

A close-up photograph of a young Black woman wearing a wide-brimmed straw hat and a light-colored, textured shirt. She is looking down with a focused expression. The background is blurred, showing green foliage.

Driving smallholder farmer resilience: How the inclusive insurance ecosystem is leveraging agritech for change

A practical guide for identifying opportunities for using technology in agricultural insurance, its successful implementation and operation

By Microinsurance Network's Building the Resilience of Smallholder Farmers Best Practice Group

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Acknowledgements

For those with the mandate to build sustainable, tech-driven resilience products but find themselves paralysed by the complexity of vendor evaluations, internal pushback, or the daunting task of scaling, or find yourself restricted by the task of engineering a commercially viable product that balances meaningful coverage with affordable premiums, this guide serves as a supportive resource. It aims to demystify the technology, break down complex concepts into accessible terms, and empower practitioners to ask the right operational questions. Above all, it serves as a roadmap to navigate the ecosystem, proving that with the right mindset, sustainable agricultural insurance is not just possible—it is already happening.

To give practitioners immediate access to an actionable roadmap, Chapter 2 presents our Step-by-step implementation playbook. The chapters that follow it are designed as specialised Deep-Dive Toolkits and you will be directed to these toolkits as you cross specific decision gates within the playbook

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About the Building the Resilience of Smallholder Farmers Best Practice Group

MiN’s Best Practice Group (BPG) on Building the Resilience of Smallholder Farmers brings together the Microinsurance Network members, providing a platform for discussing key issues and challenges, sharing good practices, and exploring initiatives that address the risks faced by smallholder farmers and strengthen their resilience.



1. Scaling resilience: The technology and necessary mindset shift

Structural flaws - not tech failures - keep good initiatives trapped in “pilotitis”

The inclusive agricultural insurance sector is at a critical juncture. For years, the potential of Agritech to close the protection gap has been widely recognised across the industry. Yet, the ecosystem frequently finds itself stuck in a cycle of “pilotitis”—launching small-scale, heavily subsidised projects that generate valuable PR but rarely survive the transition to commercial reality.

These pilots often fail, not because the underlying idea is fundamentally flawed, but due to structural “Volatility Intolerance”, because insurance fundamentally requires a large risk pool to function. However, when an early payout occurs in a small pilot, capital providers often react by raising rates or exiting the market entirely. This creates a “death spiral” that destroys the product before it ever reaches the scale and stability required by the Law of Large Numbers.

As insights from market experts emphasise — such as UC Davis Associate Director of the Resilience & Innovation Facility, Tara Chiu’s core principle that a quality insurance product must guarantee the farmer’s risk-adjusted income is greater with insurance than without it—the market must evolve. We can no longer afford to push poorly designed products just for the sake of having an insurance offering. There is an urgent need for high-quality, thoughtfully designed products that respond accurately to the farmer’s reality.

Technology is uniquely positioned to help achieve this. However, while the sector has spent years demanding one new technological innovation after another, the truth is that the technology required to drive meaningful change and increase smallholder resilience is already available today. The real challenge—and the true barrier to scale—lies somewhere else entirely.



The agritech toolset is mature; The true barrier is the traditional insurance mindset

To break this cycle, a fundamental realisation must guide our strategy: the inclusive insurance industry does not face a lack of technology. The “Toolset”—comprising high-resolution satellites, automated weather stations, mobile payment rails, and digital onboarding platforms among others—is largely available, mature, and readily provided by specialised InsurTechs.

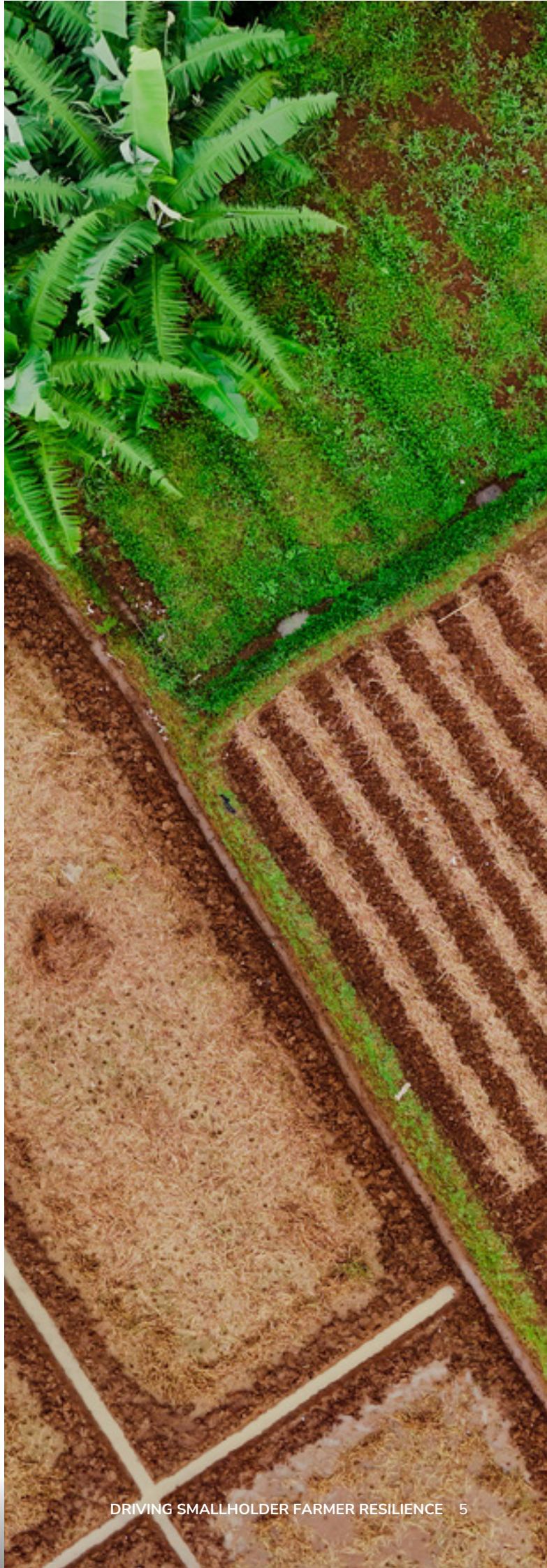
The real friction preventing scale lies in the “mindset” and the “skillset”

Historically, traditional insurance models have relied on a profound sense of control, utilising human loss adjusters to assess claims and negotiate payouts. Shifting to automated, parametric algorithms forces insurers to cede this power to a pre-set digital trigger. This “Loss of Control” is not merely a technical hurdle; it is a formidable psychological and cultural barrier.

As operators on the ground like Natalia Lopez Uris from Rio Uruguay Seguros’ department of Regulatory Strategy & Corporate Affairs highlight, overcoming this barrier requires managing expectations. Aligning the cautious, data-heavy mindset of traditional insurance companies with the agile, rapid-deployment expectations of technology providers takes significant time, transparency, and deep collaboration among all stakeholders. We must move beyond “technology for technology’s sake”. Success now depends entirely on how traditional insurers and aggregators utilise these tools to shorten the value chain, optimise product design, and finally bridge the gap between Demand and Supply.

Empowering innovators to bypass vendor hype and execute sustainable agritech

This report is designed to be a practical manual for implementation. It is written specifically for the champions of innovation within the inclusive insurance ecosystem—the practitioners, underwriters, product designers, and aggregators who are ready to move beyond high-level generalisations.



2. The implementation playbook: A step-by-step guide

Execution is not just what happens after the planning phase; it is the continuous integration of evaluating technology, managing internal stakeholders, and aligning external partners. The following playbook distills the operational experiences, tech-stack inventories, and real-world failures of the MiN ecosystem into a practical launch methodology. As you navigate the 9 steps below, use the cross-references to pull directly from the specialised Deep-Dive Toolkits (Chapters 3 through 7) to address your technical and structural needs.

Step 1: Define the problem (the “ground truth” mandate)

Innovation must be demand-driven, not technology-pushed. Before evaluating any software, the initiative must be anchored in a clearly defined, localised problem.

