Market Mapping

an IFC—BMZ initiative

MAPPING OF DIGITAL SOLUTIONS TO SUPPORT FINANCIAL SERVICES PROVIDERS IN ASSESSING CLIMATE IMPACT ON AGRICULTURAL PORTFOLIOS
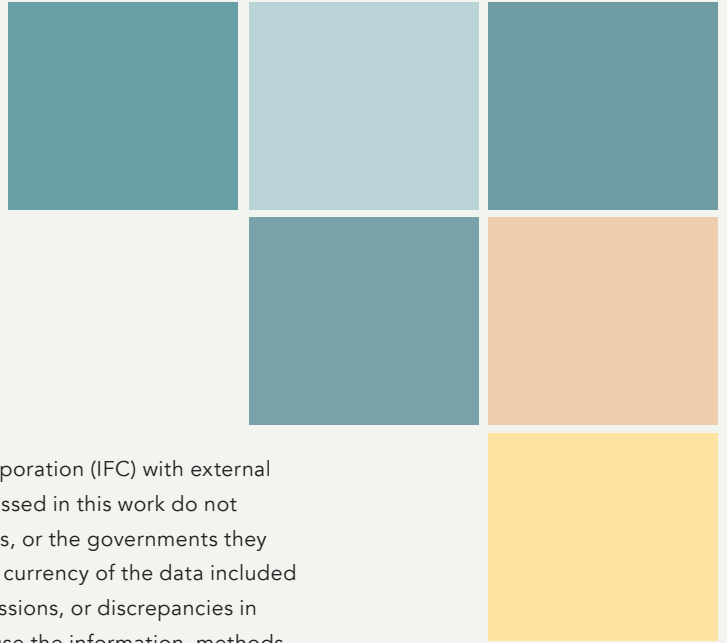
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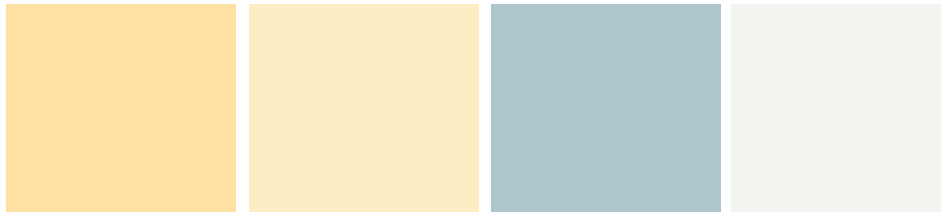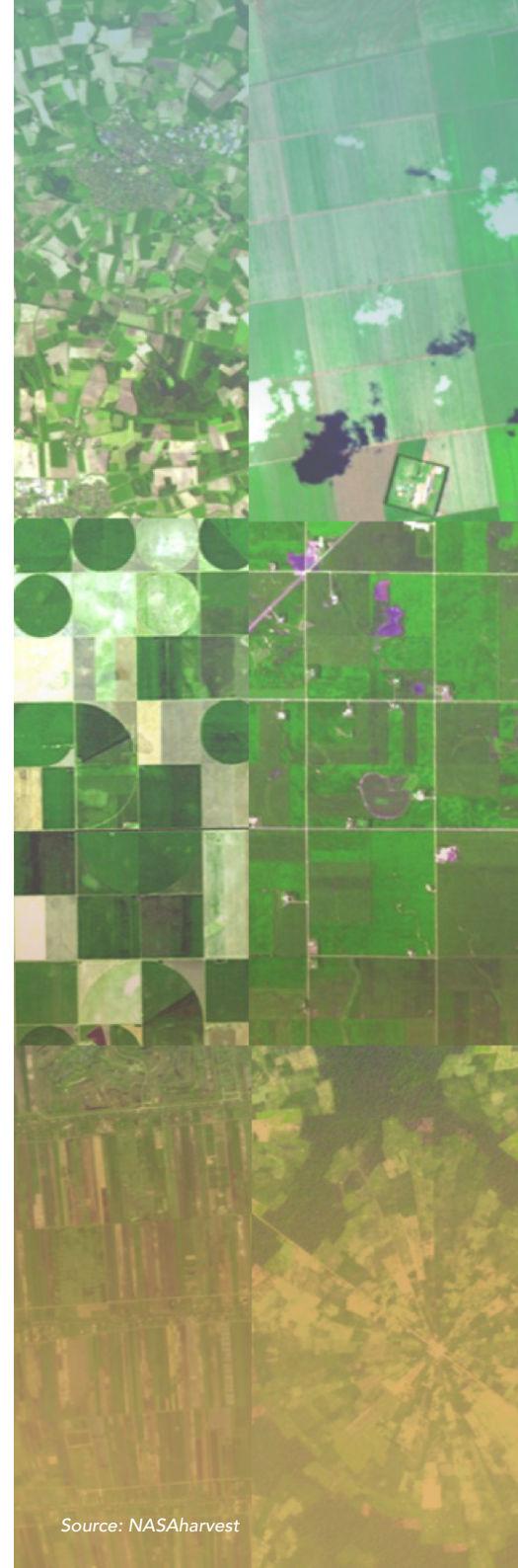Cover photo: NASA

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Note on the Mapping

With this mapping, IFC aims to provide a snapshot of the fast-changing landscape of digital solutions available to support financial services providers in assessing climate impact on agricultural portfolios and showcase their analytical capabilities and applications for the financial sector. While the research was global, there was a particular focus on tools and service providers operating in developing economies. Moreover, IFC does not represent or endorse any tool or service provider reviewed in this research. Given the evolving nature of these new digital solutions, IFC will continue to monitor the market, and might update the mapping in the following years.

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ACRONYMS & GLOSSARY

AgTech	Agricultural Tech
APAC	Asia Pacifc
CBAM	Carbon Border Adjustment Mechanism
CHIP	Change Health Impact Profile
CHIRP	Climate Hazards InfraRed Precipitation with Station Data
DSP	Digital Services Provider
ECB	European Central Bank
FAO	Food and Agriculture Organization of the United Nations
FSP	Financial Services Provider
GDP	Gross Domestic Product
IFC	International Finance Corporation
IoT	Internet of Things
MFI	Microfinance Institutions
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegatation Index
NFS	Non-financial Services
NGO	Non-governmental Organization
SAR	Synthetic Aperture Radar
SHF	Smallholder farm/er/ing
SMS	Short Message Service
TCFD	Task Force on Climate-related Financial Disclosures
UK	United Kingdom
UNEP	United Nations Environment Programme

Geo-location: the identification of the geographic location of a user based on their geographic coordinates

Satellite data: provides satellite imagery and earth observation data of the earth's surface and its atmosphere

Remote sensing: the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance

Executive Summary

Climate change can affect agriculture in multiple ways, leading to increased production risks that impact the viability of farm businesses and their credit risk profile. Financial institutions are not able to assess the viability of an agricultural producer beyond the business risks. This information and skill gap has been recognized by not only the financial institutions themselves, but also by digital solution providers, who have recently begun to tap into this business opportunity.

These solution providers offer services, which are either directed at banks and value chains or adjacent to these, in assessing the viability of a farm based on its specific soil, crop and climatic conditions. Combining site-specific historical and real-time data with new modeling approaches and analytical technologies, such firms can for instance assess which crops may be best suited for a geographical area depending on the type, frequency, and severity of hazards (e.g. droughts, floods, water stress, typhoon, temperature rise, etc.), how much input is required for optimal yield and estimate future production outcomes. Often a number of these parameters and other data points will result in a farm's climate hazard exposure and/or climate risk score which financial institutions can use to supplement their credit risk assessment, as well as support their due diligence approach and business development.

The market of digital solutions to assess climate risk impact on agricultural portfolios of financial services providers is growing in size and coverage rapidly. This report is the result of a mapping exercise to ascertain the status quo of tools and providers on both a global and a targeted market level. The study mapped solution providers and categorized them based on use case offering in a three-step process. Mapping began with desk research which was global in scope but then narrowed to focus on tools and digital service providers operating in developing economies. From this, complementary interviews with a sub-set of the providers were used to establish a decision tree and detailed profiles that could guide FSPs looking to leverage digital solutions and integrate them into their lending processes.

This report should assist FSPs and agricultural value chain players to better understand the capabilities and application of climate risk digital tools that are available that can help support the financial sector in actively and accurately assessing and managing risk in their agricultural portfolios.

The study resulted in several recommendations for how financial institutions may engage with different digital solution providers to assess the impact of climate events on their agriculture portfolios and clients, as well as innovative solutions such as adaptation investments and/or indexed insurance. The study also resulted in the following insights detailed in this report:

- **Constrained demand from financial institutions:** Agriculture focused FSPs often desire the tools to properly assess climate risk, but struggle to afford existing offerings from solution providers. While larger banks can afford these offerings, they do not express strong immediate demand

- **Limited focus on agriculture by climate risk tools:** Initial scanning has shown a broad array of climatic risk tools (even in emerging markets), however only a select few focus on agriculture

- **Enriching site-specific forecasts with satellite data:** The digital solution providers rely on site-specific historical and real-time data to generate forecasts. Many experts however have indicated the need for specificity and human validation to bolster the accuracy of the projections and granularity of various models. The more accurate and granular data used, the more costly and complex the model.

- **Emerging in-house development (or acquisition) of climate risk tools:** Large ratings firms and sophisticated financial institutions appear to be bringing climate risk capabilities in house, either through in-house development (Rabobank), or acquisition of existing climate risk firms (Moody's, BlackRock, McKinsey)

- **Limited FSP first offerings:** In most cases, solution providers tend to add FSPs offerings on top of existing offerings, as opposed to focusing on FSPs as a primary customer from the onset.

- **The importance of geo-location information:** FSPs will fully benefit from the using digital solutions if they have geo-location information of their borrowers. Currently most of FSPs have the registered addresses of the borrowers, but don't have precise locations (ideally geo coordinates) of their borrowers' assets and business operations.

Aware of the risks arising from climate change, FSPs seek to improve their capabilities of assessing the climate risks affecting their portfolios and incorporate this information into their market, credit risk decisions and operations.

1. BACKGROUND

1. CLIMATE CHANGE & DIGITAL SOLUTIONS

Climate change poses a significant threat to the agriculture sector. Farmers are especially affected, due to their direct dependence on land and specific climate conditions (e.g., temperature and precipitation) as well as the sector's direct exposure to climate hazards (e.g. floods, droughts, pests and disease outbreaks). Climate events can have significant social and economic repercussions, including losses and damage to ecosystems, businesses, and populations. From 2008 to 2018, the decline in crop and livestock production due to disasters has resulted in losses of US$ 116.7 billion globally (FAO, 2021[1]); the sector is expected to be substantially affected in the future, with losses estimated at 0.9% of the global annual GDP by 2060 (Dellink et al., 2019[2]).

The physical impacts of climate change on agriculture can be observed immediately after a hazard event occurs in the form of harvest loss, animal mortality, and destruction of equipment and machinery, and damage to property and landscapes. More subtle, gradual, but likely irreversible climate change impacts include changes in crop growing seasons, disruption to bloom and pollination time patterns, warmer winters that delay blooming or break dormancy of fruit trees, and shrinking the areas suitable for producing specific crops, such as coffee and cocoa.

As climate change intensifies, the risks affecting agriculture represent a credit risk for FSPs (Box 1) due to the direct impact on farming cash flows and value chains. This can lead to increased probability of default of farmers, traders, and processors, reduced collateral value, higher insurance claims and insurance costs, changes in cost and availability of credit, and the need for increased provisioning.

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[1] https://www.fao.org/resources/digital-reports/disasters-in-agriculture/en/
[2] https://link.springer.com/article/10.1007/s10640-017-0197-5

Source: NASA

A better understanding and anticipatory approach to climate risks also offers a strategic opportunity for FSPs to manage its own exposure to risks, as well as mobilize finance and develop products and services in support of their clients' adaptation and resilience needs.

There are a growing number of tools, data, and service providers supporting the financial sector that can help assess both physical and transition risks in portfolios. The UNEP Finance Initiative regularly summarizes these in their publications (UNEPFI, 2021[3]; UNEPFI, 2022[4]), but no publication to date has cataloged climate risk-mitigating digital solutions developed specifically to assess and manage climate risks of commercial agricultural portfolios.

The recent increase in digital technologies and applications, such as remote sensing and satellite imagery, has enabled the collection of real-time and non-traditional agricultural data (e.g., geo-position of farmer field, satellite data on soil moisture and vegetation growth). The combination of these with new modeling approaches and analytics can result in a reduction in information gaps impeding farmer access to credit; it can also help provide timely information for multiple applications, and consequently assist FSPs in their credit decision processes.

The market for digital solutions that assess the impact of climate change on agricultural portfolios is growing rapidly in size and coverage. The tools and providers listed in this report represent the status quo of climate risk digital tools that fall within the proposed classification framework and have been operating in the market for at least one year when this research was conducted in Q3 2022.

This report is intended to assist FSPs and agricultural value chain players to better understand the capabilities and application of climate risk digital tools available and support the financial sector in actively managing their agricultural portfolios. This report provides the following:

1. Highlighted landscape of providers offering tools and services to assist banks in assessing the impact of climatic risks in agricultural lending throughout their credit processes.
2. A framework classifying the various tools and services offered.
3. A company profile template (including: tools and services available, customers targeted, technical and commercial dimensions) to interview https://www.unepfi.org/industries/banking/the-climate-risk-landscape/ relevant firms and complete their respective profiles (available in the Annex).

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[3]—https://www.unepfi.org/industries/banking/the-climate-risk-landscape/
[4]—https://www.unepfi.org/publications/the-climate-risk-tool-landscape-2022-supplement/

Box.1 UNDERSTANDING CLIMATE RISKS

Climate risks arise from potential physical impacts of climate change, as well as how humans respond to the transition to a low-carbon economy. These risks are grouped into:

Transition Risks: Transition risks arise as economies move towards a green and low-carbon economy which leads to policy & regulatory changes (e.g., climate commitments, carbon pricing schemes, carbon footprint, no-deforestation agreements), technology advances (substitution of high-carbon technologies by low-carbon ones), market demand changes (e.g., consumer preference for low-carbon products and products that are certified), and reputational concerns (e.g., changes in consumer and communities perceptions of a company/organization).

