factor in the construction, planning, and execution of an outcome of a project.



From initial breaking ground to post-project documentation, weather can affect site/building conditions, operations, scheduling, and worker safety. As a matter of fact, just one

serious weather event led to a day of lost work on a \$ 200M project that could cost a construction company \$ 250k directly from its profit.

Tourism: The Change of weather heavily affects decision-making in the tourism industry. In fact, tourism can be considered a highly weather-sensitive economic sector, but, at the same time, the tourism industry has a



crucial role to play in dealing with the hurdles of the weather. The UK's washout summer of 2012 resulted in cancellation of sports events and music festivals. At one point it even threatened certain events at the London Olympics with two waterlogged venues – Eton Dorney and Greenwich Park – having to be hastily resurfaced prior to the start of the games, leading to fears that the rowing, canoe, equestrian and modern pentathlon events could be interrupted or delayed.

Agriculture: Floods, droughts, heat waves, cold spells, and other natural disasters are large sources of risk for farmers. A drought, heat wave, or other disaster can lead to a poor harvest, leaving uninsured farming households with



little income for the season. In order to cope with unpredictable weather, farmers often plant low-risk, low-return crops instead of investing in more profitable crops that are more sensitive to weather. Furthermore, farmers wary of bad weather may hesitate to make other investments in their farms, such as increasing fertiliser use. As a result, the threat of

extreme weather can trap farmers in a cycle of low productivity. Weather-related risks in agriculture are important not only for farm managers but also for policy makers, since income stabilisation in agriculture is frequently considered as a governmental task.

Major risks on account of bad weather with illustrative examples:

| Risk | Scenario |
|-------------|--|
| Supply Risk | <ul style="list-style-type: none">· Lack of wind significantly impairs power generation and, potentially, the ability to fulfil financing commitments, Annual wind power generation can deviate by more than 20% from the long-term average· Warmth for plant growth· Water for hydropower |

| | |
|-------------------------|--|
| <p>Operational Risk</p> | <ul style="list-style-type: none"> · An array of weather perils cause travel disruptions. The aviation sector is vulnerable to weather perils such as snow and ice. Airport and airline operations rely heavily on correct schedules and punctuality. · During 2020, 45.8% National Aviation System (NAS) - US delay was on account of bad weather conditions · Low rivers impact barge transportation · Cooling of manufacturing plants – excessive heat can negatively impact workers, production levels and quality of goods. |
| <p>Demand Risk</p> | <ul style="list-style-type: none"> · Sales of many retail products are highly sensitive to the weather · Hot summers increase beverage sales · Rain affects vacation bookings |

Economic Impact of bad weather

According to Swiss Re Institute's stress-test analysis, the World economy can lose up to 18% GDP from climate change if no actions are taken.

Economies in Asia would be hardest hit, with China at risk of losing nearly 24% of its GDP in a severe scenario, while the world's biggest economy, the US, stands to lose close to 10%, and Europe almost 11%.

Impact of bad weather in India

India suffered an average annual loss of around USD 87 billion in 2020 due to extreme weather events, such as tropical cyclones, floods and droughts as per the State of the Climate (SoC) in Asia 2020 report by the World Meteorological Organisation (WMO). The report highlights the impact of extreme weather and climate change which, in the past year, has caused the loss of life of thousands of people, displaced millions and cost the country Smart Farming based on IoT, involves the usage of different kinds of sensors that monitor the field based on weather data, soil moisture, light intensity, humidity, temperature etc. Farmers can also control water flow, optimise inputs to the field and treatments based on the action suggested by these systems.

Almost every solution for smart weather monitoring relies on data. It needs not be forecasting extreme weather like floods but regular weather conditions in the field that impact crops on a day to day basis. Thanks to technologies like IoT weather stations, weather collection data, and AI weather prediction, agribusinesses can store and process countless data sets to be prepared for weather changes, react to them fast, and promote climate change management initiatives.

The report highlights how extreme weather and climate hazards, especially floods, storms, and droughts have a significant impact on many countries in Asia, particularly, India, China and Japan, and affect agriculture and food security. This, in turn, contributes to the increased vulnerability of migrants and those displaced by such extreme weather events. It also increases health risks and leads to a major loss in natural ecosystems.