- **Establish the “ground truth”:** Building generic “weather insurance” in a boardroom often leads to misalignment with ground realities. As operational surveys confirm, successful project origin stories begin with Farmer Focus Groups and interviews. What specific event is destroying livelihoods? Is it a lack of rainfall precisely between days 1 and 10 after planting, or is it extreme heat stress? Defining this exact parameter dictates what technology is actually needed.
- **Establish the strategic goal:** Is your goal to de-risk a microfinance loan portfolio, or to provide direct cash assistance to farmers during a drought? Defining the initiative’s ultimate objective provides the critical lens through which you will evaluate all subsequent technology partners.



Step 2: Empower an internal champion & control information flow

Once the problem is defined, securing the internal baseline becomes a critical next step. Innovation often struggles when internal departments are blindsided or operate in silos.

- **Appoint the internal champion:** As demonstrated by the operational realities of market leaders like Río Uruguay Seguros, you cannot launch a tech-driven product by committee. Appointing a dedicated “Internal Champion” helps steer the project through internal bureaucracies. This individual must translate the technology’s capabilities into terms that satisfy the Legal, IT, and Underwriting departments, preparing them for the shift from indemnity to parametric models.

- **Manage the information flow:** The internal champion must become the central hub for information exchange. The most frequent cause of regulatory friction is a disconnect between the data the tech provider uses and the evidence the local regulator demands. The champion ensures that the methodology built by the tech partner is seamlessly and transparently communicated to the reinsurer (who takes the risk) and the regulator (who grants the approval).

For concrete strategies on managing internal actuarial, legal, and IT pushback, see the Deep-dive toolkit in **Chapter 6**.

Step 3: Evaluate the tech inventory & the “build vs. buy” dilemma

With the champion in place, the focus can then shift to evaluating the technology. Apply the 6 / 29

“No-nonsense” checklist from Chapter 5 to analyse the exact tech inventory being offered and make a fundamental structural decision regarding authorship and ownership.

- **Assess the tech stack inventory:** Operational surveys indicate that a standard, robust tech deployment stack today involves Public/Medium Resolution Satellite Imagery (e.g., Sentinel), Digital Onboarding Tools, and In-field Automated Weather Stations (AWS). Identify exactly what the vendor offers and ensure it maps to the peril defined in Step 1.
- **Verify data consistency and event correlation:** While some traditional risk carriers mandate that historical data sources perfectly match operational data sources, advanced practitioners (like Luxelare) prove that it is possible to back-test on one satellite’s historical data and operate the live policy on another, provided there is rigorous calibration. The true test of consistency is not just using the same satellite, but ensuring that the historical data model perfectly correlates with actual, remembered loss events on the ground to accurately calibrate the live operational trigger.
- **The authorship decision (in-house vs. external):** Will you build the actuarial model and risk engine in-house (retaining full technical control but requiring immense internal R&D investment), or will you outsource it to an InsurTech?
- **Define ownership and IP:** If you outsource, contractually define who owns the product and the customer data early on. Does the tech provider operate as a Vendor (selling a white-label “Operations Layer” where the Insurer retains product ownership), or do they operate as a Managing General Agent (MGA) retaining ownership of the design and the data?

See Chapter 3 for the complete Tech inventory map across the four lifecycle phases.

Step 4: Align external stakeholders and co-create

With internal teams aligned and tech partners selected, integrating the end-user and external partners into the design process is the next key step.

- **The co-creation mandate:** Bring skeptical farmers into the product development phase immediately. Involving farmers during the design phase serves not only as product validation but also as an effective trust-building and educational mechanism, which can significantly improve future adoption. Use their ground-level insights to shape the triggers, and use the process to educate them on how the technology works.

For details on aligning incentives across end-users, risk carriers, aggregators, and governments, see Chapter 6.2.



Step 5: Design for quality (what makes a “good” product?)

Unfortunately, there are many parametric insurance products in the market that are simply not good. A flawed product harms the farmer through “false positives” (which artificially raise premiums) and “false negatives” (where a farmer suffers a devastating loss but receives no payout, destroying trust).

As defined by researchers at UC Davis, practitioners must commit to building a **Quality Index Insurance** product. The core mathematical mandate is simple: *the farmer’s risk-adjusted income with the insurance must be greater than their income without it*. To achieve this quality standard, design must be rooted in rigorous analytics and realistic timelines:

- **Confront the expectation gap:** As highlighted by survey respondents, the biggest expectation gap in product development is the illusion of “plug-and-play” tech solutions. Quality technical precision cannot be rushed. Practitioners should budget for a 6-to-12-month R&D phase to adapt products to local regulatory and data realities.
- **Shift to hybrid trigger compositions:** Purely digital triggers are increasingly insufficient. To combat basis risk (false negatives), survey data shows a strong shift toward Hybrid models—combining a Tech Trigger (Weather + Satellite) with Field Verification (“Ground Truthing”).

Step 6: Bridge the mindset and skillset gap

Technology alone will not force adoption if the people operating it do not understand it. Actively training stakeholders helps bridge the gap between traditional insurance and Agritech.

- **Internal capacity building:** Organisations must invest in cross-training. Traditional underwriters must be trained to read and understand satellite NDVI data, while InsurTech data scientists must be educated on the strict regulatory constraints of insurance compliance.
- **Shift to proactive resilience:** The mindset must shift from “selling a payout” to “providing a resilience service.” The product is most valuable when it uses technology (like SMS early warnings or Augmented Reality advisory) to help the farmer prevent a total loss in the first place.

For a deeper look at the foundational mindset shift required to cede control to algorithms, see **Chapter 1**. For strategies on building cross-disciplinary teams that combine satellite data with behavioral economics, see the infrastructure conclusion in **Chapter 10**.

- **Overcoming data scarcity:** When experiencing a lack of reliable historical yield data, do not rely solely on anecdote. Triangulate: utilise crop simulation models (e.g., DSSAT) to create synthetic data, leverage secondary Earth Observation metrics, and partner with specialised local meteorological institutions to validate the models.
- **The absolute necessity of back-testing:** Before a product ever goes to market, the trigger must be rigorously back-tested. Use modern policy management platforms (like IBISA’s RING) to run proposed triggers against 15-20 years of historical data. If the back-test doesn’t calculate a payout for an actual historical disaster year that the farmers remember, the product fails the quality test and must be redesigned.

To evaluate the precise pros and cons of Sentinel, Landsat, CHIRPS, or commercial weather APIs for your design, consult the Agritech matrix in **Chapter 11**.



Step 7: Design for the “patience gap” (proving operational value)

Commercial capital providers and donor funds operate on strict time horizons. The fundamental problem with parametric pilots is they often lack the time to be tested against statistically rare, catastrophic events before funding dries up. Designing the pilot to prove operational value even if a major weather event does not occur in Year 1 is crucial for maintaining stakeholder support.

- **Focus on process metrics:** Survey respondents explicitly target specific operational objectives to prove efficiency when weather events don’t trigger. You can demonstrate immense value to capital providers through these exact metrics: dramatically reducing the administrative cost per policy (Cost Ratio), improving risk pricing accuracy (Loss Ratio), and radically shrinking the turnaround time between the event and the payout. High farmer engagement rates with digital onboarding and advisory platforms also serve as critical proof points for scalability.

To benchmark your operational efficiency objectives, see the process metrics breakdown in **Chapter 4.2**.

Step 8: Learn from the “Graveyard” (what NOT to do)

The BPG network has openly shared its failures. Before launching, cross-check your strategy against these common pitfalls:

- **Graveyard lesson 1:** Technology for the sake of Technology. Technology should never be deployed simply because it is technologically possible. A project attempting to fully automate policy issuance via a WhatsApp bot failed because it bypassed the necessary human distribution bridge. Always identify the best technological solution to solve a specific problem, keeping the farmer’s reality at the center.
- **Graveyard lesson 2:** Ignoring Basis Risk for the Sake of Scale. Operational surveys show that relying on cheap, low-resolution gridded data in complex topographies (like Fiji) is a fatal error. Do not select a technological tool just because it allows you to scale faster or cheaper if the basis risk becomes so high that the product fails its core mandate. Invest in the right resolution and ground-truthing required for your specific geography.
- **Graveyard lesson 3:** Relying on Anecdote over Analytics. Designing a trigger based entirely on what farmers remember happening, without running that memory against rigorous historical data analytics, almost always results in flawed product designs. Co-creation is essential, but it must be mathematically validated.