Physical Risks: Physical climate risks are the potential impact of weather and climatic events affecting a given entity (farm, company, FI, or household), as a result of the interaction between a climate-related hazard, and the exposure and vulnerability of the entity facing this hazard (IPCC, 2023). These hazards can be acute or chronic. Acute hazards are short-term severe and extreme events that cause immediate harm (e.g., flooding, drought, typhoons, etc.). Chronic hazards are gradual changes to the climate (e.g., rising temperatures, changes in precipitation patterns, changes in crop suitability areas, etc.).

Besides being affected by climate hazards, **agriculture is also susceptible to biological hazards**, which are conveyed by biological vectors, such as bacteria, viruses, and mosquitoes, and can cause negative impacts on agriculture production, disturb farming systems and disrupt markets and trade, as well as cause harmful effects in humans (FAO, 2021*). Examples of recent biological hazards affecting the agriculture sector are COVID-19 pandemic, desert locusts in Eastern Africa and Southwest Asia, and African Swine Fever outbreaks in Southeast Asia.

* https://www.fao.org/3/cb3673en/cb3673en.pdf
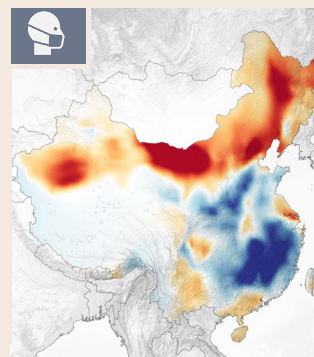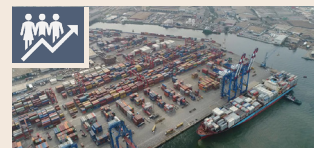
Top photo: Port in Côte d'Ivoire. Innovations are helping the shipping industry reharness the power of wind. *Source: World Bank webpages*

Middle photo: Satellite imagery of flooding in Australia. *Source: Nearmap*

Bottom photo: Mapping of air pollution resulting from the impact of the COVID-19 pandemic *Source: NASA*

Feature

How Satellite Data Has Transformed Agriculture*

The agriculture sector first began to make use of satellite data in 1972, when NASA's Landsat program began supplying regular images of Earth. The sector is now in a golden age of satellite quality, availability, and open data applications, which has led to the launch of dozens of start ups providing products and services to individual farmers, collectives, and relevant sector actors. This leveraging of satellite data, coupled with advances in farming techniques and materials, are instrumental in improving harvests, maximizing supply chain efficiencies, and mitigating crop loss. Such developments are crucial in the face of climate risks and other threats to the global food supply.

Data Harvesting

Standard RGB imagery provides a good overview for farm managers, though most vegetation indexes—obtained by analyzing the reflectance of the leaf canopy—rely on parts of the electromagnetic spectrum not visible to the naked eye.

Normalized difference vegetation index (NDVI) is one of the best-known products from spectral analysis, but there are also indices adjusted for soil, or based on the detection of water, moisture, or chlorophyll, which can all be of use at different stages throughout a crop's life cycle.

Hyperspectral data: holds huge potential in the identification of specific problems, like lack of a specific nutrient, and has applications in plant breeding. Hyperspectral data has incredible precision, with the capacity to hone in on individual plants.

Synthetic aperture radar (SAR): a type of imagery that can be captured at any time of day, and even through cloud cover. Its best use is for monitoring large areas on a regular basis—to measure seed emergence, ensure compliance, or to assess whether a crop is ready to harvest.

Agricultural Applications

The most common use for satellite data in agriculture is farm management, whereby farmers visualize the state of their fields and monitor crop health against seasonal calendars. Aerial scouting is used to check for specific diseases or to measure the impact of applications of agricultural inputs (e.g., nitrogen, fungicides) at different rates depending on crop needs.

Satellite imagery can be used to predict yield per acre—especially effective when combined with deep learning technologies: Crop canopy reflectance is tracked over the growing season—to assess chlorophyll content, for example—and combined with climate, topography, and soil data. The data is mined and analyzed to give more accurate predictions of yields than traditional methods.

Agricultural insurance has become a major use case for satellite data and is increasingly relevant in the face of extreme weather. Insurance companies use remote imaging either to complement or substitute for on the scene damage inspections, as the imagery can make appraisals more transparent, objective, and scalable than traditional examination of a section and then extrapolation.

Data from satellite imagery can help estimate the amount of carbon that a farm is able to capture (e.g. captured by the vegetation on the farm), with farmers then able to sell it to companies needing to offset their CO_2 emissions.

*The content in this feature has been primarily sourced from:
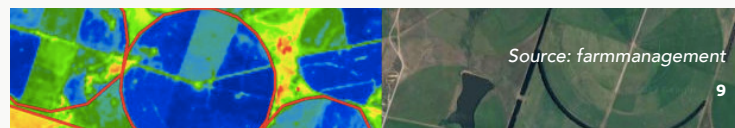
https://geoawesomeness.com/eo-hub/how-satellite-data-is-transforming-agriculture/

2. METHODOLOGY

The analysis underlying this report was conducted in three distinct phases. First, firms offering tools and services were identified and a framework was developed to categorize the tools and services. Firms with similar characteristics were grouped together. Second, a company profile template was developed, and relevant firms were interviewed to complete the profiles (please see the Annex). Third, the interviews and profiling exercises helped to establish a decision tree for financial service providers (FSPs) to select tools according to their specific needs.

PHASE 1

Market scoping: This initial phase focused on a broad market mapping of 87 digital solutions providers offering products that identified, measured, and/or clarified the impact of climate risks on agricultural production (full list of climate risk digital solutions provided in the Annex). The intent of this exercise was to cast a wide net of climate risk digital solutions in order to include both offerings that work directly with FSPs in the agriculture sector, as well as offerings directed at other value chain actors (e.g., agribusinesses, farmer cooperatives, insurance providers). Industry-leading resources and proprietary databases were used to facilitate the scoping exercise, although there may be additional providers that were missed when developing this list. The following chart illustrates the process.

This report aimed to map digital solutions supporting financial services providers in assessing climate impact on agricultural portfolios.

Given the wide range of analytical capabilities, applications, coverage, delivery method and business models, a taxonomy was developed to capture different solutions and facilitate their evaluation.

Source:WBwebpage

Figure 1: Scoping Process
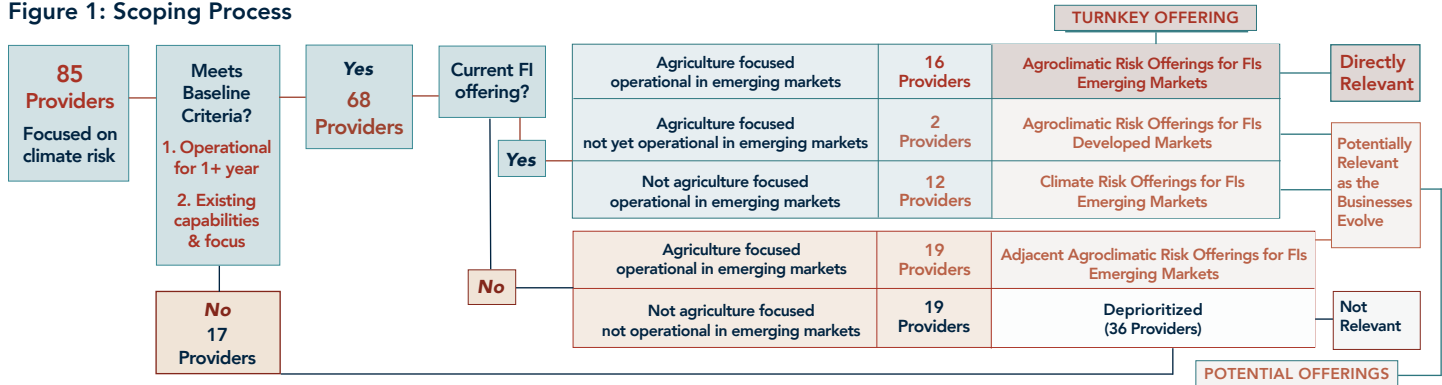
Phase 2

Baseline screen: In the second phase, each digital solution identified was screened against three filter criteria:

1. Operational for one or more year(s)
2. Capabilities to assess climate risk
   (i.e., not purely offering climate advisory services)
3. Agriculture focus/operates in emerging markets

The criteria reduced the identified number of solution providers to 49. An analytical framework (Figure 2) was established for further segmentation of these digital solutions, based on type of products, experience in agri sector, and market coverage FSPs. These solution providers were grouped into five categories with different analytical capabilities and client targets:

Figure 2: Analytical Framework

Taxonomy	Climate Intelligence Provider	Value Chain Management & Decisioning	InsurTech	Financial Analytics Company	Public Good Initiatve
Definition	Companies primarily focused on collecting and analyzing environmental data	Solutions designed to facilitate more efficient and effective interactions in the value chain	Technologies and platforms that help optimize any of the principles for success or requirements of insurance	Firms primarily focused on providing financial market data, analytics, or research to financial sector participants	Government, NGO, or non-profit sponsored initiatives aimed at increasing transparency around climate risk
Sub-categories	Data Capture & Monitoring Intelligence & Reportin Predictive Analytics Platform Specialized Risk Modeling	Value Chain Management Precision Agriculture Advisory	Insurance Support Provider Insurance Broker/Facilitator Reinsurer	Credit Ratings Provider ESG Monitoring Solution Farmer-focused Fin Analytics Climate Finance Advisor Internal FI capability	Climate Data Services Communications & Information Sharing
Examples					

Phase 3

In-depth profiling: Fourteen digital solutions providers supporting financial services providers with assessing climate impact on agricultural portfolios were selected for in-depth profiling. Selections were based on the following criteria:

- **Current lending risk offering**
- **Operational in emerging markets**
- **Agroclimatic focus**

Using a company profile template that focused on:

- **Tools and Services**
- **Target Customer**
- **Modeling: Technical Dimensions**
- **Modeling: Commercial Dimensions**

The fourteen firms were interviewed (see Annex for their respective profiles) in order to ascertain the tools, services, offerings for commercial banks and agribusinesses, and the methodologies used in assessing climate risk. The fourteen firms were then grouped into four categories, as seen in Figure 3.

Figure 3: Categorization of the DSPs

Taxonomy	Agroclimatic Risk Offerings for FIs Ememrging Markets	Agroclimatic Risk Offerings for FIs Developed Markets	Climate Risk Offerings for FIs Emerging Markets	Adjacent Agroclimatic Risk Offerings Emerging Markets
Climate Intelligence Provider	ADAPTA Jupiter agCelerant Mantle Labs AgroClimatica Planet ClimateAI Satelligence GroIntelligence SatSure ImpactTerra YAPU	AgCurate Agryo	Accuweather for Business Acin Cervest Climate X Planetrics (McKinsey) The Climate Service (S&P) Sowit	6th Grain Hummingbird Technologies Numer8 Praedictus Rezatech Syecomp Weather Impact
Value Chain Management & Decisioning	Agritask Cropin		agCelerant Mozar3	FarmERP Koltiva SCOPEinsight Village Link
Insurtech				ACRE Africa Blue Marble Descartes OKO PlanetWatchers Pula
Financial Analytics Company	FarmDrive Rabobank		Aladdin Climate ISS ESG Dow Jones Moody's IHS Markit MSCI	
Public Good Initiative	InsuResilience Partnership World Bank Group - Agriculture Observatory			

Key: ■ Prioritized for Phase 2

For the purpose of this report, firms focusing on developed markets were excluded, leaving three distinct categories:

- **Turnkey solutions:** Digital Solutions Providers with climate risk analytics in agriculture, a current lending risk offering, operations in emerging markets, and a demonstrated focus on the agriculture sector. These providers target a more diverse clientele in emerging markets, including agri value chains, government policy formation, and lending operations.

- **Financial institution-targeted solutions primarily operating in developed markets:** Digital Solutions Providers who work with FSPs, but whose current clients are primarily in developed markets (e.g., real estate companies, asset managers, or hedge funds). While their current client base is centered in developed markets, some providers have the capabilities to operate in emerging markets.

- **Adjacent agroclimatic risk solutions:** Digital Solutions Providers who assess climatic risk in agriculture in emerging markets, but do not currently have lending risk offerings. Primary customers include agribusinesses, NGOs, research institutions, governments, farmer cooperatives, or insurance companies.

Key Findings

The analysis revealed nuances in the types of analytical capabilities and applications between and within each of these categories, including differences in product delivery, customization ability, pricing structure, and data integration. Key findings suggest:

- **STRONG RELIANCE ON PUBLIC DATA**
  Nearly all Digital Solutions Providers interviewed have historically relied primarily on public data (e.g. Sentinel satellite data), and use purchased or proprietary data coupled with machine learning algorithms to fill in data gaps and boost resolution.

- **MOVE TOWARDS VERTICAL INTEGRATION**
  Both upstream and downstream providers appear to be vertically integrating. This is demonstrated in the downstream player, SatSure, launching its own fleet of satellites, and upstream players (e.g., Planet) developing their own databases and platforms.

- **VARIED DEFINITIONS AND SCOPE**
  Providers tend to define "climatic risk" differently, but most products focus on physical risks.

- **CLIMATE INTELLIGENCE PROVIDERS ARE INCREASINGLY OFFERING SUPPORTING SERVICES**
  Many providers utilize their data to offer auxiliary services, such as value chain traceability or advisory services, that appeal to agribusinesses, SHFs, and/or financial institutions.