Strategies to Mitigate Weather Risk in the *Agricultural Sector*

Traditional Approaches:

- **Production insurance (PI):** Production insurance can cover yield loss from reduced fruit size from extreme heat. Your premiums will depend on the coverage you choose, your claim history, and the yield potentials of your orchards.
- **Surround Crop Protectant:** This kaolin-clay product will protect the fruit from sunburn, and reduce the temperature in the leaves, which improves photosynthesis and subsequent yields. It has the added benefit of discouraging several insect pests
- **Bagging fruit:** Tucking each individual fruit into specially-designed bags will prevent sunburn, insect injury and is a common practice for elite markets when labour is less expensive. The main disadvantage is the cost of bags, labour to apply and remove.
- **Evaporative cooling:** Use of overhead irrigation at low rates will cool the trees and fruit when used properly, which increases photosynthesis and yield and improves fruit quality.
- **Orchard floor cooling:** Under-tree micro-sprinklers may be useful to cool the orchard environment, but the investment in the system and its maintenance is large.
- **Increased storage capacity:** When high temperatures continue through harvest, storage needs to have enough capacity to quickly remove field heat from the harvested fruit. The investment cost in refrigeration is needed to preserve fruit quality and extend storage life.

IoT in Agriculture

The application of IoT with AI, just like in other sectors, is changing the game majorly in the agricultural sector as well. It brings in the

much-needed efficiency and preciseness, and is extremely reliable. IoT integrated

agriculture can be commonly termed as Smart Farming. This type of hi-tech farming takes a capital intensive approach, thus making it sustainable for the future. The



usage of such systems not only can target large, conventional farming operations but also uplift other modern types of farming such as organic farming, vertical farming etc., enhancing transparency in farm decision making.

The most critical weather data for agriculture are:

- Rainfall – Analysing historical data on rain over defined periods provides bold observations and serves as valuable input for future predictions based on artificial intelligence algorithms.
- Temperature – Tracking changes in temperature during the day, month, and year gives an outlook at conditions for crops and inputs for further analytics on conditions determining weather changes.
- Wind – Wind direction and speed can warn farmers of a coming storm.
- Air pressure – This is one of the most important measurements for predicting weather changes.
- Humidity – This metric is critical, especially with regard to preparing for rain and using water smartly.

Later, all these data sets can be gathered into a unified platform for weather monitoring and made available from any device. Farmers may customise dashboards to monitor the most critical data and visualise analytics for better decision-making.

On a smart weather dashboard, farmers also can:

- Set the number of measurements collected over a defined period (hours, days, weeks, months, years)
- Track all historical data or choose a period to display
- Observe community data from other farms as open-source information
- Locate all sensors across fields to know where weather changes may already be impacting crops
- Correlate metrics to build forecasts accounting for all potential hazards and get suggestions for protecting fields

Technologies critical for successful weather monitoring and forecasting in agriculture

Applying real-time data on weather conditions relevant to the current location and season helps farmers take care of soil and crops and manage all weather-related risks. When it comes to selecting technologies for weather forecasting, agribusinesses should consider a mix of agricultural tech solutions that complement each other.

The three main technologies that contribute to the development of intelligent weather monitoring for agriculture are:

- smart IoT sensors to collect and analyse data
- satellites and weather stations
- AI and machine learning systems for weather predictions.

IoT sensors for weather monitoring

IoT sensors lay the foundation for a bigger connected system for weather tracking in agriculture. These systems rely on a network of connected sensors that collect data in the field. Cloud computing

platforms then process the collected data to provide alarms and notifications on potential weather hazards affecting crops.

Connected system of IoT sensors for weather monitoring:

- Weather Monitoring Technologies to Save Crops from natural disasters
- Using IoT systems, farmers can get real-time access to information on the environment and soil to plan actions ahead of weather changes.
- When a system receives disturbing data from weather sensors, it can send a notification on upcoming frost or rainfall.

The most recent addition is IoT-connected sensors installed by individual farmers in their fields. All of these provide enough inputs to teach algorithms how to distinguish between cloud patterns, recognize the consequences of the smallest temperature and humidity changes, and detect potential hazards based on changes in wind direction that may bring weather fronts from other terrains.

