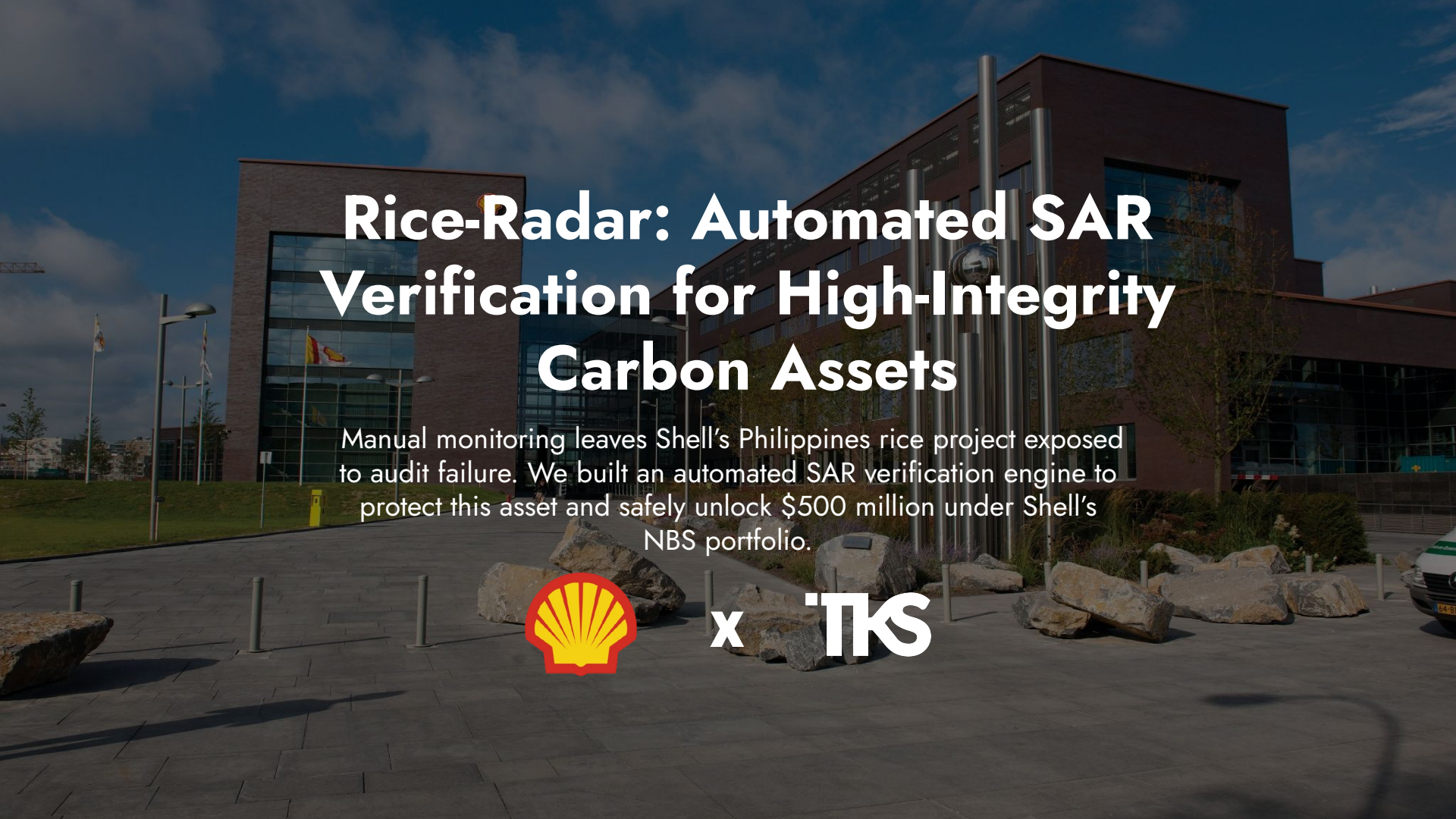


Rice-Radar: Automated SAR Verification for High-Integrity Carbon Assets

Manual monitoring leaves Shell's Philippines rice project exposed to audit failure. We built an automated SAR verification engine to protect this asset and safely unlock $500 million under Shell's NBS portfolio.

x TKS

Executive Summary

Problem

Monitoring Systems are the major failure points.

Monitoring integrity has become one of the biggest risks in the voluntary carbon market. Many land-based carbon projects rely on manual reporting and intermittent satellite coverage to verify environmental conditions such as flooding or water management. These systems often leave gaps in the evidence auditors require to confirm emissions reductions.