These warnings are grounded in real project failures reported across the ecosystem. To review the candid survey data regarding the ‘Plug-and-Play’ myth and how low-resolution data fails in complex topographies, see the Operational Realities in **Chapter 4.3**.



Step 9: Continuous iteration and transparency

A parametric product is never “finished.” As climate patterns shift and new data becomes available, the product must evolve.

- **Post-season reviews:** At the end of every season, gather the stakeholders—especially the farmers and the local aggregators—to review the trigger’s performance. Did it rain on the farm but not at the weather station? Did the satellite NDVI reading and weather data correlate with the actual crop yield? Use this feedback loop to refine the algorithm and improve the product quality for the following year.

Managing this ongoing iteration requires a tech partner committed to the long haul, rather than someone who just hands over an API key – see **Chapter 5 (Point 5)** for evaluating a vendor’s long-term commitment. To see how a ‘slow and steady’ approach to technical validation creates a permanent operational framework, read **Case Study 3**.

3. The tech inventory map: deploying solutions across the entire insurance lifecycle

For a project champion who has secured the mandate to innovate, the immediate question is: “I want to launch a resilience product, but what technology is actually available, how can it be used to support the farmer, and where exactly does it fit into the process?”

Technology is not a single software package. It is a sequence of specialised tools deployed across the agricultural insurance lifecycle. Crucially, modern technology must not be viewed merely as a financial risk engine; it holds massive potential for **educating farmers, providing ongoing technical support, and introducing scalable digital extension programs**. At its core, technology acts as a conversational enabler rather than a replacement for human relationships—it serves as the operational infrastructure that empowers trusted local networks on the ground. Understanding this map is the essential prerequisite for evaluating vendors, as it allows identification of operational gaps needing technological support.

Phase 1: Building trust and accuracy (pre-launch)

- **The tech available:** AI-Driven Risk Assessment Platforms and Simulation Viewers (e.g., ACRE’s TARA, IBISA’s RING).
- **How it is used:** Before a single policy is sold, historical climate data and crop requirements are ingested to generate location-specific climate risk scores. Simulation tools are then used to “back-test” proposed parametric triggers against 15-20 years of historical Earth Observation (EO) data.
- **The resilience impact:** Ensures the product is mathematically viable and priced accurately. Furthermore, showing a farmer a visual simulation of how the policy would have paid out during a historical drought they personally remember is the most effective way to build initial trust.

Phase 2: Distribution & onboarding (the “phygital” bridge)

- **The tech available:** Digital Wallets, Mobile Banking (USSD/SMS), and Agent Operations Platforms.
- **How it is used:** This phase relies on a “Phygital” (Physical + Digital) approach. Human “Village Champions” or cooperative leaders use smartphones to digitally onboard farmers, capture farm GPS coordinates, and verify crop health with photos. Premiums are collected seamlessly via mobile money or embedded directly into seed/input loans.
- **The resilience impact:** Drops the Customer Acquisition Cost (CAC) to near-zero and allows policies to be issued in seconds. Here, technology serves as an operational enabler rather than a replacement for the trusted human agent; it arms field staff with the digital efficiency required to make micro-premiums economically viable for the insurer.



Phase 3: Active monitoring & digital extension programs (in-season)

- **The tech available:** Earth Observation (EO) Satellites (e.g. measuring NDVI vegetation health, soil moisture, precipitation, floods, wind speed, track of cyclones, extreme temperatures, solar irradiance), In-Field Automated Weather Stations (AWS), and Augmented Reality / SMS Extension Platforms.
- **How it is used:** Satellites and AWS monitor the crop dynamically throughout the season. Simultaneously, the platform functions as a **digital extension program**, pushing actionable technical support directly to the farmer's phone— such as SMS early warnings to harvest before an impending frost, or Augmented Reality-based pest management tutorials.
- **The resilience impact:** This provides continuous technical support, representing a massive shift from Reaction to Prevention. The technology acts as a scaling enabler, equipping the provider to deliver the localised agronomic education needed to avoid a total crop failure in the first place, transforming the insurance from a passive financial safety net into a proactive resilience service.

Phase 4: Claims processing & post-season education (post-event)

- **The tech available:** Hyper-Localised Algorithmic Risk Engines (Smart Contracts) and Generative AI Voice Assistants.
- **How it is used:** When highly specific, pre-agreed weather parameters are met (e.g., less than 10mm of accumulated rain between days 1 and 10 after planting, as utilised by Luxelare's CAPTUM), the risk engine triggers the payout automatically. Generative AI is then deployed via WhatsApp voice notes in local dialects to explain the payout calculation to the farmer.
- **The resilience impact:** Eliminates the need for slow, expensive human loss adjusters, cutting settlement times from months to hours while simultaneously removing the risks of subjective human influence or bias. In this final stage, automation and GenAI function as administrative and communication enablers—breaking down literacy and technical jargon barriers to provide personalised financial education that reinforces trust and guarantees renewal for the next season.

How this inventory improves vendor evaluation

Mapping the technology to these four phases fundamentally changes how you evaluate potential tech partners. When evaluating a vendor, the focus can shift beyond solely the accuracy of their satellite data. Helpful questions to consider include: *Does your platform include digital extension capabilities? Can it deliver continuous technical support to the farmer? How does your tool educate the policyholder before, during, and after a crisis?* If a tech partner only offers a risk calculation but leaves the farmer without agronomic support or education, they are providing an incomplete solution.



4. Operational realities: scaling requires value chain integration and friction reduction

To ground this manual in reality, the Microinsurance Network (MiN) conducted a comprehensive “Mindset vs. Toolset” Operational Survey among its members. The results offer a transparent look into the actual motivations, experiences, and friction points of organisations currently deploying Agritech. By examining these collective experiences, practitioners can benchmark their own initiatives and anticipate common hurdles before they arise.

4.1 Standalone policies struggle; integration into existing value chains drives adoption

The survey reveals that the drive to innovate rarely stems from a generic desire to “sell more insurance.” Instead, initiatives are typically born from specific ecosystem pressures:

- **Value chain bundling:** Many successful initiatives are “Vendor Initiated” — specifically by financial institutions, seed companies, or off-takers who need to de-risk their own credit portfolios or supply chains. They use insurance not as a standalone product, but as a protective wrapper for their primary business.
- **Donor and NGO initiation:** A significant portion of projects are catalysed by development agencies looking to build resilience infrastructure and pilot new approaches.
- **Direct-to-market hurdles:** Standalone, direct-to-farmer sales were overwhelmingly reported as the hardest path to scale due to trust barriers and acquisition costs.

Self-evaluation guidance

Before launching, it is helpful to consider: Are we pushing a product just because funding is available, or are we solving a structural problem in an existing value chain? Aligning the insurance with a transaction the farmer is already making is the most reliable path to adoption.



4.2 Process metrics define success: cutting costs, speeding payouts, and retaining farmers

When asked what defines a successful tech deployment, members did not just point to “number of farmers insured.” They highlighted rigorous operational metrics to prove efficiency:

- **Slashing turnaround times:** Reducing the time between a climate event and the actual payout from months to mere days or hours.
- **Administrative cost ratios:** Driving down the operational expense per policy to make micro-premiums economically viable.
- **Retention over acquisition:** Using technology (like digital advisory and transparent payouts) to increase the percentage of farmers who renew, rather than constantly battling the high cost of acquiring new ones.

Self-evaluation guidance

Pilots can be evaluated not solely by whether a weather event triggered a payout in Year 1, but rather by whether the technology successfully lowered your operational friction and improved turnaround times.