DSP

**Financial Sector
Opportunities**

**Climate Impact
Products & Services**

**Emerging Market
Landscape**

*This chapter provides
additional detail on
different climate risk
digital solutions, and
outlines a number of
considerations for FSPs
when determining
the best and most
appropriate DSPs to
engage.*

3. The Solutions Landscape

1. MARKET OVERVIEW

The global agricultural tech (AgTech) market has expanded rapidly over the last decade. In 2020, GSMA tracked more than 700 digital agriculture services—a substantial increase from the 53 services mapped in 2009. This universe of AgTech solutions includes digital technologies with promising application for FSPs working in the agriculture sector to quantify the climate risk impacting agricultural production and assist lenders in making more informed decisions. The focus of this mapping lies on the latter.

2. DRIVERS OF CHANGE IN THE FINANCIAL SECTOR

The landscape of **companies offering digital solutions supporting FSPs in assessing climate impact on agricultural portfolios is expected to expand from US$800 million in 2021 to US$4 billion by 2027[5].** This expansion is being driven by compliance considerations, such as climate disclosures required by central banks and global regulators, policies, actual financial losses due to acute hazards, as well as digital technologies enabling collection and analyses of data previously unavailable for agriculture.

- **Global regulators in developed markets, such as in the EU, Japan, UK, and US have placed a greater focus on identifying, measuring and disclosing climate-related financial risks.** In 2022, the United States Securities and Exchange Commission proposed rules that would increase the disclosure of climate related risks by FSPs. The Bank of England recently executed exploratory climate stress testing, which included large UK banks and insurers[6], while the ECB held climate stress tests in 2022 to assess how prepared banks are for dealing with financial and economic shocks stemming from climate risk.[7] Aside from developed markets, numerous other countries such as Kenya, Morocco, and South Africa now have central bank-led climate risk assessments and management guidelines.

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[5] https://www.verdantix.com/report/market-size-and-forecast-climate-risk-digital-solutions-2021-2027-(global)

[6] Bank of England, "Results of the 2021 Climate Biennial Exploratory Scenario (CBES)," May 24, 2022, https://www.bankofengland.co.uk/stress-testing/2022/results-of-the-2021-climate-biennial-exploratory-scenario

[7] European Central Bank Banking Supervision, "2022 Climate Stress Test" (European Central Bank (ECB), July 2022), https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.climate_stress_test_report.20220708~2e3cc0999f.en.pdf

- **Climate regulations in importing markets are pushing FIs in exporting markets to evaluate transitional risks (carbon footprint and risk of deforestation) for clients with importing markets exposure.** For instance, the European Union's Carbon Border Adjustment Mechanism[8] (CBAM) proposes to apply a carbon price adjustment for import products to make them equivalent to the carbon price of domestic production. CBAM currently does not apply for any agricultural products, but it is likely to be included in the future.

- Impacts and opportunities from climate change have spurred certain **banks and investors to voluntarily improve and increase their climate-related financial information disclosures** (i.e., through the Task Force on Climate-related Financial Disclosures (TCFD) framework).

- Developments in satellite and drone imagery and weather data, when combined with data science applications, have enabled collection and analysis of traditional and non-traditional data used by FSPs to make informed investment decisions and monitor their portfolios in a timely (even real-time), low-cost manner. **FIs are now able to estimate a borrower's ability to repay by projecting future crop yields based on farm geolocation, remote sensing data, and crop yield forecasting.**

Source: WBwebpage

3. HOW DIGITAL SOLUTIONS ASSESS CLIMATE RISK ON AGRICULTURAL PORTFOLIOS WORK

Data is key to all business models offering digital solutions supporting financial services providers to assess climate impact on agricultural portfolios, but the offering of each solution provider depends on their ability to access data and automate the analysis.

1. **Data analysis and modeling:** To build climate risk models, solution providers collect historical and real-time data, such meteorological and hazards events, which are overlayed with administrative boundaries, topographic and other data of interest. In a second step, crop yields and livestock productivity are estimated based on simulation models and machine learning algorithms are later applied to fill in data gaps, boost resolution and improve prediction. Most part of the data used in this modeling part depends on public data sources - primarily, but not exclusively, satellite imagery and historical climate data, as well as commercial and private data, such as drone imagery, inventories, emission factors, carbon density measurements, deforestation monitoring, etc.

2. **Risk scoring:** At a slightly more advanced level, providers translate data into risk scores using in-house methodologies. These methodologies are heavily dependent on the provider and the type of climate risk assessed. Risk score offerings include farm credit risk analysis, portfolio-level risk management, and risk capital allocation by type of climate risk. Providers vary in terms of the degree of adaptation in their risk scoring models and degree of machine learning "trainability" to specific crops and geographies. Select providers are able to integrate client data, such as farmer financial history, into the risk decisioning process.

8   https://taxation-customs.ec.europa.eu/green-taxation-0/carbon-border-adjustment-mechanism_en#:~:text=The%20EU's%20Carbon%20Border%20Adjustment,production%20in%20non%2DEU%20countries.

3. **Predictive analytics:** Some solution providers also create future models using predictive analytics, generally backed by AI. These predictive models can include crop yield projections, climate risk assessments and long-term climate change scenario forecasting. Providers offer these predictive models as independent reports or incorporate them into their risk scoring.

4. OVERVIEW OF COMPANIES OFFERING DIGITAL SOLUTIONS SUPPORTING FINANCIAL SERVICES PROVIDERS IN ASSESSING CLIMATE IMPACT ON AGRICULTURAL PORTFOLIOS

On the supply side, the landscape revealed **84 providers offering broad climate risk analysis services relevant to FSPs, agribusinesses, and other stakeholders. However, only a few standout providers (~10) appear to offer agroclimatic risk services tailored for FSPs lending to the agriculture sector.** These are a mix of FSP-first providers, whose core business model is to offer agroclimatic lending risk services for FSPs (e.g., Agroclimatica, Mantle Labs), and those that work primarily with agribusinesses, but have expanded their business models to include financial institution offerings (e.g., CropIn, SOWIT). Solution providers fall into five categories:

1. **Climate Intelligence:** Digital solutions primarily focused on collecting and analyzing environmental and climatic data

2. **Value Chain Management and decisioning:** Digital solutions designed to support more efficient and effective interactions throughout agri value chains

3. **InsurTech:** Technologies and platforms that help optimize any of the principles for success or requirements of insurance

4. **Financial Analytics:** Solutions primarily focused on providing financial market data, analytics, or research to financial sector participants

5. **Public Good Initiatives:** Government, NGO, or non-profit sponsored initiatives aimed at increasing transparency around climate risks

The majority of digital solutions cataloged in this research fall within the first category of broad climate intelligence. This category includes both FSP-first providers (e.g., SatSure) and those that work primarily with agribusinesses or other value chain participants (e.g., 6th Grain, agCelerant). A smaller subset of providers — categorized as financial analytics companies — primarily focus on FSPs; however, the analysis showed only a few offer relevant agroclimatic services for financial institutions. The three remaining categories — Value Chain Management and Decisioning (Mozare3), Insurtechs (Pula), and Public Good Initiatives — are providers that collect and/ or analyze climate risk data, but their business model is not centered around FSPs. Within these categories, **only a handful of providers appear to have successfully pivoted or expanded their model to include offerings for FSPs (e.g., CropIn). The five types of providers offer either turnkey solutions, solutions for financial institutions or adjacent solutions.**

Source: WBwebpage

4.1 TURNKEY SOLUTIONS FOR EMERGING MARKETS

Six of the sample 15 providers offer turnkey solutions providing agroclimatic risk services to inform lending decisions in emerging markets. **Turnkey solution providers meet all three thesis criteria: (i) offer lending risk assessment; (ii) operational in emerging markets; and (iii) demonstrated focus on the agriculture sector.**

While these providers offer similar services for FSPs, there are nuances in their methodologies, data sources, and product delivery models. Agroclimatic, Mantle Labs, SatSure and YAPU are all FSP-first offerings—meaning their core business models revolve around providing climate risk services for financial service providers. All four operate proprietary platforms that offer credit risk decision support for commercial banks and microfinance institutions. Each of these providers can assess both individual and portfolio-level risk. Mantle Labs typically positions their offering as portfolio-level, while the other three providers appear to focus primarily on individual farm-level risks.

The remaining two of the six turnkey solution providers focus on value chain management first and offerings to FSPs second. CropIn began as a value chain management solution and has since expanded to include agroclimatic risk services for FSPs. The latter offering is similar to other FSP-first providers and also includes a proprietary platform. Satelligence is a climate risk provider focused on deforestation and carbon monitoring. It looks primarily at value chain and portfolio-level risks for both FSPs and agribusinesses, with analyses delivered in the form of reports and raw data exports.

Many of these turnkey providers also offer auxiliary services—such as farm management solutions, value chain digitization, and advisory services—as documented in the detailed provider profiles in the Appendix.

Figure 4: Turnkey Solutions Provider Overview

	agroclimatica	SATELLIGENCE	SatSure	YAPU	Cropin	Mantle Labs
Taxonomy	Climate Intelligence Provider	Climate Intelligence Provider	Climate Intelligence Provider	Climate Intelligence Provider	Value Chain Managment Solution	Financial Analytics Company
Brand Positioning	Platform that assesses agroclimatic risk at an individual farm level to assist FIs in making objective lending decisions	Remote sensing company monitoring forest landscapes for real-time value chain risks	Decision intelligence platform assessing agroclimatic risks, with full banking suite	FI-centric CRM platform to facilitate resilient finance in agriculture sector	AI-enabled agriculture value chain management software to digitally connect value chain	Automated financial analytics platform for banks, insurance, and asset managers to make lending decisions and monitor portfolios
Client Focus	Agribusinesses / Govt/NGO / FIs	Agribusinesses / Govt/NGO / FIs	Agribusinesses / Govt/NGO / FIs	Agribusinesses / Govt/NGO / FIs	Agribusinesses / Govt/NGO / FIs	Agribusinesses / Govt/NGO / FIs
Degree of Analysis	Individual loan level credit risk analysis / Portfolio level risk management / Predictive analytics	Real-time value chain environmental risk monitoring / Portfolio level risk management	Individual loan level credit risk analysis / Portfolio level risk management	Individual loan level credit risk analysis / Portfolio level risk management / Portfolio allocation	Farm-level short-term climate risk assessments / Portfolio and regional level risk assessment	Proprietary platform / Customizable reports
Product Delivery	Proprietary platform	Customizable reports	Proprietary platform / Customizable reports	Proprietary platform / API integrated platform / Customizable reports	Proprietary platform / API integrated platform / Customizable reports	Proprietary platform / API integrated platform

4.2. FINANCIAL INSTITUTIONS-TARGETED SOLUTIONS PROVIDERS

There are providers that collect and analyze climate risk data, but do not yet offer solutions that are fully relevant to lending in the agriculture sector within emerging markets. Discussions with these providers revealed varied business models, as well as potential future applicability of these broader climate risk services. Providers that work with financial institutions in developed markets primarily operate as technology firms out of North America and Europe. From the sample, four providers fell into this category: ClimateAI, Climate X, Gro Intelligence, and Jupiter Intelligence.

Understandably, these providers possess advanced in-house analytics capabilities. While many indicated that they have the ability to operate globally, they choose to focus on developed markets, physical assets, and/or highly profitable value chains (e.g., wineries, palm oil). Similarly, instead of offering climate risk services to FSPs in emerging markets, they tend to work with real estate companies, hedge funds, asset managers, or insurance providers in developed markets. Some providers noted that their price point is likely too high for microfinance institutions at this time.

From Value Chain Management to Financial Services

example

Founded in 2010, CropIn achieved scale as a B2B model focused on value chain management and digitization. To date, it has worked with over 250 business partners to digitize more than 16 million acres of farmland. Their work centers around data capture at the individual farm level, using on-the-ground teams and satellite imagery to assist agribusinesses in farm management and traceability.

While CropIn has historically worked with agribusinesses, the company recognized that its data can also be used to assist FSPs in the credit decisioning process. Therefore, CropIn launched SmartRisk: a satellite and weather-based AI/machine learning platform that assists FSPs in credit decision support and loan recovery. This platform combines satellite imagery, weather data, and on-the-ground data to detail agroclimatic risk at both the individual farm and regional levels.

example

Founded in 2014, 6th Grain works to transform satellite and farm data into actionable insights for players in the agriculture sector. It offers both regional and individual farm-level analysis. One of its core offerings is predicting optimal growth curves through coupling abiotic and biotic risk assessments. These services are highly customizable based on client needs. 6th Grain has worked extensively with large agribusinesses in sub-Saharan Africa to facilitate farm mapping and related insight generation.

example

ClimateAI is a SaaS solution that uses satellite data (and sometimes local data) to project the probability of climate risk impacting crop yield and then translates this risk to financial implications. It offers both short- and long-term forecasts. The majority of its work appears to be in developed markets — for example, ClimateAI recently did a regional assessment on the impact generation.