Shell's **50,000-hectare rice methane project in the Philippines** is now encountering this challenge directly. The project depends on verifying water-level changes across thousands of farms, but current monitoring relies heavily on manual farmer logs and incomplete remote sensing, creating a structural verification gap.

Solution

Shell validates farmers log with synthetic aperture radar

Rice-Radar introduces an independent monitoring layer using **Synthetic Aperture Radar (SAR)**. Unlike optical satellites, SAR can observe surface water conditions through clouds and at night, allowing continuous verification of environmental changes on the ground. Applied to Shell's Philippines rice methane project, Rice-Radar can automatically detect water-level changes across rice paddies and provide independent evidence that AWD practices are being implemented.

Impact

Bulletproofing a $4 million USD carbon credit asset

Deploying Rice-Radar would strengthen verification for Shell's Philippines rice methane project, protecting an estimated **$1.5–4 million in carbon credits over its lifecycle**. More importantly, the project provides a **controlled pilot environment** to validate a monitoring architecture that could support **roughly $300–500 million in annual carbon credit value across Shell-linked landscape projects**.

Overview

Monitoring failures cause distrust.

Carbon credit projects face three main risks: methodology flaws, verification failures, and monitoring weaknesses. **Monitoring is often the most critical** because it operates continuously throughout a project's life. Many nature-based projects rely on decentralized reporting, manual logs, or periodic observations, creating gaps and inconsistencies in the data used to prove emissions reductions.

When monitoring evidence is incomplete, auditors may question the credibility of the credits, leading to downgrades or rejection. For **Shell**, the stakes are significant: its global nature-based solutions portfolio represents **hundreds of millions of tonnes of potential carbon credits (~400 $MtCO_2e$)**. Weak monitoring, therefore, threatens not just individual projects but also the credibility and value of a large portion of Shell's carbon portfolio.

In 2022, Shell has already experienced how quickly carbon credit assets can collapse when auditors lose confidence in project integrity.

China Rice Farming Scandal

Shell lost trust and assets in China Rice Farming Scandal.

In 2022, Shell experienced firsthand how fragile carbon credit assets can be. After a prolonged audit review, 1.8 million rice carbon credits associated with projects in China were **rejected**, resulting in more than $10 million in losses. The credits had been issued from **37 rice methane reduction projects in Anhui Province**, developed under a voluntary carbon methodology intended to reward improved irrigation practices.

During the review, auditors concluded that the methodology used to calculate emissions reductions could not reliably demonstrate that the reductions were genuine. Once the methodology was scrapped, **every credit issued under it was invalidated**, including hundreds of thousands that had already been retired for corporate carbon-neutral claims.

The episode is a reminder of how quickly credits can disappear when **auditors lose confidence** in project integrity.

Today, **Shell's Philippines rice methane project** enters a carbon market that is now more skeptical, and it all depends on proving its monitoring data will hold up under the scrutiny.

1.8M

Credits rejected after a 17-month probe

$10M

Lost in 2022 China scandal

450k

Credits became phantom credits

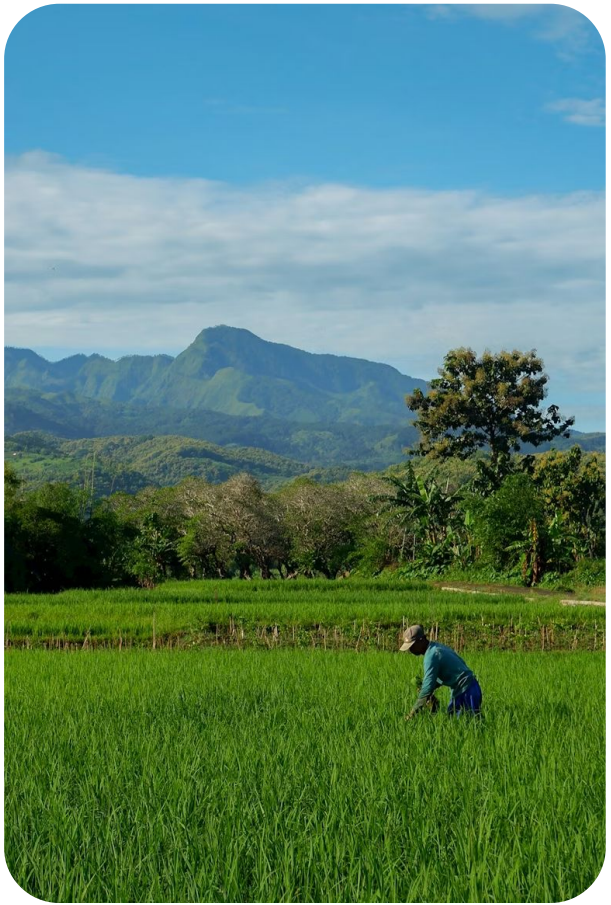
Pilot Opportunity

Today, Shell's 50,000 hectare rice farm depends on monitoring integrity.