4.3 Expectation gaps: customisation needs and high acquisition costs block immediate scale

The survey respondents were remarkably candid about the failures and friction points they experienced during implementation:

- **The “plug-and-play” myth:** The most frequently cited expectation gap is the illusion that tech solutions can be deployed instantly. In practice, practitioners report that parametric products require significant adaptation to local regulatory frameworks, data realities, and distribution networks, which severely limits immediate scalability.
- **The “Graveyard” of high basis risk:** Several members shared stories of abandoned projects (the “Graveyard”), specifically noting that utilising cheap, low-resolution gridded data in complex topographies (like island nations or mountainous regions) led to unacceptable basis risk and, ultimately, product failure.
- **The scale barrier:** The two most universal obstacles preventing products from scaling are (1) Customer Acquisition Costs (CAC) being too high to reach farmers digitally without physical networks, and (2) the risk pool remaining too small to secure affordable reinsurance.



Self-evaluation guidance

Anticipating a 6-to-12-month R&D and adaptation phase is highly recommended. Sacrificing data resolution just to save money on the tech fee can lead to data blind spots, and leveraging existing human distribution networks remains essential for scaling.

5. Vendor evaluation: buy a strategic partnership, not just off-the-shelf solution

Once you understand the tech inventory and the operational realities of the sector, you are prepared for vendor evaluation. Selecting a technology provider is not a standard procurement exercise; you are not just buying software. You are selecting a strategic partner whose data and infrastructure will power your entire lifecycle. When evaluating a tech provider, it is highly beneficial to seek concrete answers to the following operational constraints:

1. The vendor must co-create the Solution Around Your Specific Local Problem: The project initiator must start with a clear, localised objective (e.g., “We need to protect dairy farmers from heat stress”). The tech partner’s role is to act as a guide to develop this specific solution, not simply sell a pre-packaged index off the shelf. If the vendor does not collaborate to co-design the product around your specific operational goals and farmer realities, they are the wrong partner.

2. Triggers must be rooted in validated historical data, not guesswork or anecdote: The biggest threat to parametric insurance is poor historical data. As experts emphasise, official historical yield data is often wildly inaccurate or artificially inflated. If a vendor is building a trigger, exactly what data are they correlating it against? Relying on anecdotal farmer input rather than rigorous historical analytics leads to flawed triggers and complete product redesigns.

3. Require local data validation to unblock compliance and secure regulatory approval: InsurTechs often promise rapid deployment in 48 hours. However, as traditional risk carriers and operators point out, technical precision cannot be rushed. A true tech partner actively assists in validating climate data with specialised, local meteorological institutions. Without this rigorous local validation, securing approval from regulatory bodies (e.g., Ministries of Agriculture or Insurance Commissions) is nearly impossible.

4. Choose an adaptable “operations layer” over a rigid single-peril product: Is the vendor trying to sell you a rigid, single-peril product, or are they offering an adaptable “Operations Layer”? You need a platform that can manage multi-peril policies, handle digital onboarding, and ingest various data sources (satellites, automated weather stations, or yield estimates) across all four phases of the lifecycle without requiring you to change vendors every time you enter a new region.

5. Demand “skin in the game” and a long-term commitment to survive the patience gap: Building a viable product takes time and iterations. Does the vendor understand the “Patience Gap” of the industry? You need a partner willing to commit to the pilot-to-scale journey, providing ongoing operational support, trigger refinement, and platform maintenance, rather than just handing over an API key and walking away.



6. Overcoming stakeholder friction: alignment is as critical as the technology itself

Innovation does not happen in a vacuum. The most sophisticated technology will fail if it cannot survive the internal bureaucracy of an insurance company or align with the commercial realities of an agricultural aggregator. Implementing Agritech requires managing two distinct fronts: the “Internal Battlefield” within your own organisation, and the “External Ecosystem” of partners.

6.1 Internal battlefield: champions must proactively manage actuarial, legal, and IT pushback

- **Actuarial & underwriting (the trust deficit):** Transitioning to parametric products means ceding control to an algorithm, which triggers intense “Loss of Control” anxiety for traditional actuaries.
 - *The strategy:* Rather than expecting blind trust in a new InsurTech’s model, market operators highlight that bridging this gap through rigorous back-testing is highly recommended.. Use platforms to visually demonstrate to underwriters how the trigger would have reacted during historical catastrophic years. Transparency in data correlation is the only way to replace human loss adjusters with algorithmic confidence.
- **Legal & compliance (the regulatory hurdle):** Compliance teams will immediately flag that parametric triggers often fall outside the legal definition of traditional indemnity insurance, and are heavily scrutinised by regulators.
 - *The strategy:* Treat regulatory bodies (like Ministries of Agriculture or Insurance Commissions) as early technical partners, not just final gatekeepers. Early regulatory engagement not only facilitates approvals but also helps build technical understanding, align expectations, and reduce the likelihood of costly product redesigns later in the process. Furthermore, successful implementation often depends on maintaining technical consistency and continuous alignment among insurers, reinsurers, and regulators, particularly when introducing innovative products in highly regulated markets. Operational experience shows that benchmarking the satellite data against local ground realities, often by collaborating with local agricultural or meteorological institutions, is the key to removing the ‘black box’ stigma, unblocking compliance, and securing regulatory approval, where required.
- **IT & systems (the integration fear):** Legacy core systems are notoriously rigid. Proposing a new tech-driven product will often be blocked by IT departments fearing a massive, multi-year API integration project.
 - *The strategy:* Utilise “Operations Layers” provided by modern tech enablers. These platforms can function in parallel to legacy systems, handling digital onboarding, trigger monitoring, and claims calculation entirely in the cloud, requiring only a simple data export to the core system for final financial reconciliation.



6.2 Aligning external incentives: co-creation, bundling, and PPPs are mandatory for scale

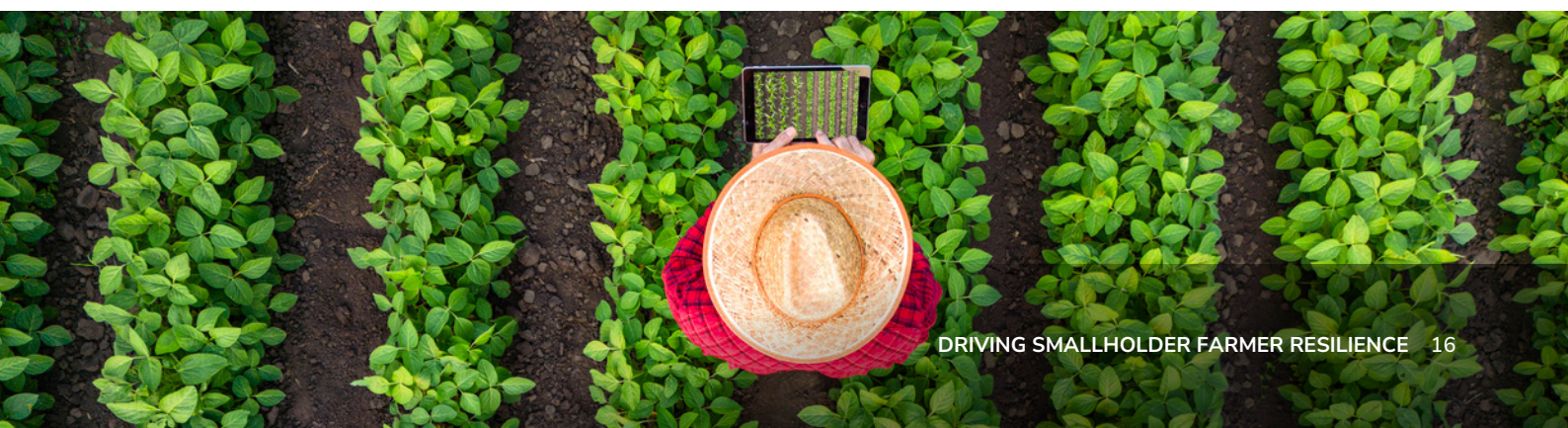
Scaling a product requires bringing together entities with fundamentally different motivations. Speaking the language of each stakeholder helps to effectively align their incentives.