Industry Example (Fasal)

Atmospheric conditions of farms differ vastly from those in the larger areas. We call that microclimate of the farm. To simply put, the temperature in your field is different from the garden, different from the city, different from another farm which is 10 kms away from it, different from the field which has a large canopy and different from the field which just has grass.

Getting the accurate microclimate around the crop canopy allows farmers to potentially minimise disease and pest incidence, effectively manage crop growth, optimise resources and plan optimal harvest time.

To help farmers achieve this **Fasal** has built its own microclimate weather forecast model. **Fasal's** microclimate forecasts are tailored to each farm location and are performed at a point scale, not at a kilometre-wide spatial scale. In essence, as **Fasal** collects more data, our

AI based microclimate forecasting algorithm incorporates real in-field information and relates it to publicly available weather forecasts, so farmers get real-time, actionable information relevant to day-to-day operations at their specific farm.

Advantages of IoT solutions for weather condition monitoring:

- Reduce risks to crops by monitoring severe weather conditions
- Help farmers optimise use of resources and protect crops
- Increase the quality of products by suggesting the best time for harvesting
- Send notifications to multiple devices and platforms in real-time
- Collect reliable data in the field that's relevant to a farm's location and the current season
- Integrate with third-party services and access community data

AI and machine learning to predict weather events

The application of AI and machine learning to weather forecasting is the most recent and promising technological advancement for agriculture.

Industry Example (IBM)

IBM has created a decision platform for agriculture by implementing its IBM Watson technology.

Watson Decision Platform for Agriculture combines the power of Artificial Intelligence (AI), analytics, and predictive insights with unique agricultural Internet of Things (IoT) data, the expertise of veteran industry leaders, and decades of IBM research.

It begins by creating an Electronic Field Record (EFR) as the single source of truth for each farm. Similar to the electronic medical records that have become crucial to the healthcare industry, the EFR is populated with premium, exclusive data such as – The world's most accurate weather data from The Weather Company, including historical data, near-real time observations, and forecasts fifteen days in advance as well as seasonal and sub-seasonal trends.

The Watson Decision Platform for Agriculture applies AI, machine learning, and advanced analytics to this EFR data to extract valuable insights and automatically generate guidance for smarter decisions. A unified dashboard enables growers to easily visualise data and alerts related to critical elements such as weather forecasts, soil conditions, evapotranspiration rates, and crop stress.

As with any AI solution, weather forecasting requires a huge amount of data to teach machine learning algorithms. This data can be crowdsourced from connected sensors, satellites, and local hardware weather stations to create accurate localised weather predictions. These predictions require great computing power to process large data sets, and capable storage is required to save this data for future use.

As deep learning algorithms rely most on the quality of training data, data quality and labelling are critical for accurate predictions. Sorting data and recognizing weather patterns should help to extract accurate insights on determining weather conditions following the training of a deep learning model.

The increase in accurate data sources plays a big role in successful weather prediction. There are more than 1,000 weather monitoring satellites currently orbiting the Earth, and there are thousands of weather stations on the Earth's surface.

Therefore, strategic and systematic application of IoT and AI can help us swiftly move towards, and benefit from smart farming techniques.

References

1. [\(PDF\) Weather monitoring and forecasting system using IoT](#)
2. [Mapped: How climate change affects extreme weather around the world](#)
3. [Data Science for Weather Impacts on Crop Yield](#)
4. [Weather risk management](#)
5. [Indian economy will be hit hard by rising heat: Global report](#)
6. [How weather affects India's economy; RBI reveals role of temperature, humidity, climate in GDP growth](#)
7. <https://www.google.com/amp/s/www.techrepublic.com/google-amp/article/how-iot-is-improving-weather-forecasts/>
8. [weather monitoring precision in agriculture](#)
9. [iot in agriculture technology use cases for smart farming and challenges to consider](#)
10. [Internet of Things in arable farming: Implementation, applications, challenges and potential](#)
11. [Precision agriculture using IoT data analytics and machine learning](#)
12. <https://fasal.co/>
13. <https://www.ibm.com/watson>