Mozare3 for Agricultural Services (Mozare3) is an Egyptian AgTech firm offering contract farming solutions to SHFs. Using a suite of four applications, Mozare3 provides SHFs with access to market, in kind input financing, and agronomy support. Mozare3 is focusing on high value export crops such as sesame, strawberries, peppers, cucumbers, etc. Launched in 2021, Mozare3 secures off-take agreements with credible manufacturers and exporters as anchors. SHFs are supported by a team of agronomists who support and oversee crop yields and quality. Financing offered is currently focusing on in-kind input credit to contracted farmers, which is repaid through a deduction from the SHFs' last payment installment.
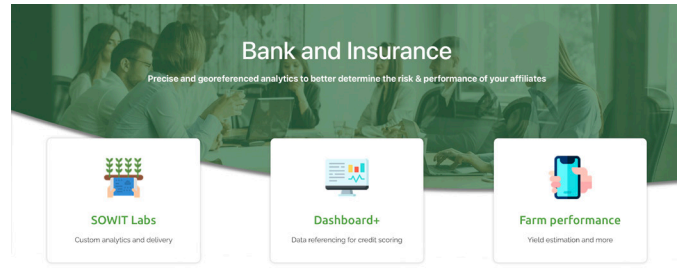
source: SOWIT
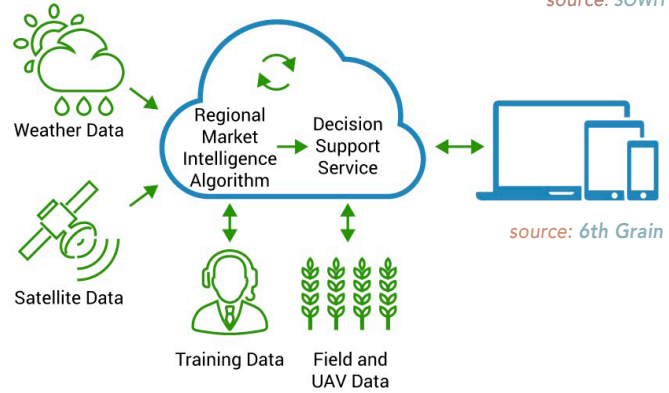
source: 6th Grain

4.3. ADJACENT AGROCLIMATIC RISK SOLUTIONS

Adjacent agroclimatic risk solutions tend to largely be tailored to agribusinesses and insurers, rather than commercial banks or MFIs. From the representative sample of 14 providers, four adjacent climate risk digital solutions were identified: 6th grain, Praedictus, Pula, and Weather Impact. SOWIT is focused on providing services to farmers, but also directly sells data sets to two banks in Morocco.

Some providers (e.g., 6th Grain and Pula) indicated that they have explored selling their data to commercial banks but failed to generate sufficient demand for their offerings. Despite these setbacks, there remains strong potential for these providers to offer climate risk services to FSPs.
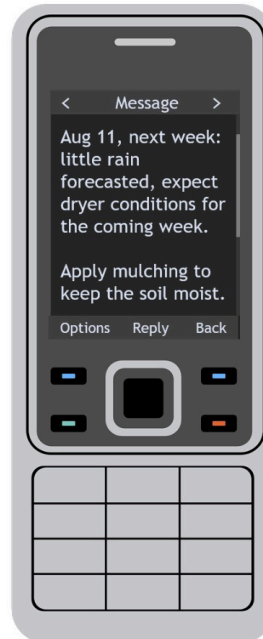
source: Weather Impact

source: Cropin

agCelerant
PHYGITAL AGRICULTURE

CASE STUDY

agCelerant's hyperlocal data ecosystem lays the ground for phygital agriculture and inclusive value chains

agCelerant, a next-gen value chain orchestrator uses geo mapping and a digital platform combined with proximal presence and value chain expertise to connect farmers in Senegal with credit, insurance, inputs, and buyers, thereby addressing Senegal's longstanding lack of access to capital and finances in smallholder agriculture, and helping the country achieve food sovereignty.

agCelerant, a next-gen value chain orchestrator uses geo mapping and a digital platform combined with proximal presence and value chain expertise to connect farmers in Senegal with credit, insurance, inputs, and buyers, thereby addressing Senegal's longstanding lack of access to capital and finances in smallholder agriculture, and helping the country achieve food sovereignty.

A properly functioning agriculture sector is critical for Senegal. President Macky Sall has shared the conviction that 'Senegal can feed itself' – an ambitious goal, given Senegal's population has doubled to 17 million over the past 30 years and currently imports roughly 60% of rice consumed locally. To achieve independence from rice imports, the country must improve its rice production. This requires increased productivity through access to better inputs, like seeds and fertilizer and reducing post-harvest losses through accelerated, appropriate-scale mechanization as well as improving the country's value chains overall capacity to deliver quality rice to increasingly urban consumers.

agCelerant builds on the foundational concept of phygital agriculture, a combination of physical presence through agents and utilization of data. Phygital agriculture recognizes that digital technologies alone cannot solve the arduous problem of getting highly complex, heterogeneous systems like smallholder value chains to function efficiently. Overcoming information and power asymmetries and the inefficiencies of informal markets requires deep contextual knowledge which is only achievable through sophisticated value chain expertise and nimble, proximal presence.

agCelerant thus aggregates smallholder farmers into an organized value chain through proprietary franchise networks (agents) and hyperlocal data ecosystems that profile farmers, structure access to quality inputs, support compliance with good agricultural practices, secure harvest produce offtake, and make contracting simple, safe, and effective. agCelerant platforms concomitantly act as online data archives on farmer practices, harvests, and livelihood outcomes, meaning that with each and every incoming farm and plot-level data record, new knowledge is generated, and foresights about Senegal's agriculture improve. agCelerant's deployment is accompanied by agCelerant Academy, to train and handhold newly onboarded franchise agents, and by agCelerant Factory, to facilitate its penetration into new markets and industrialize services through the design and exploitation phases.

agCelerant operates under the premise that access to credit is only possible once investment risk is quantified. The platforms' constant data entry continually helps reduce risk, liberating resources for further expansion and scalability of services, thus building trust between the agricultural and financial sectors. agCelerant builds unique data infrastructures required to track production and transactions in smallholder value chains through to final consumers, making the farm to fork concept a reality. The resulting traceability, transparency, and accountability are paramount for primary bank and industrial investments for these smallholder markets. agCelerant is also deployed in Benin, Niger, Nigeria, and six other African countries.

4.4 PRODUCT DELIVERY MODELS

Depending on the provider, clients can access risk analyses via standalone or integrated solutions, as mapped below.

Pricing models for turnkey providers tend to be fairly standardized based on product type, with slight differences in terms of fixed vs. variable pricing. Standalone reports are generally priced as either a fixed cost per report or a variable cost based on the amount of data collected. Provider platforms, whether standalone or API integrated, tend to be subscription-based, with a few providers offering a fee per loan assessment. Costs for customized development of in-house risk management platforms are fully dependent on the project.

Providers package these offerings at individual farmer, portfolio, value chain, or regional levels. The analysis showed that, as long as providers have the geo-tagged location of the farm, they are able to assess individual farm risk (though this data is only accessible to the end consumer with certain product offerings).

A service market built on customization

There is a range of ever-evolving capabilities and product delivery options that turnkey providers use to serve FSP lending in agricultural markets. While some product offerings have standardized delivery models and analytical options, a key finding from the research is that—in almost every use case — providers are willing to customize both the service configuration and pricing model to suit the client.

Some service providers (e.g., CropIn) assign a product manager and technical data science team to each client and work with them to customize the offering. YAPU offers a full platform development service that is fully customizable to each client. This is an important aspect of the market, as it reflects the unique ways that decisioning tools and datasets are utilized by FSPs— often needing to fit into other customized processes and systems that already exist.

Figure 5: Product Delivery and Pricing Models

Delivery Model	Standalone Solutions			Integrated Solutions	
	Standardized Reports	**Custom Reports**	**Provider Platform**	**AP Integration within FI Systems**	**Customized FI Platform Development**
Description	Automated reports or data exports tailored to client scope (i.e., geo, crops)	Customized analyses or assessments based on client needs	Proprietary platforms accessible to clients, generally allowing for client data to be incorporated	Direct API that allows for data and risk scores to be directly fed into FI systems	Consultancy services to assist FIs in building internal risk management platforms
Relevant Producer Pricing	Price per report (CropIn, Satelligence, SatSure) Variable pricing by amount of data collected (YAPU)	Price per report (CropIn, Satelligence, SatSure) Variable pricing by amount of data collected (YAPU)	Subscription fee per client (Agroclimatica, Satelligence) Subscription fee per user (Mantle Labs - under 50 users, SatSure, YAPU) Price per loan assessed (CropIn, Mantle Labs - 50+ users)	Subscription fee per user (Mantle Labs - under 50 users, SatSure, YAPU) Price per loan assessed (CropIn, Mantle Labs - 50+ users)	Dependent upon client project (YAPU)

4.5 GUIDANCE FOR FSP ENGAGEMENT

Increasing Importance of Climate Risk Tools and Services

As noted, climate risk is directly impacting the quality of FSP's portfolios. Therefore integrating climate risk assessment in credit appraisal will help FSPs to make informed lending decisions. In the absence of proper methodologies to assess climate risks and understanding vulnerability, many FSPs often choose to avoid lending to the sector, in turn contributing to the already large financing gap for SHFs and agri-SMEs. For instance, FSPs may resort to restructuring loans or limiting agriculture portfolios if they feel that risks resulting out of climate change impacts on agricultural production pose too high a risk. In doing so, FSPs miss out on opportunities to expand their portfolio in the agriculture sector.

Fortunately, the advent of providers offering innovative tools and services to identify, measure and manage agroclimatic risks has enormous potential to help FSPs navigate these increasingly apparent risks. FSPs can capitalize on these tools and services to help grow their agriculture portfolios and make informed lending decisions that account for agroclimatic risk.

Furthermore, amidst the evolving climate risk regulatory landscape, providers can assist FSPs in complying with new regulations related to climate. For instance, in conversations with providers, (primarily those in the category "FI solutions primarily operating in developed markets") they indicated increased demand from UK FIs for climate risk data services in response to the Bank of England's exploratory climate stress tests. Although these regulatory requirements are not yet widespread in developing markets, they will almost certainly emerge in the coming years as countries seek to transition to net zero greenhouse gas emissions and accelerate financing for climate investments. These providers can work with FSPs to supply and analyze the climate risk data they need to meet regulatory requirements.

Improving accuracy by collecting geospatial information of clients

FSPs will fully benefit from using digital solutions if they have geo-location information of their borrowers. Currently, most of the FSPs have the registered addresses of the borrowers but don't have the exact location (ideally coordinates) of their borrowers' assets and business operations. The precise location is ideal for accurate mapping and analysis, but in their absence, a partial address may be used, which may include information such as a street, neighborhood (e.g., postal codes), or administrative unit (e.g., town or district or county).

example

SOWIT

The SOWIT platforms provide farmers with actionable insights regarding their land(s), that help them efficiently manage their farms and optimize their productions, while also providing data to Ag organizations that help them mitigate risk, manage investments, and performance. The SOWIT platforms provide farmers with actionable insights regarding their land(s), that help them efficiently manage their farms and optimize their productions, while also providing data to banks that help them mitigate risk, manage investments, and performance.

Using soil and irrigation data can form the basis for FIs to explore new opportunities for lending. If for example a crop in a specific area is susceptible to drought, the FI could offer financing for irrigation or finance farmers switching to another more drought resistant crop and enable FIs to extrapolate what may happen with a crop in a specific area due to climate change over time, enabling a FI to manage the resulting risk.
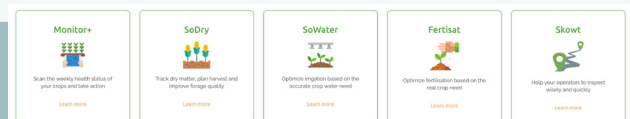
CASE STUDY

SatSure's Decisioning Framework for Agriculture Lending

SatSure worked with one of India's largest private sector banks to develop a customized agricultural lending decisioning framework linked to crop performance, with the aim of increasing lending to smallholder farmers.

The bank wanted to increase its agriculture portfolio, specifically loan services, in rural India. However, the bank faced challenges typical of the sector, including resource allocation, dependency on field officers, and limited digitization. The bank also struggled with limited access to alternate data and information on smallholder farmers, such as climate risk insights that impact lending decisions.

To address these challenges, the bank engaged SatSure to establish a decision-making framework for lending to smallholder farmers throughout the loan cycle, from underwriting, to portfolio monitoring, to loan collection. The decision-making framework incorporated data-led models that assess crop production risk through linking crop performance in the current season, historical risks, and other ancillary parameters such as weather and climate. Through this framework, the bank built a business strategy for agricultural lending that allowed them to consider agroclimatic risks and create customized plans to reach farmers at the right location and time.

Through this engagement, the bank relied on SatSure's core product suite: SatSure Sage, a loan life cycle risk management product suite that informs agri-lenders on key decision-making insights for credit underwriting, portfolio monitoring, and loan recovery management. SatSure worked with the bank to tailor the offering to fit the bank's specific requirements and challenges. The SaaS offering comprises an online dashboard and mobile application that enables all individuals in the lending decision making process to access the data and information, at both the individual and portfolio level. Through the mobile application, field officers collect and digitize customer and farm information. This data is combined with other parameters, including crop yields, irrigation conditions, weather insights (18 parameters in total), which allows SatSure to generate an asset (land) score and rating system to help the bank make informed lending decisions. During the production phase, SatSure Sage also helped the bank track crop growth stages using satellite imagery, such as harvest progression, to determine repayment potential, and, when necessary, create efficient recovery plans.

As a result, the bank was able to build a robust lending review mechanism with real-time information and data consolidation for its rural lending portfolio. SatSure was ultimately able to address: i) high agricultural loan recovery costs ii) digitalizing and tracking their field officers, activities, and resolution efforts iii) equipping the bank's resources with the information needed to assess rural loan recoveries and iv) providing alternative data sources, including satellite-based crop and weather forecasts to incorporate their impact on lending portfolios. Through this engagement, SatSure helped the bank assess agroclimatic risks in an environment with historically poor data infrastructure. Ultimately, this allowed them to make informed lending decisions while increasing financing to smallholder farmers.

Source: agricultor

Based on this research, FSPs should consider the following primary questions when determining the type of provider to engage.

FSP CONSIDERATIONS
FOR ENGAGING PROVIDERS

What core and supporting services are needed?

There are a broad range of tools and services offered that can assist FSPs throughout the credit decisioning process, at both the individual and portfolio levels. The graphic below breaks out a typical loan cycle, along with example use cases and the applicability of different turnkey service providers at each step. Most turnkey service providers offer services that are applicable across the loan cycle. FSPs must consider what specific support would be most useful (i.e., their core needs) within their current lending process and systems.

How can services be best configured to support the needs?