- **The end-user (the skeptical farmer):** They are the ultimate beneficiaries but often the biggest skeptics due to a history of broken promises, complex jargon, and invisible financial products.
 - *The alignment (the co-creation mandate):* The most sophisticated satellite data is useless if the end-user fundamentally distrusts the product. Operational experience—such as field insights from Río Uruguay Seguros—demonstrates that integrating farmers into product development from day one is essential. Involving them directly in the initial design process grounds the index in local reality and uncovers invaluable, ground-level insights into their specific operational risks.

Furthermore, this active participation serves as a powerful educational mechanism. Crucially, it fulfills a foundational requirement for the technology to be successful: farmers must have absolute clarity on how the technology works. By understanding exactly how the parameters function and how triggers are calculated, farmers transition from skeptics to informed advocates. This transparency transforms doubt into ownership, creating the ideal window to introduce proactive risk prevention strategies. This works symmetrically: the farmer learns to adapt to changing climate variations, while the risk carrier reduces its exposure to constant claims payouts.

- **The risk carriers (insurers & reinsurers):** They hold the balance sheet and are primarily driven by Volatility Intolerance and the “Patience Gap.” However, the operational survey revealed a critical insight: the myth of needing a massive minimum premium on Day 1 is often wrong. Most reinsurers are actually willing to get something running—even starting small—if they see a credible path to growth. They want rapid premium volume eventually, but understand immediate profitability is rarely possible in Year 1 of a smallholder program.

- *The alignment:* Moving away from pitching isolated pilots and instead presenting a mathematical path to the Law of Large Numbers is often more effective. Structure the rollout to absorb initial volatility (accepting a higher loss ratio early on) but demonstrate a clear scaling mechanism—such as bundling the insurance with a mandatory credit line. Technology automates this bundling: integrated APIs link the policy directly to the loan issuance, executing enrollment and premium deductions in real time to eliminate operational friction. This ensures a sustainable, growing risk pool within 24 to 36 months.
- **Aggregators & NGOs (the demand side):** These entities—cooperatives, input providers, and microfinance institutions—own the “Last Mile.” However, their primary hurdles are exorbitant customer acquisition costs and the challenge of explaining invisible financial products to skeptical farmers.
 - *The alignment:* Rather than asking them to sell a standalone insurance policy, integrating the insurance directly into their existing operations yields better results. A prime example is the success of dairy heat index products in India, which achieved massive scale by utilising existing milk unions as the distribution channel. Furthermore, use platforms like ACRE’s TARA to help these aggregators de-risk their own loan portfolios, turning the insurance from a difficult sell into a core business enabler.
- **Governments & the public sector (the market makers):** Achieving true national scale without public sector involvement is exceptionally rare. As evidenced by frameworks like IFAD’s INSURED initiative and the Kenya Agriculture Insurance Program (KAIP), the government’s role is foundational.
 - *The alignment:* Leverage Public-Private Partnerships (PPPs). Governments should not be viewed merely as regulators, but as active participants who can provide reliable localised data, fund smart premium subsidies to overcome affordability barriers, and integrate insurance into long-term national agricultural development plans.



7. Scale Mandate: Designing for Massive Volume from Day One

A fundamentally sound insurance product cannot survive without scale. The fundamental law of insurance—the Law of Large Numbers—dictates that the larger the risk pool, the more predictable the losses. Operational surveys across the inclusive insurance ecosystem consistently identify two primary fatal flaws in new programs: the risk pool is too small to secure affordable reinsurance, and the Customer Acquisition Cost (CAC) is too high to be sustainable.

To transition from a subsidised pilot to a commercial reality, practitioners must architect their products for massive scale from Day One.

7.1 Direct-to-farmer sales fail; scale demands mandatory, seamless aggregation

Attempting to sell microinsurance “one-by-one” using traditional sales forces is mathematically doomed in the smallholder context. The operational costs of acquiring an individual farmer will almost always exceed the lifetime value of the premium they pay.

Escaping this “Pilot Gap” requires mandatory, seamless aggregation. Practitioners must shift their focus from direct-to-farmer sales towards B2B2C (Business-to-Business-to-Consumer) models.

- **Value chain bundling:** Insurance must be embedded into transactions the farmer is already making. Whether bundled with a loan from a microfinance institution, tied to a bag of drought-resistant seeds, or integrated into contract farming agreements where buyers pre-finance the premium, bundling instantly aggregates thousands of farmers into a single risk pool while driving CAC down to near-zero.
- **National schemes:** As noted by several survey respondents, attempting to reach the required volume purely through private commercial channels is often impossible. The fastest route to the Law of Large Numbers requires tapping into national schemes and cooperatives.



7.2 Smart subsidies: funding must shift from artificial price drops to permanent data systems

The elephant in the room of inclusive insurance is the reliance on donor and government subsidies. While subsidies are frequently necessary to launch a product, poorly designed subsidies create artificial markets. If a program collapses the day the donor funding ends, it has hit the “Subsidy Cliff.”

To build resilience, the ecosystem must transition to “Smart Subsidies”:

- **Subsidising the setup, not just the premium:** Instead of using 100% of donor funds to artificially lower the premium for a small cohort, funds should be directed toward building the permanent public goods that lower costs for everyone. As the IFAD INSURED framework highlights, investing in data systems (e.g., funding public automated weather stations, conducting baseline feasibility studies) creates lasting infrastructure that attracts private sector insurers long after the initial project ends.
- **Adaptive premium support:** Operational surveys reveal that premium subsidies are highly valuable during the pilot phase to address immediate affordability constraints and facilitate essential data validation. However, these must be adaptive. The subsidy should be designed on a sliding scale—decreasing year-over-year as the product proves its value, operational efficiencies kick in, and the farmer experiences the tangible benefits of the payout or the agronomic advisory services. Ultimately, this resulting economic stability will also lead to the natural growth of the insurance portfolio.

7.3 Leverage public-private partnerships to secure data, trust, and scale

Achieving sustainable scale is rarely a purely private endeavor. Governments are the ultimate market makers. As demonstrated by the Kenya Agriculture Insurance Program (KAIP) and highlighted by major insurers, the public sector’s role goes far beyond regulation.

To truly build for the Law of Large Numbers, practitioners must actively court Public-Private Partnerships (PPPs). In a successful PPP:

- **The private sector** brings operational efficiency, digital distribution platforms, claims processing agility, and reinsurance capacity.
- **The public sector** provides the enabling environment: they set policy frameworks, offer timely premium support to maintain farmer trust, provide reliable localised data from national meteorological departments, and legitimise the product through community-level awareness campaigns.

By embedding insurance directly into long-term national agricultural development plans, the sector stops running isolated experiments and begins building permanent financial infrastructure.



8. The limits of digital tech: uninsurable risks require physical adaptation first

The hard truth: financial risk transfer does not eliminate physical climate threats

While digital technology optimises the insurance value chain, there are fundamental limits to what financial tools alone can solve. Practitioners must recognise a hard truth: insurance is a mechanism for risk transfer, not risk elimination. If the underlying agricultural risk in a specific region is too severe or too frequent, the cost of transferring that risk (the premium) will simply be unaffordable for the smallholder farmer, regardless of how efficient the digital distribution or parametric algorithm might be.

Pairing digital solutions with physical “agro-tech” is the only path to affordability

In highly vulnerable zones, selling a reactive payout is less effective than investing in proactive risk prevention. To make insurance mathematically viable and practically affordable, the ecosystem must sometimes lower the baseline risk first by integrating physical “Agro-Tech” alongside digital tools.

- **Biological risk prevention:** Utilising advanced agricultural science — such as drought-tolerant seed varieties or short-cycle crops that mature before severe water stress hits—physically reduces the probability of a total crop failure .
- **Infrastructure investments:** Deploying physical interventions, such as micro-irrigation systems, water harvesting infrastructure, or protective netting, directly mitigates the impact of erratic climate events on the ground.
- **The resilience synergy:** By treating these physical inputs and infrastructure upgrades not merely as external farming supplies, but as integrated Loss Prevention measures, aggregators and insurers can fundamentally lower the risk profile. This synergistic approach transforms an uninsurable risk into a manageable one, making the accompanying digital insurance policy significantly cheaper and much more sustainable for all stakeholders.