Shell's Philippines rice project is now the immediate test of monitoring integrity in the voluntary carbon market. Shell recently launched a **50,000-hectare AWD rice methane reduction project in the Philippines**, expected to generate **$1.5M–$4M in carbon credits over its lifecycle**. The project is developed in partnership with **Green Carbon, a Japanese agricultural carbon developer specializing in rice methane reduction projects across Asia**. Together they rely on monitoring systems built around **manual farmer reporting and intermittent satellite observations** to prove that emissions reductions occurred.

In today's voluntary carbon market, **projects face significantly greater scrutiny** from auditors and regulators. Monitoring systems that rely heavily on manual logging and incomplete satellite coverage can **leave critical gaps** in the evidence required to validate carbon credits.

The Philippines project is more than a single asset. It is the **first step toward a $300M–$500M JCM rice carbon market across Southeast Asia**, making it the proving ground for whether Shell can safely scale similar rice methane projects across the region.



Pilot Opportunity - Problem

Manual Monitoring Cannot Scale Across 50,000 hectares.

Shell's Philippines project depends on monitoring thousands of smallholder farms implementing Alternate Wetting and Drying (AWD). In practice, this monitoring relies heavily on **manual farmer reporting**, where farmers log water levels and drainage cycles throughout the growing season.

Across tens of thousands of hectares, this system struggles to produce consistent data. Even a **10–20% rate of missing or mis-logged entries** can translate into thousands of questionable drainage records each season — enough for auditors to downscale or reject large volumes of carbon credits.

At the same time, **optical satellite monitoring cannot fully replace manual logs**. Heavy wet-season cloud cover in the Philippines can block **30–40% of satellite passes**, leaving large gaps where no independent verification of field conditions exists.

Together, these limitations create a **monitoring integrity gap**: the people closest to the fields struggle to produce audit-grade records, while the eyes in the sky cannot fully backstop them.

Validation

Green Carbon Executives Claim...

In our chat with executives at Green Carbon, they claim that farmers struggle to log data reliably and consistently, supporting our concern on the risk of carbon credits invalidation.

*"The primary bottleneck is not necessarily technical failure, but rather the cultural shift required for technology uptake among farmers. **Farmer adoption** remains the **biggest challenge** to consistent data logging."*

Jamie Lualhati

Despite the bottleneck in manual logging, new remote sensing technologies are not reliable enough to be fully implemented on-site. This creates a technology gap that may cause Shell thousands of credits.

*"We have begun doing remote sensing, but it is **not yet reliable** and frequent enough to entirely shift from manual data logging."*

Together, these two admissions from Green Carbon confirm that the project has a data integrity gap with no current solution. Farmer logging is inconsistent, and remote sensing is too immature to compensate. The vulnerability is structural, and it is already acknowledged by the people running the project. A better solution is urgent.

green carbon

Solution

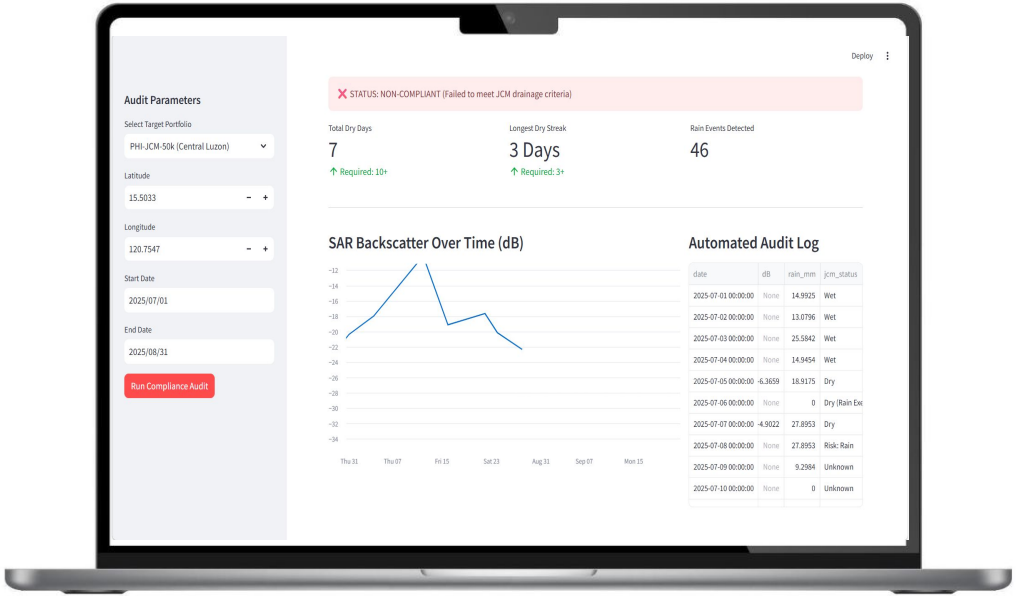
The **Right** Tool to Ensure **Nothing Goes Wrong**.