Product delivery models vary, but the two most common are reports or platforms. Reports tend to be delivered quarterly or annually, and generally detail long-term climate risk at a regional or portfolio level. While providers can customize reports based on their needs, they generally do not incorporate client data. Reports have many use cases—for example, Satelligence combines satellite, value chain linkage, and on-the-ground data, and then uses AI to create actionable maps that show changes in carbon stock over time. This analysis is delivered to clients in the form of PDF reports on a quarterly or annual basis; or clients can export raw data to integrate into their own systems.

Platforms are more dynamic; they can be standalone or fully integrated into the client's banking system to allow for real-time loan decisioning and monitoring. Many platforms are able to incorporate data from clients, such as borrower financial history. For example, Agroclimatica's risk score combines farmer production risk (based on agroclimatic data) and farmer financial risk (based on farmer financial history). Some providers (e.g., CropIn, Mantle Las, YAPU) offer API integrations with FI systems, making the data and risk scoring directly accessible within the client's existing systems.

A few providers (e.g., YAPU) also build in-house customized platforms for FSPs.

Where do providers currently operate and how strong are they in the respective country/region?

Each of the six turnkey providers has a track record of working in one or more countries in Latin America, sub-Saharan Africa, or Southeast Asia (individual countries are noted in the annex). Most providers confirmed they are able to easily scale to another market, though exact details should be confirmed with each provider.

While each provider offers their standard services, this research demonstrates that the majority are receptive to meeting their client's specific needs. Given the relatively nascent nature of these service offerings, providers are keen to understand how they can best package and customize their services to appeal to FSPs and other clients in the agriculture sector. Furthermore, providers were hesitant to provide specific details on their pricing models, specifically on customization, which underpins the ongoing experimentation of service offerings.

Figure 6: Loan Cycle Use Cases

| Process Step | Loan Cycle | | | Portfolio Management | Portfolio Allocation |
	Underwriting & Loan Assessment	Monitoring	Collection		
Example Use Case	Generates farm credit risk score incorporating agroclimatic risk parameters to inform lending decision	Continuous weather and crop disease risk monitoring during production to predict growth progress and harvest timeline	Satellite insights on farm plots to forecast crop yield prediction and likelihood of loan collection	Uses crop yield predictions to inform loan and portfolio level valuation	Quantifies potential economic losses from agroclimatic risks in certain regions
Providers					
agroclimatica	YES	YES	YES	YES	NO
Cropin	YES	YES	YES	YES	NO
Mantle Labs	YES	YES	YES	YES	YES
SATELLIGENCE	NO	NO	NO	YES	YES
SatSure	YES	YES	YES	YES	NO
YAPU	YES	YES	YES	YES	YES

Source: GPA photoarchive

CASE STUDY

YAPU's Integrated Climate Risk Management System

YAPU developed a fully integrated climate risk management system for a large Guatemalan microfinance institution (MFI) to assess agroclimatic risks at the loan and portfolio level.

The Guatemalan MFI had a longstanding interest in introducing a tailored loan product for the agricultural sector. Through this loan product, the MFI desired to improve the efficiency and effectiveness of its lending process by creating a systematic way to incorporate agroclimatic risks into lending decisions. Furthermore, the MFI hoped to provide recommendations for suitable crops and climate solutions to its clients.
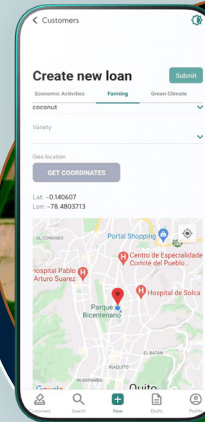
Source: YAPU

After a number of unsuccessful attempts to launch this product, the MFI engaged YAPU to assist in developing a climate risk management system that integrated the YAPU platform with the MFI's existing field application. The MFI had a standalone field application to gather on-the-ground farmer data for its loan evaluation form, however did not have a standard way of collecting or assessing data surrounding agroclimatic risks.

YAPU helped the MFI expand its existing application to include external climate data (CHIPS/CHIRPS) and integrated this application with the YAPU platform via an API. The resulting climate risk management system included an automated credit analysis, which was enriched with climate risk indicators (i.e. historic and current climate exposure of farming units and climatic sensitivity of different crops and animal husbandry). The system also featured recommendations of suitable climate solutions to increase productivity and resilience.

The climate risk system was delivered in the form of a proprietary software, created by YAPU, that includes external exposure data as risk maps that highlight drought, rain, flooding, and frost threats at the individual borrower and portfolio level.

At the borrower level, the system allows the MFI to identify and make comparisons between individual customer risk profiles and increase resilience by recommending nature-based solutions to finance. At the portfolio level, the risk maps display insights on possible climatic events that could impact farming activity and portfolio concentration in regions that could be high risk due to weather and climatic events.

These risk analyses were then directly integrated into the MFI's core banking system, allowing the MFI to make real-time and informed lending decisions for smallholder farmers. Through this engagement YAPU was ultimately able to help the MFI: 1) analyze climate risks for 40,000 clients; 2) develop a system recommending suitable climate solutions; and 3) establish a comprehensive view of the MFI's clients' production and associated risks by integrating climate indicators into credit decisions.

Source: NASA

District boundary

Flood Risk Intensity

- Very high: 0.014 - 0.030
- High: 0.012 - 0.014
- Moderate: 0.008 - 0.012
- Low: 0.005 - 0.008
- Very low: 0 - 0.005
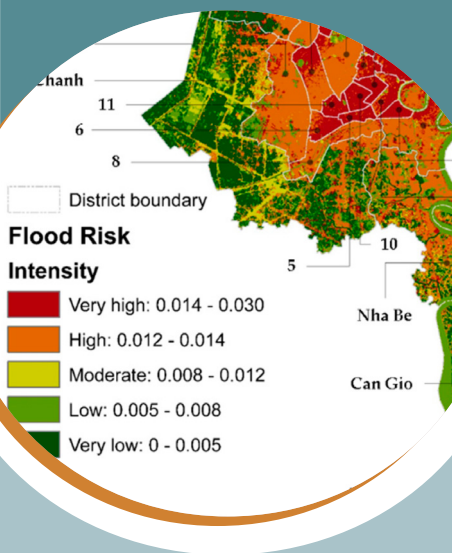
At this time, the market for agroclimatic risk services remains nascent, and many providers are still evolving their offerings or pivoting to meet new client needs. There are, however, a few trends that indicate where the sector is headed.

4. Outlook

KEY TRENDS FOR AGROCLIMATIC SERVICES PROVIDERS

The market for agroclimatic risk services remains nascent, and many providers are still evolving their offerings or pivoting to meet new client needs. There are, however, a few trends that indicate where the sector is headed:

EXPANSION OF SERVICE OFFERINGS: Many FSP-first providers are repackaging their data to offer auxiliary services, such as value chain traceability or advisory services, that appeal to agribusinesses and/or other types of financial institutions. Similarly, solutions—such as Satelligence or CropIn—which have historically worked primarily with agribusinesses are launching services tailored to FSPs.

VERTICAL INTEGRATION: Both upstream and downstream providers appear to be vertically integrating. For example, downstream player SatSure is launching its own fleet of satellites, while some upstream players are developing their own databases and platforms.

IN-HOUSE CAPABILITIES: Large ratings firms and financial institutions appear to be bringing climate risk capabilities in house, either through internal development (e.g., Rabobank) or acquisition of existing climate risk firms (e.g., Moody's, BlackRock, McKinsey).

Whilst this landscape is still emerging—the majority of providers have begun operations within the last 10 years—these DSPs display great promise for helping to quantify climate risk, especially in the agriculture sector which is extremely vulnerable to the impacts of climate change. There are strong signals that innovation is likely to accelerate in the future, building on the work of these early pioneers. Looking ahead, it is likely that new players will enter the market while existing players with demonstrated adjacencies will expand their business models.

KEY TRENDS FOR FINANCIAL SERVICES PROVIDERS

As available solutions scale, there will be increased uptake from commercial banks and microfinance institutions. As climate risk worsens, these solutions will become increasingly important and impact nearly all lending decisions over the coming decades. Financial services providers will make increasing use of the available digital solutions to support financial services providers in assessing climate impact on agricultural portfolios for:

1. **BUSINESS DEVELOPMENT ACTIVITIES:** FSPs can use the tools and services offered by providers to grow their agriculture portfolio, thus promoting increased lending and investment into the sector. Traditionally FSPs base their lending decisions on financial and non-financial information collected by field officers from farmers and farms. This traditional method does not factor in climate data and climate related risks because: i) FSPs are not aware of the climate risks; ii) the climate data are not available to FSPs; iii) FSPs do not have the technical capabilities to analyze those climate data, create modeling and make business interpretations. The availability of climate risk assessment digital solutions gives FSPs an opportunity to update their due diligence approach and business development.

The use of these digital solutions can have multiple benefits for FSPs:

- **KYC: improving FSP understanding of their clients exposure to climate hazards and potential impact faced by borrowers.**
- **DD/appraisal process**
- **Risk mitigation and management**
- **Product development**
- **Cross selling (e.g. insurance products).**
- **Compliance (with regulations)**

This data can be incorporated into lending decisions and assist FSPs in growing their footprint in the agriculture sector. With an improved understanding of the sector, FSPs can launch new loan products tailored towards SHFs and agri-SMEs to reach untapped markets.

2. **IMPROVING EXISTING OPERATIONS:** FSPs can also use provider services and enhanced knowledge of climate risks to improve various aspects of their existing operations. Increased knowledge of the "riskiness" of the location of production in terms of agroclimatic risks can enable FIs to better assess the potential of farmers failing to repay their loan enabling FSPs to improve their existing operations. This includes:

- **Optimizing capital and portfolio planning and allocation**
- **Digitizing and streamlining lending processes for smallholder farmers**
- **Enhancing risk assessment and management systems**
- **Reducing their agricultural loan recovery costs.**

3. **PROMOTING CLIMATE SMART INVESTMENTS:** FSPs can capitalize on providers to assist in developing financial products that would enable their clients to invest in making their agricultural and livestock product more resilient to climate risks, more productive and less polluting. This could also include partnering with providers to offer non-financial services (NFS) to their clients so they can better plan their planting, application of inputs, timing of harvest, etc. all very valuable services to create loyalty between FSPs and their clients and enable clients to achieve better yields and increase their revenue.

5. Annexes

6grain

Molly Brown
mbrown@6grain.com
https://www.6grain.com

Growing the future through accessible digital technology

Using remote sensing and farm-level data to facilitate field mapping, regional market intelligence, and predicting optimal crop growth curves

Year founded:
2014

Headquarters:
Maryland, USA

Regional Scope:
20 countries across Europe, Latin America, and SSA

Provider Type:
Climate Risk Intelligence Provider

Climate Risk Tools and Services

Relevance to thesis

| Climate Risk Analytics | Agriculture Focus | Working in emerging markets |

Business model overview

Transforms farm data into information that can be used to increase success and boost uptake in crop protection services, credit provision, and high-yielding seeds

Services are highly customizable based on client, i.e., worked extensively with Syngenta to facilitate farm mapping in sub-Saharan Africa using remote sensing

Climate risk analytics

Couples abiotic and biotic risk assessments to predict optimal crop growth curves, backed by remote sensing

Offers regional market intelligence

Data Sources

Public satellite data, weather, farmer data

Uses proprietary weather & disease model

Uses proprietary yield assessment model

Supporting Services

Farm mapping

Mapped all maize fields in Zimbabwe using remote sensing and allows users to digitally draw field boundaries

Climate risk analytics

Assisted agronomists in digitizing farm data collection

Commercial Parameters

Target customers

| FI | AG Producer | GOVT/ NGO | AG Buyer/ Processor |

Readiness to implement

Low (FIs in developing markets)

Pricing/Revenue model

Annual license - direct sales/reseller options, enquire directly for pricing

Customization options

Configurable API+ license options

Data Protection

GDPR compliant, data passporting, ISO/Cyber essentials certified

Geographic reach

Europe, US, and Canada. Plans to expand to Africa, APAC, and LatAm H1'23

Crops covered

Flood and drought-related crop losses to be added in Q4'22

Languages available

English, additional languages in 2023

Engagement Opportunities

Financial Institutions

Has not worked extensively with FIs in past, but looking to expand services:

- Loan underwriting
- Loan monitoring
- Loan collection/recovery
- Portfolio management
- Portfolio allocation

Potential services include farmer loan automation: digitize and streamline loan process for SHFs, allowing real-time decisioning

Agribusiness

Ability to use remote sensing to map and monitor farm productivity

ADAPTA
Unlocking Capital for Adaptation

German Vegarra
German@adapta.earth
https://www.adapta.earth

Climate adaptation FinTech platform using data and climate technologies to unlock capital for agriculture

A climate and agriculture data intelligence SaaS company developing climate finance products for financial intermediaries.

Adapta aims to expand climate finance for the food and agriculture sector that only gets 2% of total climate finance but produces 25% of all greenhouse gas emissions.