9. The “How” of execution: creativity and craftsmanship

When practitioners ask how technology is applied to inclusive insurance, they often search for a universal, technical playbook—a literal instruction manual for deploying software. However, there is no fixed, plug-and-play script. To use an analogy: possessing a hammer and a nail does not make one a master carpenter. The technology (the “Toolset”) is readily available, but its successful application relies entirely on the operator’s “Mindset” and “Skillset.”

The true how of technology is rooted in creativity. It requires the ability to spot a specific localised risk, understand the operational reality of the farmer/insurer/supply chain, and creatively and with empathy architect a solution using the different technological tools available. It is about strategic business architecture: forming the right partnerships, navigating complex regulations, and transforming the product from a passive safety net into an active resilience tool.

The following case studies from the MiN Smallholder Farmer BPG ecosystem demonstrate this reality. They illustrate the “Before and After” of technological interventions, proving that when applied.

CASE STUDY 1: TRANSFORMING INSURANCE FROM A SUNK COST TO A DAILY ASSET

The operator: Luxelare (Agroblindaje), with GMX Seguros and Hannover Re - State of Mexico, Mexico (Ongoing Pilot)

- **Lifecycle impact (Chapter 2):** Phase 2 (Distribution & Onboarding), Phase 3 (Active Monitoring & Digital Extension), Phase 4 (Claims Processing).
- **Tech matrix applied (Chapter 11):** Adaptable Digital Platforms, Earth Observation (EO) Satellite Systems (NDVI), Commercial Weather APIs.

The gap (before): Previously, attempting to sell standalone, direct-to-farmer policies was economically unviable due to unsustainable Customer Acquisition Costs (CAC). Furthermore, traditional multi-peril insurance only interacted with the farmer when a disaster occurred, relying on subjective human adjusters, hidden deductibles, and slow payout timelines. For the farmer, paying a premium felt like a sunk cost with no daily operational benefit.

The technology (the tools): A multi-peril parametric system utilising a combination of hyper-localised satellite weather data, satellite indexes (such as NDVI), and dynamic triggers. Rather than using a static threshold for each plot, the triggers are calculated according to the specific risk and needs of the crop for each development stage (germination, vegetative growth, flowering, and harvesting) based on each field’s individual seeding date. For example, to accurately capture drought or excess rain events, the necessary rainfall triggers for this project are defined dynamically as percentages relative to 40-year historical weather data for that specific micro-climate.

The execution & distribution (the “How”): Luxelare solved the acquisition cost barrier by shifting to B2B2C embedded sales. For this ongoing pilot targeting up to 300 maize farmers, “Agroblindaje” is bundled directly at the point of sale through alliances with four local savings banks and agricultural input distributors. When a farmer takes out a loan or purchases a package of Hybrid Maize seed, the digital protection is seamlessly integrated. The distributor earns a direct commission (e.g., 20% on the membership fee), transforming the supply chain into a proactive, incentivised distribution engine. Furthermore, the technology is used to deliver “Captum Digital Extensionism” (CDE), pushing weekly weather forecasts and agronomic alerts directly to the farmer’s phone via WhatsApp.

The result (after): By moving away from direct sales to distributor bundling, Luxelare dramatically expanded its reach while driving acquisition costs to near-zero. By removing human adjusters, the system aims to process transparent indemnities in under 30 days without deductibles. Most crucially, through proactive digital extensionism, the insurance became an active, daily production tool rather than an invisible, passive contract.

CASE STUDY 2: LEVERAGING MUTUALITY AND ADVISORY TO DRIVE “PHYGITAL” SCALE

The operators: IBISA & DHAN Foundation (People Mutuals) - India

- **Lifecycle impact (Chapter 2):** Phase 1 (Product Design), Phase 2 (Distribution via the “Phygital” Bridge), Phase 4 (Claims Processing).
- **Tech matrix applied (Chapter 11):** Adaptable Digital Platforms, Grid-Based Datasets (ERA5).

The gap (before): Highly vulnerable demographics—such as rain-fed smallholders cultivating less than 1 hectare, widows, and families living below the poverty line—faced devastating climate shocks but remained completely uninsurable. Reaching them individually was economically impossible, and there was a deep-seated distrust of traditional financial institutions alongside a lack of financial literacy.

The technology (the tools): IBISA deployed an adaptable Policy Management Platform that serves as a single source to track enrolments, triggers, and payouts. For risk calculation, the system relies on satellite-based historical and live weather information (specifically the ERA5 dataset) to monitor widespread precipitation and temperature events, alongside digital onboarding tools for livestock.

The execution (the “How”): The product is live in the market (launched June 2022 and currently expanding into new states). Under a regulatory sandbox, the product is underwritten by Federation Mutuals (trusts owned by the farmers themselves) acting as the first risk-taker, with DHAN acting as the reinsurer. IBISA’s tech platform integrates directly with these mutuals. To adopt this technology, DHAN pays a technological service fee directly to the tech provider, ensuring no IT infrastructure costs are passed down to the farmer’s premium.

To bridge the trust gap, the technology was creatively embedded into existing Self-Help Groups (SHGs). Recognising that tech alone cannot build trust, the project established 100 physical Agri-advisory centers serving over 200,000 farmers to provide essential capacity building. They utilised the tech platform’s land data visualisation to show farmers historical data on triggers, and simplified the algorithms (e.g., using easily understandable “millimeters of precipitation” rather than complex vegetation indexes) to facilitate informed decision-making.

The result (after): By bypassing traditional acquisition methods and combining automated climate data with the trusted, low-cost distribution channels of SHGs, the project achieved massive scale. The transparent tech platform, combined with timely payout ceremonies, fundamentally changed the farmers’ perception of insurance, dramatically boosting their willingness to pay. The strategic use of premium support and transparent advisory resulted in a 28% uptake among highly vulnerable farmers in previously uncovered areas, with the initiative now targeting 555,000 beneficiaries across six states, proving that technology achieves maximum impact when it empowers existing community structures.

CASE STUDY 3: OVERCOMING THE REGULATORY AND MINDSET BARRIER

The operator: Río Uruguay Seguros (RUS) - Argentina

- **Lifecycle impact (Chapter 2):** Phase 1 (Product Design & Risk Assessment).
- **Tech matrix applied (Chapter 11):** Adaptable Digital Platforms, Historical Climate Datasets.

The gap (before): Small and medium rice producers were initially left completely unprotected from extreme temperatures (note: While the initial work focused on rice producers, this approach and product architecture are designed to be applicable to soy and other crops exposed to temperature variability). Traditional multi-peril insurance was too expensive, leaving only massive agro-industrial corporations able to afford coverage. Previous parametric pilots in the country had failed to gain traction or regulatory approval, leaving both farmers and the government frustrated by the lack of a modern safety net.

The technology (the tools): A specialised parametric algorithm built to trigger based on extreme temperature fluctuations (heat waves or frosts) during critical, short-window crop growth phases.

The execution (the “How”): Argentina possesses strict regulatory barriers; the Ministry of Agriculture demands a rigorous technical report detailing data sources, risk calculations, and historical parameterisation before the Superintendencia de Seguros will authorise a product. Recognising that regulators deeply distrusted “black box” algorithms, RUS did not simply buy an InsurTech API and push it to market. Instead, they orchestrated an internal mindset shift by creating a specialised internal cell containing agronomy, claims, institutional, and IT experts. To solve the lack of historical yield data, they partnered directly with the government and the National Institute of Agricultural Technology (INTA) to co-create the required historical baselines.

The result (after): Rather than rushing to launch an unverified product and failing compliance, RUS invested over two years in rigorous technical and regulatory collaboration. This highlights a crucial lesson from the field: speed should not always be considered the primary indicator of success. In highly regulated environments, extended preparation periods dedicated to technical validation, stakeholder engagement, and regulatory collaboration are actually a prerequisite for long-term scalability rather than a sign of implementation failure. By prioritising technical consistency and stakeholder alignment over speed, they successfully broke down the institutional barriers to algorithmic trust. This “slow and steady” craftsmanship created a legally sound, permanent operational framework for future parametric products in a highly traditional, heavily regulated market.

10. Conclusion: The toolset is mature; scaling resilience now demands a shift in mindset and skillset

As this manual demonstrates, the question is no longer whether Agritech can close the protection gap, but how practitioners choose to leverage it. The “Toolset”—from high-resolution Earth Observation satellites, which can measure crop health accurately, mobile platforms which can register farmers in seconds, automated systems which can process claims in hours to digital extension platforms and AI risk engines—is mature, available, and ready to be deployed across the entire agricultural lifecycle.

We also know this technology works. Initiatives from Microinsurance Network members prove that when applied correctly, these tools actively improve a farmer’s access to insurance and improve resilience. However, technology alone cannot drive change. To move from the trap of “pilotitis” to sustainable, commercial scale, the ecosystem must undergo a fundamental shift in “Mindset.”

Stop waiting for better tech and radically overhaul how the business serves the farmer now

Driving true smallholder farmer resilience requires risk carriers, tech providers, and aggregators to stop viewing Agritech as a plug-and-play silver bullet. Instead, they must deploy it as the operational infrastructure that empowers human networks. It requires internal champions brave enough to challenge legacy underwriting processes, strategic partnerships built on rigorous data validation, and, above all, a commitment to co-creating quality products alongside the skeptical farmer through a “Phygital” approach.



Cross-disciplinary collaboration is the only way to build effective infrastructure

Equally important is addressing the “Skillset” required to build these products. Creating effective, tech-driven agricultural insurance requires a combination of very different knowledge areas—ranging from satellite data analytics, local agronomy, behavioral economics and how everything works together on a digital infrastructure. Because it is nearly impossible for any single organisation to have all this expertise under one roof, collaboration is essential. Being part of a community like the Microinsurance Network’s (MiN) Smallholder Farmer Best Practice Group (BPG) offers practitioners a practical environment to exchange ideas, share real-world lessons, and fill the gaps in their own organisational skillsets.

Learn from experience to drive true smallholder resilience

The path forward is no longer about waiting for a new technological breakthrough. By learning from the proven experiences of the sector and focusing on the concrete needs of the end-user, practitioners can use technology to expand access, build better products, and drive lasting resilience for smallholder farmers.

11. Navigating the agritech matrix to choose the right operational tools

To effectively evaluate technology vendors (as outlined in Section 4), project champions must understand the raw materials those vendors use to build triggers. Below is a concrete guide to the most common satellite systems, historical weather datasets, and commercial APIs operating in the market today.

EARTH OBSERVATION (EO) SATELLITE SYSTEMS

System	Key characteristics	Common indexes produced	How it is used	Pros	Cons to understand
Sentinel-2	Optical satellite. 10m to 20m high resolution. Revisits the same location every 5 days.	NDVI (Vegetation Health), NDWI (Water Stress).	Monitoring crop health, estimating yields, detecting drought impacts.	Free public data, excellent resolution for smallholder plots.	It is optical, meaning it cannot “see” through heavy cloud cover.
SAR (e.g., Sentinel-1)	Synthetic Aperture Radar. Emits energy and measures the backscatter.	Soil Moisture, Flood Extent, Biomass estimation.	Tracking soil moisture levels and mapping flood perimeters.	“All-Weather” capability; it easily penetrates clouds and works at night.	Complex to process and requires specialised skillsets to interpret accurately.
Landsat	Optical satellite. 30m resolution. Revisits every 8 to 16 days. Operating since the 1970s.	NDVI, Thermal mapping.	Setting historical baselines and correlating past yields to weather events.	Unmatched historical archive, perfect for robust long-term back-testing.	Lower resolution than Sentinel-2 and slower revisit times.
Planet Labs	Commercial optical satellite network. Very high resolution (~3m). Daily revisit times.	High-definition NDVI and detailed crop phenology.	Micro-plot monitoring, field-level ground-truthing, and highly granular loss assessment.	Incredible daily frequency and detail.	High commercial SaaS fees; short historical archive limits long-term back-testing.

USE GRID-BASED DATASETS FOR LONG-TERM BACK-TESTING, BUT BEWARE OF LOCAL BASIS RISK

System	Key characteristics	How it is used	Pros	Cons to understand
ERA5 / ERA5-T	ECMWF Reanalysis. Covers a ~30km grid globally. Provides hourly/daily data.	Back-testing historical temperature, wind, and broad rainfall events.	Global coverage, highly consistent, and offers a deep historical record.	Low resolution. A 30km grid creates high basis risk for localised micro-climates.
CHIRPS	Climate Hazards Group InfraRed Precipitation with Station data. ~5km resolution.	Specific drought indices and rainfall-based parametric triggers.	Excellent historical rainfall record, blending satellite estimation with actual station data.	Only measures rainfall. Can have latency delays in final data releases.

Providers	Key characteristics	How it is used	Pros	Cons to understand
meteoblue, Tomorrow.io, Meteomatics	Commercial data aggregators. API-driven. They combine multiple global models with localised AWS data.	In-season monitoring, localised trigger operation, and powering SMS early warning forecasts.	Easy API integration, hyper-localised data delivery, and robust short-term forecasting.	Incurs subscription fees. True accuracy heavily depends on the density of underlying physical stations in your region.

Utilise adaptable digital platforms to bridge new triggers with legacy it systems

Beyond raw data, practitioners need platforms to run the insurance rules and experts to connect these new tools to older, existing software. Several Microinsurance Network (MiN) members provide exactly this infrastructure:

- **Adaptable digital platforms (IBISA and Luxelare):** If you need a flexible system to actually run your digital insurance products, both IBISA and Luxelare offer highly adaptable platforms. These systems ingest the data from the sources listed above and accommodate almost any type of parametric or digital insurance product you design.
- **Legacy system integration (MBM Consultants and trunord.io):** A common roadblock is figuring out how to connect a new digital trigger system to an older insurance core system. If your IT team has doubts about this process, MBM Consultants and trunord.io specialise in building these exact bridges. They help risk carriers securely link older systems with modern Agritech solutions without requiring a massive internal IT overhaul.

Google Earth Engine (GEE): The low-cost R&D baseline for initial evaluations

For insurance companies and aggregators who are just beginning their Agritech journey, purchasing expensive commercial software immediately is often unnecessary. Google Earth Engine (GEE) is a cloud-based geospatial processing platform that serves as a highly effective, low-cost baseline.

- **How to use it:** GEE allows practitioners to access and analyse the massive, petabyte-scale archives of Sentinel and Landsat data for free (for research and evaluation purposes) without needing to download data or buy physical servers.
- **Why it matters:** While it requires coding expertise and is not a “finished” consumer insurance platform, it is the perfect sandbox for insurers to gain a basic, hands-on understanding of Earth Observation data and test initial assumptions before evaluating commercial vendors.

12. Technical & operational glossary

This glossary provides a comprehensive, plain-English reference for all technical systems, data metrics, and insurance terms used throughout this guide.

Core insurance & scale concepts

- **Parametric / Index insurance:** Insurance that pays out automatically based on pre-agreed data triggers (like a specific drop in rainfall or temperature spike) measured by objective technology, rather than relying on human adjusters to inspect field damage.
- **Indemnity insurance:** Traditional insurance where payouts are determined after a loss occurs, based on a physical assessment of the actual damage conducted by human claims adjusters.
- **Basis risk:** The mismatch where a technology trigger does not align with actual losses on the ground. It results in either a False Negative (a farmer suffers a devastating loss but receives no payout) or a False Positive (a system calculates a payout when no real damage occurred).
- **Law of large numbers:** The fundamental mathematical rule stating that a larger risk pool results in more predictable, stable loss trends. Inclusive insurance requires this massive scale to secure affordable reinsurance.
- **Reinsurance:** Insurance for insurance companies. Traditional risk carriers pass a portion of their risk pool onto global reinsurers to protect their own balance sheets from catastrophic volatility.
- **Customer acquisition Cost (CAC):** The total operational cost required to enroll an individual farmer. High CAC is a leading reason direct-to-farmer digital sales fail.
- **“Phygital” bridge:** An operational strategy combining face-to-face human distribution networks (like local cooperative leaders or “Village Champions”) with modern digital tools.