Year founded:
2021
Headquarters:
Nairobi, Kenya
Regional Scope:
East Africa, Latin America in 2023
Provider Type:
Climate Risk Intelligence Provider

Climate Risk Tools and Services

Relevance to thesis

| Climate Risk Analytics | Lending Risk Offering | Agriculture Focus | Working in emerging markets |

Business model overview

Algorithm incorporating weather, soil, water, and biodiversity data into the credit underwriting process to unlock capital in agriculture sector. Acts as the equivalent of credit scoring algorithms for consumer and corporate finance but for agriculture adaptation for lenders and investors

Climate risk analytics

Three-stage Climate Smart System (CSS) that layers into traditional credit approval flow: delivers a Climate Score (CS) at credit entry, a Climate Adaptation Plan (CAP) to enhance borrowers' resilience, and a digital Portfolio Monitoring System (PM) to monitor CAP

Data Sources

Geospatial information, climate change projections, and data covering soil Ph and carbon, water availability, and protected habitats. Data updated daily, and some annually

Supporting Services

Training to FIs on ADAPTA CS and interpreting data

Climate Adaptation Plan jointly developed with the farmer and service can be provided to FIs for a fee

Land Report is being developed to provide buyers of land key climate, soil, water, and biodiversity information

"We developed ADAPTA CS to transform the way we assess food and agricultural risk. Our SaaS leverages climate, soil, water, and biodiversity data to provide a score that can guide you on risks at the farm level while providing you with mitigation solutions to lower such risks."

from website

Commercial Parameters

Target customers

| FI | AG Producer | AG Buyer/ Processor |

Readiness to implement

High

Pricing/Revenue model

1) ADAPTA CS sold to FIs as a SaaS model for annual subscription fee 2) ADAPTA Finance lends and invests using CSS

Customization options

SaaS accessed through the WEB and via an APP. Mobile token for access

Data Protection

GDPR compliant

Geographic reach

East and Southern Africa, Central America, Peru; Colombia and Ecuador in 2023

Crops covered

30 value chains (maize, potatoes, tea, grass, tomatoes, tea, coffee, onions, macadamia, dairy, etc.)

Languages available

English, Spanish in 2023

Engagement Opportunities

Financial Institutions

Track record of working with FIs across loan cycle:

- Loan underwriting
- Loan monitoring
- Portfolio management
- Portfolio allocation

Facilitates decision-making across the loan cycle from underwriting and portfolio monitoring

Provides early risk climate adaptation plan to enhance farmer resilience thereby lowering probability of default

Five Kenyan banks testing beta version

Agribusiness

ADAPTA has 3 committed projects, expects to close 4 more by end 2022 with cooperatives, processors, and medium-sized farmers as clients

agCelerant
PHYGITAL AGRICULTURE

Daniel Annerose, CEO
agcelerant.com
https://www.agcelerant.com

Combines physical asset management with digital solutions to ensure trust and scalability of service.

Unlocks primary bank and industrial investments for smallholder markets.

Year founded:

2018

Headquarters:

Mauritius (Manobi Africa)

Senegal (agCelerant)

Regional Scope:

SSA

Provider Type:

Ag Value Chain Orchestrator x

Operation risk control for FIs

Climate Risk Tools and Services

Relevance to thesis

Climate Risk Analytics	Lending Risk Offering	Agriculture Focus	Working in emerging markets

Business model overview

agCelerant's hyperlocal data ecosystem significantly de-risks agri-finance transactions: farmers do not receive cash during growing season; service providers are paid directly by bank after delivery; monitoring is done in near real-time.

Products: data driven farmer profiling, farm-mapping and pre-season, in-season, and late-season de-risking solutions (AIRMAP, BRISK, TARGET) for partner banks and financial institutions to scale up agri-finance to smallholder farmers. Franchised agent networks provide continuous support to farmers on good agricultural practices.

Climate risk analytics

Enables control of delivery of input (fertilizers and agrochemicals), agri-insurance coverage and farm services (land preparation, harvesting) to farmers, monitoring of farmer practice, and the sale of the crop to off-takers.

Data Sources

Frequent site visits by agents, plot-level, 5-day satellite monitoring, IoT, AI & LM, predictive models

Supporting Services

Digitization

Customization of Manobi Africa digital platform for agri value chains financing in Africa based on *phygital agriculture* concept

Farm mapping

TA by agents, weekly upload of farm data on electronic portal; crop blueprints/protocols developed by experts include fungicide and pesticide spraying schedule and crop rotation programs; agronomists keep track of adherence to the crop blueprints

R&D

Business-driven cost and risk control innovations combining AI, EO, IoT and mobile data streams; embedded R&D partners

Commercial Parameters

Target customers

FI	AG Producer	GOVT/ NGO	AG Buyer/ Processor

Readiness to implement

Mid-stage start-up

Pricing/Revenue model

% of generated added value to agricultural value chain actors (farmers, input and service providers, insurance companies, off-takers, etc.)

Customization options

Farm characterization, qualification, exploitation scenarios; for various VC stakeholders: FI, agro-industry, etc.

Data Protection

Servers hosted on two separate data centers in Europe; Regular back up by company

Geographic reach

Mapped c. 58,260 farmers c. 100,920 ha of cultivable lands in 10 African countries (+France), with major presence in Senegal on rice (27,665 ha)

Crops covered

Rice, Cocoa, Peanut, Cotton, Maize, Sorghum

Languages available

Wolof, Pular, French, English, Arabic, Kiswahili, Amharic, Afan Oromo, Portuguese, Bambara, Mandarin, Malay

Engagement Opportunities

Financial Institutions

BOA Senegal (wide distribution network of 54 branches (second largest in Senegal) supports approximately 40,000 clients.

Major MFIs as PAMECAS in Senegal, FNM in Benin, etc.

Agribusiness

- Seed suppliers
- Fertilizer and agrochemical suppliers
- Industrial millers, village mills
- Ag Insurance companies
- Professionalization of farmers' organizations (FO) through the Agribusiness Leadership Program, namely on FO management

agroclimatica

Lars Saquero Mollere
lsm@ingemann.com.ni
https://www.agroclimatica.com

Platform that assesses agroclimatic risk at an individual farm level to assist FIs in making objective lending decisions

Year founded:

2016

Headquarters:

Part of Ingemann data, based in Denmark and Nicaragua

Regional Scope:

Latin America, India, Kenya adaptable worldwide

Provider Type:

Climate Risk Intelligence Provider

Climate Risk Tools and Services

Relevance to thesis

Climate Risk Analytics	Lending Risk Offering	Agriculture Focus	Working in emerging markets

Business model overview

Risk scoring platform that computes projected agroclimatic risk, identifies soil limitations, and proposes ideal crop and livestock fit for farm plots

Carbon quantifier available, plans to add water quantifier

Climate risk analytics

Combines farmer payment history/financial risk scores with future payment capacity based on agroclimatic risk scores (include temperature, precipitation, climate viability, soil suitability, crop scenario)

Offer predictive risk assessment for 3 to 4 years. Risk scores offer 95% accuracy

Data Sources

Climate data (historical performance across 13 parameters), soil data (office maps, satellite imagery), crop and livestock data (local experts, research/scientific based documentation)

Supporting Services

Does not appear to offer supporting services

Commercial Parameters

Target customers

FI

Readiness to implement

High

Pricing/Revenue model

Fee per click or subscription model

Customization options

Agroclimatic risk score is standardized, small adjustments are possible

Data Protection

No personal information about the farmers is stored

Geographic reach

Central and South America, Kenya and India with plans to expand to Eastern Europe

Crops covered

Dependent on crop varietals in individual countries, presently >4,500 crop varieties

Languages available

English and Spanish

Engagement Opportunities

Financial Institutions

Track record of working with FIs across loan cycle:

- Loan underwriting
- Loan monitoring
- Loan collection/recovery
- Portfolio management

- Offer risk and ESG management platforms for FIs
- Methodology has been validated by industry players;
- in Kenya, Agroclimatica has been approved by the Central Bank of Kenya to use among regulated financial entities.

Agribusiness

N/A, primarily geared towards FIs

Agroclimatica is a bioclimatic data platform that provides Risk Scores based on scientific data from:

Climate · Soil · Crop · Livestock · Productivity

Industry professionals perceive the information as valuable and helpful

91% Feel more informed and confident to make decisions

CLIMATE AI

Ken Anderson
ken@climate.ai
https://climate.ai

Enterprise platform to assess short and long term climate risks in food and agriculture supply chains

Year founded:

2017

Headquarters:

San Francisco, USA

Regional Scope:

Global

Provider Type:

Climate Risk Intelligence Provider

Climate Risk Tools and Services

Relevance to thesis

Climate Risk Analytics	Lending Risk Offering	Agriculture Focus	Working in emerging markets

Business model overview

Enterprise platform-focused on assessing climate risks in food and agriculture supply chains to build supply chain resiliency, improve profitability, and sustainably intensify production. Bottom-up enterprise tool, with integrated end to end risk view, from field level to boardroom.

Climate risk analytics

Facilitate historical simulations and build predictive models to forecast the following risks: Short term weather (1-14 days), sub-seasonal climate (2 weeks to 6+ months), long-term climate (10-50 years)

Risk scores translated into financial impact (i.e., agricultural yield, property damage) and actionable operational insights (i.e., optimized planting harvesting, other weather sensitive decisions)

Data Sources

Public/private satellite and weather station data

Models update between every hour and annually

Supporting Services

Production planning and decisioning

Help clients understand how they can adapt crops in specific regions prone to climate change

In the seasonal time frame, tool helps accurately predict conditions on the time scales that were previously not accessible at the accuracy and localization

Commercial Parameters

Target customers

FI	AG Producer	GOVT/ NGO	AG Buyer/ Processor

Readiness to implement

Medium (FIs in developing markets)

Pricing/Revenue model

Subscription-based on location and crops of interest

Customization options

Fully customizable for specific value chain needs

Data Protection

TBC

Geographic reach

Global operations, USA clients primarily

Crops covered

No crop limitations but most experience in seed crops, more information on crop response to weather conditions results in more robust impact functions

Languages available

English

Engagement Opportunities

Financial Institutions

Track record of working with FIs across loan cycle:

- Portfolio management (climate Sharpe ratio)
- Portfolio allocation

Primarily work with larger FIs, including agriculture lenders, real estate, asset managers. FIs use services to translate Predicted yield to economic impact. Pricing is likely too high for MFIs

Agribusiness

Currently curated for actors across agri-supply chain for understanding climate risks (i.e., regional crop assessments, identifying optimal sourcing, and balancing portfolio climate risks) and managing short term climate change impacts.

MIND YOUR BUSI...

CLIMATE X

Julio C. Othon
julio.c.othon@climate-x.com
https://www.climate-x.com

SaaS solution providing explainable climatic physical and transition risk for physical assets and land, both at portfolio and individual location levels

Year founded:

2020

Headquarters:

London, England

Regional Scope:

Operational in US, Europe, Canada; expansion to Africa, APAC, Latin America in 2023

Provider Type:

Climate Risk Intelligence Provider

Climate Risk Tools and Services

Relevance to thesis

Climate Risk Analytics	Lending Risk Offering

Business model overview

Platform providing physical and transition climate risks, financial loss impacts under a range of climate scenarios through 2100

Access to 10-90m resolution data and predictive risk analytics through Spectra (online SaaS platform), API integration, reporting, or raw data exports

Climate risk analytics

Climate risks include river/surface/coastal flood/ sea level rise, extreme heat, subsidence, landslide/ coastal erosion, drought, wildfire, wind/storm, calculated as combined risk score and total loss, up to 95% accuracy

Ability to assess physical asset risks at individual or portfolio level. Use of AI but focus on physics-based models. Suitable for retail and commercial exposures

Data Sources

Remote sensing data, geolocation data

Updated every 6-12 months

Supporting Services

Comprehensive training, knowledge hub, and support ticket services

Implementation support available via major consulting groups including Deloitte

Additional services to be deployed throughout 2023+

Commercial Parameters

Target customers

FI	GOVT/ NGO

Readiness to implement

Low (FIs in developing markets)

Pricing/Revenue model

Annual license - direct sales/reseller options, enquire directly for pricing

Customization options

Configurable API+ license options

Data Protection

GDPR compliant, data passporting, ISO/Cyber essentials certified

Geographic reach

Europe, US, and Canada. Plans to expand to Africa, APAC, and LatAm H1'23

Crops covered

Flood and drought-related crop losses to be added in Q4'22

Languages available

English, additional languages in 2023

Engagement Opportunities

Financial Institutions

Track record of working with FIs across loan cycle:

- Loan underwriting
- Loan monitoring
- Loan collection/recovery (EOY)
- Portfolio management
- Portfolio allocation

Platform allows FIs to input coordinates or addresses of assets to monitor, FIs can assess risk at portfolio or asset level, though no demonstrated agriculture use cases

API allows FIs to integrate climate risk score directly into internal scorecards for decision making and capital modeling

Agribusiness

Primarily greared towards FIs/Real Estate/Govt/NGO

Cropin®

Arjun Dutta
arjun.dutta@cropin.com
https://www.cropin.com

CropIn is an AI and Data-led agri-tech organization that provides SaaS solutions to agribusinesses eco-system globally using deep learning

Year founded:

2010

Headquarters:

Bengaluru, India

Regional Scope:

Operational in 56 countries across SSA, SE Asia, and Latin America

Provider Type:

Supply Chain Management Solution

Climate Risk Tools and Services

Relevance to thesis

Climate Risk Analytics	Lending Risk Offering	Agriculture Focus	Working in emerging markets

Business model overview

Software solution focused primarily on farm to fork supply chain digitization while also using data to offer agroclimatic risk scoring and predictive analytics for clients

Climate risk analytics

Integrated climate risk assessments in the short term (analysis of individual plots in lending processes up to a year) using satellite and field data integrated into a credit scoring mechanism. Historical data at pilot and pin code levels, weather-based real time advisory, and disease and pest alerts

Offers broader regional/sub-regional climate risk assessments, customizable to specific crops (usually 2 times a year), approximately 20% of use cases

Data Sources

Three year historical satellite data, supplemented with remote monitoring, weather station, and field data

Satellite data updated weekly

Supporting Services

Farm management

Solution for digitizing on farm activities

Traceability

Application of geo-tagging products with authenticity verification across supply chain stages

Market Linkages

Customers can integrate CropIn platform with Marketplace via APIs

Commercial Parameters

Target customers

FI	AG Producer	GOVT/ NGO	AG Buyer/ Processor

Readiness to implement

High

Pricing/Revenue model

Varies by offering: 1. Reporting: price per report; 2. Platform: price per loan assessed

Customization options

Hyper configurable, including integration of bank data

Data Protection

GDPR compliant

Geographic reach

All regions excluding China

Crops covered

388 crops, field crops and vegetables

Languages available

All languages excluding Cantonese

Engagement Opportunities

Financial Institutions

Track record of working with FIs across loan cycle:

- Loan underwriting
- Loan monitoring
- Loan collection/recovery
- Portfolio management

FIs are 10% of clients; primarily works with commercial banks, including many in India and Indonesia, and insurance companies

Streamlines lending process, loan and claim disbursals, and monitors risk in real-time

Agribusiness

Digitization, traceability, farmer engagement, risk assessment for agribusinesses (about 90% of clients)

Gro Intelligence

Joel Cherkis
joel.cherkis@gro-intelligence.com
https://www.gro-intelligence.com

SEE THE BIG PICTURE, ACT ON THE SMALL DETAILS

Predictive analytics platform providing insights across climate, agriculture, and the economy

Year founded:

2014

Headquarters:

New York, USA

Regional Scope:

Operational globally; clients primarily in developed markets

Provider Type:

Climate Risk Intelligence Provider

Climate Risk Tools and Services

Relevance to thesis

Climate Risk Analytics	Lending Risk Offering	Agriculture Focus	Working in emerging markets

Business model overview

Data and analytics platform providing a view of climate, agriculture, and economy insights for managing risk, adapting to changing conditions, and forecasting long term climate scenarios

Climate risk analytics

Predictive analytics forecasting the impact of climate change and climate risks on specific crops and resulting influence on pricing, supply, and demand

Indices developed to track impact of climate events such as drought, soil moisture, and flooding on agriculture and commodity prices

Risks covered: Climate change risks (i.e. IPCC climate scenarios), climate risks (i.e. precipitation, temperature), financial risks (i.e. future agricultural prices)

Data Sources

47,000 data sources including satellite, public, and purchased going back to 1880s

Models updated as frequently as daily

Supporting Services

Production planning and decisioning

Works with seed, fertilizer, and corporate agribusiness to forecast product demand regionally or globally

Agriculture commodities pricing

Uses predictive analytics to determine future agriculture production, enhancing clients' ability to predict data

"We illuminate the interrelationships between the Earth's ecology and the global economy, so you can develop a holistic understanding of how your end-to-end business is impacted - and act on these insights."

from website

Commercial Parameters

Target customers

FI	AG Producer	GOVT/ NGO	AG Buyer/ Processor

Readiness to implement

Medium (FIs in developing markets)

Pricing/Revenue model

Subscription platform with customizable user interface, client data can be integrated

Customization options

Standard platform with customizable user interface, client data can be integrated

Data Protection

SOC 2, Type 2 pending (Fall 2022)

Geographic reach

All regions

Crops covered

17,000 crops with expertise in corn, soybeans, and wheat

Languages available

Variety depending on user needs

Engagement Opportunities

Financial Institutions

Primarily work with asset managers, hedge funds, banks, commodity traders and insurance:

- Loan underwriting
- Loan monitoring
- Loan collection/recovery
- Portfolio management
- Portfolio allocation

Analytics on price drivers and events impacting trading and investments (i.e. yield forecasts) and forecasts on markets and climate conditions (i.e. climate projections on precipitation)

Agribusiness

Analytics to mitigate climate-related supply chain risks and improve pricing of purchases as well as analytics to forecast farmer profitability to improve sales and pricing strategy

JUPITER™

Julie Mansfield
julie.mansfield@jupiterintel.com
https://www.jupiterintel.com

Physical climate risk analytics platform for risk management and resiliency planning

Year founded:

2017

Headquarters:

San Mateo, USA

Regional Scope:

Global, customers primarily based in North America, Europe, APAC

Provider Type:

Climate Risk Intelligence Provider

Climate Risk Tools and Services

Relevance to thesis

Climate Risk Analytics	Lending Risk Offering	Agriculture Focus	Working in emerging markets

Business model overview

Physical climate risk analytics measuring short term (present day) and long term risks (up to 2100) on individual and portfolio of assets

Climate risk analytics

ClimateScore Global: impact analysis of climate risk on assets globally such as portfolio planning, risk mitigation, market value analysis, and underwriting

ClimateScore Planning: analysis and insights on impact of specific climate risks (e.g., flood) on individual assets, facilities, neighborhoods, and communities through 2100

Climate risks covered include: flood, wind, heat, precipitation, fire, drought, hail, and cold

Data Sources

CMIP6 Global Climate models, downscaled to 90m; new metrics and information updated quarterly

Supporting Services

Work with partners to offer consulting and supportive services

Commercial Parameters

Target customers

FI	AG Producer	GOVT/ NGO	AG Buyer/ Processor

Readiness to implement

Medium, able to implement globally

Pricing/Revenue model

Subscription model based on number of assets

Customization options

Customizable Tableau dashboards, API integration available

Data Protection

Customer provided data are proprietary

Geographic reach

Global, customers primarily based in North America, Europe, APAC

Crops covered

Focused on location, not specific crops

Languages available

English

Engagement Opportunities

Financial Institutions

Track record of working with FIs:

- Loan underwriting
- Portfolio management
- Portfolio allocation

Existing work with banks, insurance, asset management, and real estate companies

Analysis of physical climate change risk on financing related activity (portfolio management, underwriting) and quantifying of potential financial losses

Also assist with market value analysis and regulatory response

Agribusiness

Physical risk analysis at microclimate level to optimize management of fields, forests, and value chains

"With forward-focused, rigorous methodologies and analytics delivered by some of the best scientists in the industry, Jupiter turns sophisticated climate science into actionable data."

from website

Mantle Labs

Rishikesh Sapre
rishi@mantle-labs.com
https://www.mantle-labs.com

Climate Risk Tools and Services

Relevance to thesis

Climate Risk Analytics	Lending Risk Offering	Agriculture Focus	Working in emerging markets

Business model overview

Turnkey financial analytics platform providing complete risk assessment solution for FIs to manage their agriculture portfolios

Climate risk analytics

Two primary data sets:

Level 1. Regional credit risk score to determine risk capital allocation, default probability of loans and portfolios and collections monitoring

Level 2. Field level credit score to determine the expected loan default probability, used by banks to make final lending decisions

Provide automated risk scores to advise banks on lending (only 10% need human component)

Uses include: climate-optimize in-season production tracking, invest in climate-proof locations, understand extreme weather risks for loan portfolios at asset level

Data Sources

Satellite data from European Space Agency/NASA
Data cleaned with AI and updated every 10 days

Supporting Services

Production planning and decisioning

Offer historical and predictive yield data on plots of land, portfolios, and regions

Commercial Parameters

Target customers

FI	AG Producer	AG Buyer/ Processor

Readiness to implement

High; turnaround for new client is 2-3 weeks

Pricing/Revenue model

1. Subscription fee per month per user
2. Fee per loan for over 50 users

Customization options

Off the shelf standardized solution but customizable depending on client need

Data Protection

N/A

Geographic reach

Global, with extensive work in India

Crops covered

All major crops

Languages available

English, regional languages in India, French, Portuguese, Spanish

Engagement Opportunities

Financial Institutions

Track record of working with FIs across loan cycle:

- Loan underwriting
- Loan monitoring
- Loan collection/recovery
- Portfolio management
- Portfolio allocation

Strong track record of working with commercial banks and insurance
Uses include pre-season systematic risk index to identify where to lend, risk capital allocation tool, loan processing and collection, and FI corporate level agricultural analysis

Agribusiness

Crop monitoring platform used by agribusinesses and agri-commodity companies to plan and execute their businesses

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Ag-focused (Ag-fintech) automated financial analytics platform for banks, insurance and asset managers to make lending decisions and monitor portfolios

Year founded:

2016

Headquarters:

London, UK

Regional Scope:

India, SE Asia, Africa, Americas, Europe

Provider Type:

Financial Analytics Company

PRAEDICTUS
CLIMATE SOLUTIONS

Josh Perlman
perlman@praedictus.com
https://www.praedictus.com

DRIVING NEXT GENERATION CROP YIELD RISK TRANSFER

ANY CROP. IN ANY COUNTRY. AT ANY GRANULARITY.

Climate solutions provider focused on running predictive biophysical crop models at scale

Praedictus enables firms to more accurately model and forecast the combined impacts of weather, technology, environmental conditions and climate change on commodity crop yields globally.

Year founded:

2015

Headquarters:

Chicago, IL. USA

Regional Scope:

Global

Provider Type:

Financial Analytics Company

Climate Risk Tools and Services

Relevance to thesis

| Climate Risk Analytics | Lending Risk Offering | Agriculture Focus | Working in emerging markets |

Business model overview

Deploys cutting-edge biophysical models to predict crop growth and development

Primarily focused on working with reinsurers, deploying next-generation parametric risk products

Three distinct uses cases for their products:
1. Risk transfer/hedging series
2. Valuation and analytics
3. Predictive climate models

Climate risk analytics

Historical, in season and climate-projected crop yield simulations based on weather, soil and crop management data

Global scope: wherever crops are raised

Delivery of raw data to customers; currently, platform in pilot stage

Data Sources

Publicly available data from ERAS

Data updated daily

Supporting Services

Does not appear to offer supporting services

Commercial Parameters

Target customers

| FI | AG Producer | GOVT/ NGO | AG Buyer/ Processor |

Readiness to implement

Medium (for lending risk offerings for banks in developing markets)

Pricing/Revenue model

For insurance, risk transfer play, climate physical and transition risk; other services dependent on crops and data; platform will be subscription

Customization options

Data customizable based on client

Data Protection

All data is proprietary

Geographic reach

Applicable to any region

Crops covered

12 crops, expanding to 40 by 2023

Languages available

English, Spanish, Portuguese, can translate product based on client need

Engagement Opportunities

Financial Institutions

Have not yet worked with commercial banks

In process of partnering with lending organization

Agribusiness

Large agribusiness bought land in US, Praedictus modeled agribusiness crop system in that land, provided data back to the agribusiness

"Praedictus Climate has developed the science and technology to drive end to end agricultural crop yield risk transfer products, custom to the needs of any firm with exposure to weather-driven crop production loss."

from website

PULA

Rose Goslinga
rose@pulo.io
https://www.pula-advisors.com

Insurtech that designs and delivers agricultural insurance and digital products tailored for SHFs

Climate Risk Tools and Services

Relevance to thesis

| Climate Risk Analytics | Agriculture Focus | Working in emerging markets |

Business model overview

Insurtech partnering with local insurance and global reinsurance firms to underwrite risk by handling product design, risk placement, farmer education, claims assessment, and payouts

Climate risk analytics

Hybrid index insurance combines Weather Index Insurance and Area Yield Insurance for farmer payout under weather conditions, such as drought and flood

Yield Index Insurance that insures farmers on the value of purchased inputs, based on agro-ecological zones of region based on factors, such as historical rainfall, temperatures, prior yields

Data Sources

Self-collected farmer yield data, FAO

Supporting Services

Insurance as a service (see climate risk section)

Work with government and international NGOs to improve efficiency by providing remote agriculture monitoring, yield prediction, and sustainable ways to engage with farmers

Commercial Parameters

Target customers

| FI | AG Producer |

Readiness to implement

Low

Geographic reach

Africa and Asia

Crops covered

23 different crop varieties

Engagement Opportunities

Financial Institutions

Primarily engage with insurance and re-insurance companies and offer insurance companies and offer insurance as a service

Started partnering with AgTechs (i.e. Apollo Agriculture) to provide insurance as part of bundled products/services for SHFs

Offer insurance to FIs, however have not observed strong demand from FIs for climate risk data
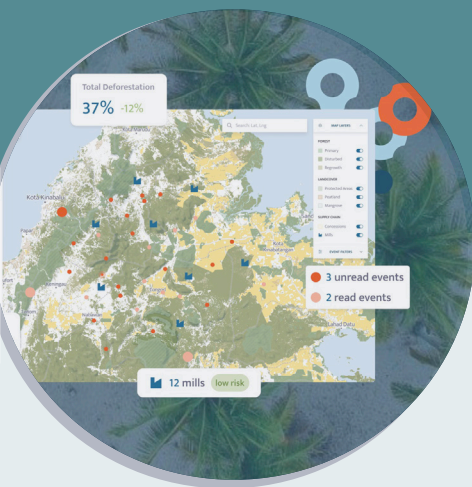
Agribusiness

Offer insurance to large agribusinesses

"Pula is an agricultural insurance and technology company that designs and delivers innovative agricultural insurance and digital products to help smallholder farmers endure yield risks, improve their farming practices, and bolster their incomes over time."

from website

Year founded:

2014

Headquarters:

Mollis, Switzerland

Regional Scope:

Operational in Asia, Africa, Latin America

Provider Type:

Insurtech

Total Deforestation
37% -12%

12 mills | low risk

3 unread events
2 read events

SATELLIGENCE

Amy Ching
ching@satelligence.com
https://satelligence.com

Remote sensing company monitoring agriculture supply chain risks in near real-time, with a focus on deforestation and carbon

Year founded:

2016

Headquarters:

Utrecht, Netherlands

Regional Scope:

Operational in Africa, Asia, Latin America

Provider Type:

Climate Risk Intelligence Provider

Climate Risk Tools and Services

Relevance to thesis

| Climate Risk Analytics | Lending Risk Offering | Agriculture Focus | Working in emerging markets |

Business model overview

Remote sensing company that monitors crop supply chains in forested areas (i.e., palm oil, cocoa) to understand deforestation risks and monitor carbon with 90% accuracy

Product delivery models include proprietary platform, PDF reports, GIS data, API integration

Climate risk analytics

Overlays satellite imagery and mill locations to identify historical forest cover change and assess supply chain and portfolio wide deforestation risks, with ability to go down to individual farm level

Data Sources

Open source optical and radar satellite data

Supply chain asset data (mill locations)

Supporting Services

Carbon monitoring

Identify amount of carbon stored and sequestered in supply chains

Commercial Parameters

Target customers

| FI | AG Producer | AG Buyer/ Processor |

Readiness to implement

Medium

Pricing/Revenue model

Varies by amount of data to be processed, price per report; platform subscription fee

Customization options

Fully customizable, API to integrate client data

Data Protection

NDA governing private data

Geographic reach

Global, existing customers in SE Asia

Crops covered

Coffee, palm oil, cocoa, soy, leather and beef, sugar cane, rubber, paper and pulp, coconut, forestry

Languages available

English, Spanish, Dutch, Bhasa, French, and local languages supported

Engagement Opportunities

Financial Institutions

Track record of working with FIs:

- Portfolio management
- Portfolio allocation

Existing work with commercial banks, asset managers, and DFIs
Use case includes identifying investments in a palm oil portfolio that are exposed to high deforestation risk

Agribusiness

Agribusinesses are primary clients

Carbon monitoring and deforestation risks

SatSure

Amit Salunkhe
amit@satsure.com
https://www.satsure.co

Decision intelligence platform to assess climate risks across agriculture value chains for the financial services sector

Year founded:

2017

Headquarters:

Mumbai, India

Regional Scope:

Operational in Africa, SE Asia, NA, and Latin America

Provider Type:

Supply Chain Management Solution

Climate Risk Tools and Services

Relevance to thesis

Climate Risk Analytics	Lending Risk Offering	Agriculture Focus	Working in emerging markets

Business model overview

Provide predictive, prescriptive and diagnostic agroclimatic data insights, backed by satellite imagery analytics, ML and AI, to facilitate decision making across the loan cycle for credit underwriting, portfolio monitoring, and loan recovery/collection

Climate risk analytics

SatScore: land score based on 3-year historical data included in a report with seasonal revenue estimations at farm level, irrigation conditions, and broader regional conditions affecting farm and farmer production and revenue potential

SatSure Saga: helps lenders with loan portfolio collections through farmer and farm level continuous crop monitoring. Integrates climate change scenarios such as extreme weather events, deforestation, etc.