Data systems, software & platforms

- **API (Application Programming Interface):** A digital pipeline that allows two completely independent software applications to instantly share data with each other.
- **Operations layer:** An adaptable cloud software platform that runs parallel to legacy IT architectures. It handles onboarding, index monitoring, and automated claims processing without requiring a massive overhaul of an insurer’s core system.
- **Smart contracts / Hyper-localised risk engines:** Digital agreements written into code that instantly calculate and execute payouts to digital wallets the exact moment a pre-set weather index threshold is crossed.
- **Generative AI voice assistants:** Advanced artificial intelligence models configured to send automated, personalised audio updates (such as WhatsApp voice notes) in local dialects to explain complex payout parameters to policyholders.
- **USSD / SMS rails:** Basic mobile communication protocols (unstructured supplementary service data and text messaging) that allow farmers without internet access or smartphones to safely register policies, receive weather warnings, and execute mobile banking transfers.

Earth observation (EO) & satellite technology

- **Optical satellites:** Satellites that capture visual images of the Earth's surface using sunlight, similar to a standard digital camera. Systems like Sentinel-2, Landsat, and Planet Labs track vegetation health and long-term historical baselines, but they cannot see through heavy cloud cover.
- **SAR (Synthetic Aperture Radar):** An all-weather satellite imaging technology that emits radar energy pulses and measures the reflection (backscatter). Systems like Sentinel-1 easily penetrate heavy clouds and storms, making them perfect for mapping floods or soil moisture at night or in cloudy areas.
- **NDVI (Normalised Difference Vegetation Index):** A standardised measurement derived from satellite data that tracks vegetation health by analysing how light reflects off living plants.
- **NDWI (Normalised Difference Water Index):** A specialised satellite metric used to calculate moisture levels in vegetation canopy structures to monitor crop water stress.
- **Crop phenology:** The study of a crop's natural life cycle stages (germination, growth, flowering, harvest). High-resolution agritech uses phenology to change rain or temperature triggers dynamically based on a field's exact seeding date.
- **Google Earth Engine (GEE):** A cloud-based geospatial processing platform that is free exclusively for non-commercial research and evaluation purposes. Packed with petabytes of historical satellite archives, it acts as a low-cost testing sandbox for insurers to validate initial assumptions and build data familiarity before committing to paid commercial vendor platforms.

Climate Grids, Weather Tools & Sensors

- **Automated Weather Stations (AWS):** Physical, solar-powered hardware systems deployed in fields to measure localised real-time climate parameters (rainfall, wind speed, temperature) without requiring human manual recording.
- **Commercial weather APIs:** Aggregated online weather data feeds (such as meteoblue or Tomorrow.io) that blend global climate forecasting models with physical station networks to supply highly localised alerts and triggers.
- **ERA5 / ERA5-T:** A globally respected atmospheric climate reanalysis dataset covering a 30km grid, ideal for tracking broad historical records and long-term back-testing.
- **CHIRPS (Climate Hazards Group InfraRed Precipitation with Station data):** A highly specialised 5km resolution climate dataset that combines long-term historical satellite imagery with real-world weather station data to track rainfall-specific triggers.
- **IoT (Internet of Things) Sensors:** Small, internet-connected physical hardware sensors placed directly in fields or on machinery to stream farm-specific environmental indicators to underwriting models.

Field Operations & Agronomic Verification

- **Ground truthing / Field verification:** Gathering actual physical measurements, observations, or photos directly from a farmer's plot to check the true precision of satellite algorithms.
- **Crop cutting experiments (CCEs):** Traditional or tech-optimised field assessments where a small section of a plot is harvested to measure exact agricultural yields, used by national schemes to validate seasonal indices.
- **Crop simulation models (e.g., DSSAT):** Software platforms that run mathematical equations combining crop biology, soil type, and climate data to generate synthetic historical yields when reliable written public records do not exist.

13. Annotated resource directory: exploring the technologies in action

To further support practitioners in evaluating technology, the following external resources and case studies provide deeper insights into specific technological applications. We have mapped these resources to the respective lifecycle phases (from Chapter 2) and technologies they impact:

Earth observation and actuarial risk assessment

Focus: Phase 1 (Product design) & Phase 3 (Active monitoring)

- **Swiss Re:** [Strengthening crop insurance with digital solutions](#)
 - *The Tech/Case:* Explores how global reinsurers utilise high-resolution soil moisture data and satellite-derived vegetation indices to build robust parametric triggers and reduce basis risk.
- **SCOR:** [New technology applied to enhance product offering and insurance services in agriculture](#)
 - *The Tech/Case:* Highlights concrete examples of historical field performance analysis, detailing how satellite technology assesses intra-field variabilities and crop rotation histories to build more accurate risk profiles.
- **Insurance business mag:** [How can precision agriculture help insurance brokers?](#)
 - *The Tech/Case:* Examines how localised IoT (Internet of Things) sensors and precision agriculture data are being utilised by brokers to create highly tailored, farm-specific underwriting models.

Mobile distribution, bundling, and digital extension

Focus: Phase 2 (Distribution & onboarding) & Phase 3 (Digital extension)

- **GSMA:** [Agricultural Insurance for Smallholder Farmers: Digital Innovations for Scale \(2020\)](#)
 - *The Tech/Case:* A foundational report on how mobile network operators (MNOs) and digital wallets are used to bundle insurance with mobile money, driving Customer Acquisition Costs (CAC) to near-zero.
- **GSMA:** [AgriTech Accelerator - Lessons From Scaling Digital Agriculture Services \(2025\)](#)
 - *The Tech/Case:* Provides case studies on scaling B2B2C distribution models and implementing effective “Phygital” advisory platforms via SMS and USSD.
- **GSMA:** [Agritech Digital Agriculture Maps \(2020\)](#)
 - *The Tech/Case:* A comprehensive landscape map of the various digital agriculture platforms, emphasising the integration of digital extension programs with financial services.



Workflow automation and smart claims processing

Focus: Phase 4 (Claims processing) & Adaptable digital platforms

- **iNube solutions:** [Automating crop insurance system for efficient, effective processing & Enhancing crop insurance with streamlined workflows](#)
 - *The Tech/Case:* Details the architecture of core insurance platforms designed specifically for agriculture, showing how APIs and automated workflows replace manual underwriting and human claims adjustment.
- **Climate finance lab:** [Blockchain climate risk crop insurance](#)
 - *The Tech/Case:* Explores the deployment of Smart Contracts via blockchain infrastructure, demonstrating how payouts can be triggered instantly and transparently without traditional banking rails when a parametric threshold is crossed.

Scaling via public-private partnerships and national data

Focus: Phase 1 (Product design), Phase 4 (Claims processing), and Ecosystem alignment

- **NITI Aayog (Gov. of India):** [Enhancing Technology-Use in Agriculture Insurance](#)
 - *The Tech/Case:* A critical policy document showcasing how the Indian government leverages drone technology, remote sensing, and automated Crop Cutting Experiments (CCEs) to manage the operational friction of the PMFBY (the world's largest national agricultural insurance scheme).



About the Microinsurance Network

The Microinsurance Network (MiN) is the global multi-stakeholder platform for professionals and organisations that are committed to making insurance inclusive. Membership-based, we bring together diverse stakeholders from across the value chain who share our vision of a world where people of all income levels are more resilient and less vulnerable to daily and catastrophic risks. We encourage peer-to-peer exchange and learning, facilitate the generation of knowledge and research, and act as advocates, promoting the role that effective risk management tools, including insurance, play in supporting the broader development agenda.

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