Data Sources

Satellite imagery, public datasets (i.e., economic data), and client datasets (i.e., delinquency data)

Supporting Services

Geospatial analysis

LULC, crop damage estimations, route optimization, flood inundation, forest fire monitoring, etc.

Satellite fleet

SatSure launched a subsidiary, KaleidEO, for its own high resolution, multi-spectral, optical earth observation fleet of satellites for its product and solution offerings in the infrastructure, energy, and utility sectors

Commercial Parameters

Target customers

FI	AG Producer	GOVT/ NGO	AG Buyer/ Processor

Readiness to implement

Low

Pricing/Revenue model

Fixed cost + variable cost based on number of farmers

Customization options

Fully customizable App and projects

Data Protection

Does not store client data

Geographic reach

Global, existing work focused on Africa

Crops covered

Crows agnostic

Languages available

English, Bangla, French, Ahmaric, Swahili, others added on demand

Engagement Opportunities

Financial Institutions

Track record of working with FIs across loan cycle:

- Loan underwriting
- Loan monitoring
- Loan collection/recovery
- Portfolio management

Facilitates decision making across the loan cycle from underwriting, portfolio monitoring to loan collection

Existing work with largest commercial banks in India, mortgage and project finance companies, and insurance companies

Agribusiness

Provide farm and regional data insights to support input companies, contract farming, and food processors in addressing supply chain challenges

SoDry® Ensile at the best time

SoYield® Estimate your harvest

SOWIT

Hamza Rkha Chaham
hamza.rkha@sowit.fr
https://www.sowit.fr

Agro-meteorological forecasting and advisory services provider for smallholder farmers

SOWIT data helps banks assess farmers' credit worthiness while supporting farmers through digital advisory services to mitigate risks and deliver best possible results.

Year founded:

2018

Headquarters:

Casablanca, Morocco

Regional Scope:

Operational in Africa

Provider Type:

Climate Risk Intelligence Provider

Climate Risk Tools and Services

Relevance to thesis

| Climate Risk Analytics | Agriculture Focus | Working in emerging markets |

Business model overview

Remote-sensing data provider primarily focused on providing weather forecasting and advisory services to farmers, via SMS or mobile application

Climate risk analytics

Partner with FIs and other providers to provide climate and plot health status information and forecasting: this data can help inform development of farmer credit profiles and yield risk

Deliver weather, crop health status and climate analysis for insurance companies to monitor risk of weather events for SHF payouts

Data Sources

European Centre for Medium-Range Weather Forecasts

Sentinel, Landsat, Planet constellations

Models updated daily

Supporting Services

Consulting services

Provides climate change resiliency consultancy services for local authorities and NGOs

Farmer advisory services

Delivers SMS-based and App-based advisory services to SHFs, including agro-meteorological forecasts and agronomic recommednations to improve farming practices

"SOWIT is focused on providing remote-sensing and IoT based advisory services to farmers while also providing risk & performance data to banks in Africa, such as Credit Agricole, Banque Centrale Populaire and the Tanzania Agricultural Development Bank."

from website

Commercial Parameters

Target customers

| FI | AG Producer | GOVT/ NGO | AG Buyer/ Processor |

Readiness to implement

High

Pricing/Revenue model

Fixed cost + variable cost based on number of farmers

Customization options

Fully customizable App and projects

Data Protection

Does not store client data

Geographic reach

Global, existing work focused on Africa

Crops covered

Crop agnostic

Languages available

French, Arabic, English

Engagement Opportunities

Financial Institutions - BU

Core competency is collecting and disseminating climate and plot health status data for farmers; therefore, engaging with FIs is only on project, software, or API services basis

Engaged with Credit Agricole, TADB (Tanzania), Banque Centrale Populaire

Agribusiness - BU

Services for agri-businesses including information, agronomic recommendations delivered through APP and SMS and IoT sensors to drive irrigation operations and drone spraying to optimize crop protection

Weather Impact

Edith Tea
Edith.Tea@weatherimpact.com
https://www.weatherimpact.com

Agro-meteorological forecasting and advisory services provider for smallholder farmers

Year founded:

2015

Headquarters:

Utrecht, Netherlands

Regional Scope:

Operational in SE Asia and Africa

Provider Type:

Climate Risk Intelligence Provider

Climate Risk Tools and Services

Relevance to thesis

Climate Risk Analytics	Agriculture Focus	Working in emerging markets

Business model overview

Weather provider primarily focused on providing weather forecasting and advisory services to smallholder farmers, via SMS or mobile application

Climate risk analytics

Partner with FIs and other providers to provide climate information and forecasting; this data can help inform development of farmer credit profiles and yield risk

Deliver weather and climate analysis for insurance companies to monitor risk of weather events for SHF payouts

Data Sources

European Centre for Medium-Range Weather Forecasts

Models updated daily

Supporting Services

Consulting services

Provides climate change resiliency consultancy services for local authorities and agribusinesses

Farmer advisory services

Delivers SMS-based and App-based advisory services to SHFs, including agro-meteorological forecasts and recommendations to improve farming practices

Commercial Parameters

Target customers

FI	AG Producer	GOVT/ NGO	AG Buyer/ Processor

Readiness to implement

Low

Pricing/Revenue model

Fixed cost + variable cost based on number of farmers

Customization options

Fully customizable App and projects

Data Protection

Does not store client data

Geographic reach

Global, existing work focused on Africa

Crops covered

Crop agnostic

Languages available

English, Bangla, French, Ahmaric, Swahili, others added on demand

Engagement Opportunities

Financial Institutions

Track record of working with FIs across loan cycle:

- Loan underwriting
- Loan monitoring
- Loan collection/recovery
- Portfolio management

Facilitates decision making across the loan cycle from underwriting, portfolio monitoring to loan collection

Existing work with largest commercial banks in India, mortgage and project finance companies, and insurance companies

Agribusiness

Provide farm and regional data insights to support input companies, contract farming, and food processors in addressing supply chain challenges

YAPU

Smart finance. People first.

Hannes Graf
hannes.graef@yapu.solutions
https://www.yapu.solutions

Saas solution for financial service providers to facilitate resilient finance for the most vulnerable populations in the global South

Year founded:

2017

Headquarters:

Berlin, Germany

Regional Scope:

Global

Provider Type:

Climate Intelligence Provider

Climate Risk Tools and Services

Relevance to thesis

| Climate Risk Analytics | Lending Risk Offering | Agriculture Focus | Working in emerging markets |

Business model overview

SaaS solution offers agroclimatic risk assessments at individual and portfolio level

Products: 1. Digitalization tools 2. Data insights including financial, climate and nature, and ESG factors for loan and investment decisions 3. Investor services to measure and show impact of loans and investments

Climate risk analytics

Software combines customer (farmer) data, agroclimatic data, and referential data for crop and economic activities to support lending decisions

Offers decision intelligence to generate risk adjusted cash flow projections for individual customers throughout the stages of production cycle

Agroclimatic risks measured include climatic sensitivity, adaptive capacity, green microcredit verification, detailed cashflows, climate exposure

Data Sources

Client, farmer, public, and private purchased sources

Supporting Services

Platform development

Offer consultancy services to assist FIs in developing internal platforms to manage agroclimatic risk

FI Digitization

Assist MFIs with digitizing their processes

Commercial Parameters

Target customers

| FI | GOVT/ NGO |

Readiness to implement

High

Pricing/Revenue model

Varies by offering: 1.SaaS subscription fee based on number of user licenses 2. Variable pricing by data needed 3. PayGo for standardized software

Customization options

Fully customizable and integrable into client IT system

Data Protection

GDPR compliant

Geographic reach

Applicable in all regions with existing work in LATAM and SSA

Crops covered

FAO Ecocrop database and additional crops

Languages available

English, Spanish, French, Arabic

Engagement Opportunities

Financial Institutions

Track record of working with FIs across loan cycle:

- Loan underwriting
- Loan monitoring
- Loan collection/recover
- Portfolio management
- Portfolio allocation

Primarily work with MFIs, and work with commercial banks in Ecuador and Senegal

Agribusiness

N/A, primarily geared towards FIs

PROVIDER	AFRICA	ASIA	AMERICAS	OTHER
agroclimatica	**Kenya**	**India**	Chile, Costa Rica, Guatemala, Honduras, Ecuador, El Salvador, Nicarague	Denmark, Ukraine, Turkey
Cropin	Burkina Faso, Cote d'Ivoire, Ethiopia, Ghana, Kenya, Mozambique, South Africa, Togo, Uganda, Zimbabwe	India, Indonesia, Myanmar, Philippines, Thailand, Vietnam, Malaysia, Cambodia, Lao PDR, Bangladesh, Sri Lanka	Argentina, Brazil, Chile, Colombia, Guatemala, Nicaragua, Peru, United States	Australia, Belgium, Denmark, France, Germany, Greece, Hungary, Italy, Latvia, Netherlands, New Zealand, Portugal, Russia, Spain, Switzerland, Turkey, Ukraine, United Kingdom
Mantle Labs	Chad, Egypt, Cote d'Ivoire, Kenya, Malawi, South Africa, Tanzania, Uganda	India, Vietnam, Thailand	Argentina, Brazil	Australia, Italy, Portugal, Spain, United Kingdom, United States
SATELLIGENCE	Cameroon, Cote d'Ivoire, Democratic Republic of Congo, Ethiopia, Gabon, Ghana, Liberia, Nigeria, Uganda	Cambodia, India, Indonesia, Lao PDR, Malaysia, Papua New Guinea, Philippines, Solomon Islands, Suriname, Thailand, Vietnam	Brazil, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru	N/A
SatSure	Ghana, Cote d'Ivoire, Nigeria	India, Indonesia, Mongolia, Myanmar, Philippines	Brazil, Jamaica	Russia
YAPU Smart finance. People first.	Benin, Burkina Faso, Rwanda, Senegal	N/A	Bolivia, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Panama, Peru	N/A

This table indicates where providers have a track record of operations, however all providers are able to scale their solutions to other countries in respective regions:

Climate Risk Intelligence Providers
6th Grain
Accuweather for Business: ClimateReady Risk Mitigation
Acin
ADAPTA
AgCurate
AgroClimatica
Agryo
Cervest
Climate X
ClimateAi
Gro Intelligence
Hummingbird Technologies
ImpactTerra
Jupiter Intelligence
Mantle Labs
Numer8
Planet
Planetrics (part of McKinsey Sustainability)
Rezatech
Satelligence
SatSure
Syecomp
The Climate Service (acquired by S&P)
Weather Impact
YAPU

Financial Analytics Companies

- Aladdin Climate (BlackRock)
- Dow Jones
- FarmDrive
- IHS Markit
- ISS ESG
- Moody's
- MSCI
- Praedictus Climate Solutions
- Rabobank

InsurTechs

- ACRE Africa
- Blue Marble
- Descartes
- OKO
- PlanetWatchers
- Pula

Public Good Initiatives

- InsuResilience Global Partnership
- World Bank Group Agriculture Observatory

Supply Chain Management Solutions

- Agritask
- CropIn
- FarmERP
- Koltiva
- SCOPEinsight
- Village Link

Other Providers (did not meet initial screening criteria)
Acceso - Extensio
AgriMedia
Astral Aerial
Auraia
Bloomberg ESG Solutions
Climate Data Factory
Climate Risk Engine
Climformatics
ClimINVEST
Copernicus Climate Change Service (E3CS)
CropSafe
CropWatch
Deep Planet
Demex
Descartes Labs
ExoLabs
FarmForce
Fasal
ICE Data Services
Kenya Agriculture Observatory Platform (KAOP)
Lentera Africa
OS-Climate platform
Our Kettle
Oxford Earth Observation
Reask
Risilience
riskthinking.AI
S&P Global Climate Credit Analytics
Terrafuse AI
ThirdEye
Tomorrow.io
Traive
TrueWorld
Urgentem
WeatherForce
World Food Program's Vulnerability Analysis and Mapping (VAM)

Acknowledgments

Contacts

Margarete O. Biallas
Agri-finance Practice Lead, Africa
mbiallas@ifc.org

Alan Johnson
Lead, Smallholder Supply Chains
ajohnson6@ifc.org