Project developers on the ground have explicitly confirmed that relying on farmers to manually log data is a severe adoption bottleneck that simply does not scale. It creates a structural vulnerability across the entire 50,000-hectare portfolio.

Rice-Radar completely removes the farmer from the compliance equation. By running a 100% top-down, orbital audit, we deliver instant verification without requiring any ground-level behavioral changes or new technology uptake.

Instead of subjective notebook entries, Shell's asset managers receive an immutable, real-time compliance dashboard. The system automatically tracks the 10–15 cm drainage threshold across the entire region, flagging anomalies instantly and generating the exact cryptographic evidence required to pass a JCM review.

Rice-Radar - Demo



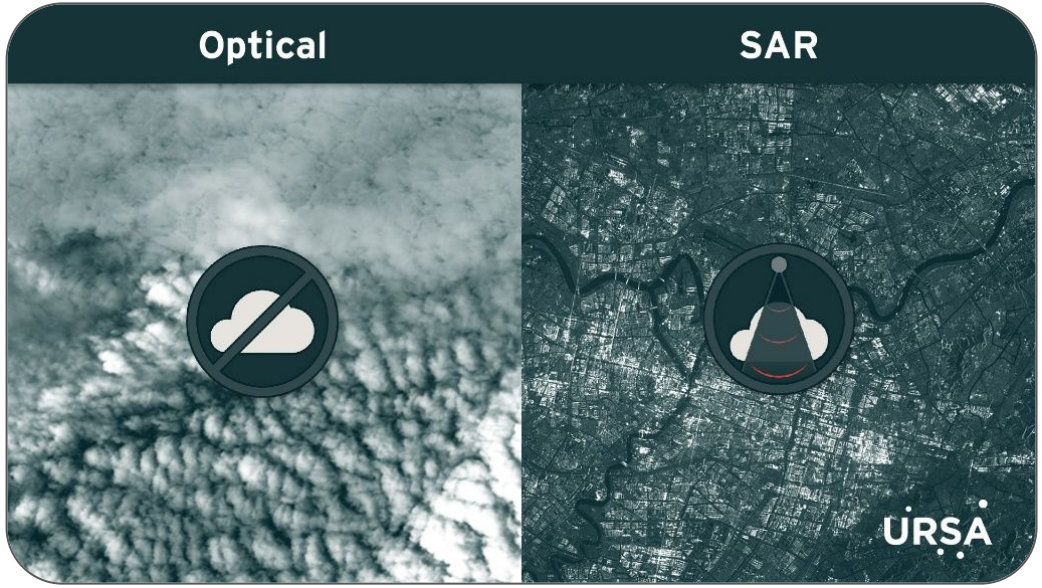
Data Acquisition

Bypassing the Cloud Barrier

Standard remote sensing relies on optical cameras, which are blinded by heavy Philippine wet-season cloud cover, blocking up to 30-40% of passes. This creates massive gaps where no independent check exists on the fields.

We bypass this failure point by utilizing Sentinel-1 Synthetic Aperture Radar. This active sensor physically pierces through clouds and severe weather, guaranteeing the continuous, high-frequency data stream that manual logs and optical satellites cannot provide.

By eliminating these weather-related blindspots, Rice-Radar guarantees an unbroken chain of evidence for JCM reviewers. Even during the heaviest monsoon rains, Shell retains total, audit-grade visibility over the entire 50,000-hectare portfolio, ensuring that not a single multi-million dollar carbon credit is lost simply because an optical satellite couldn't see through a storm.



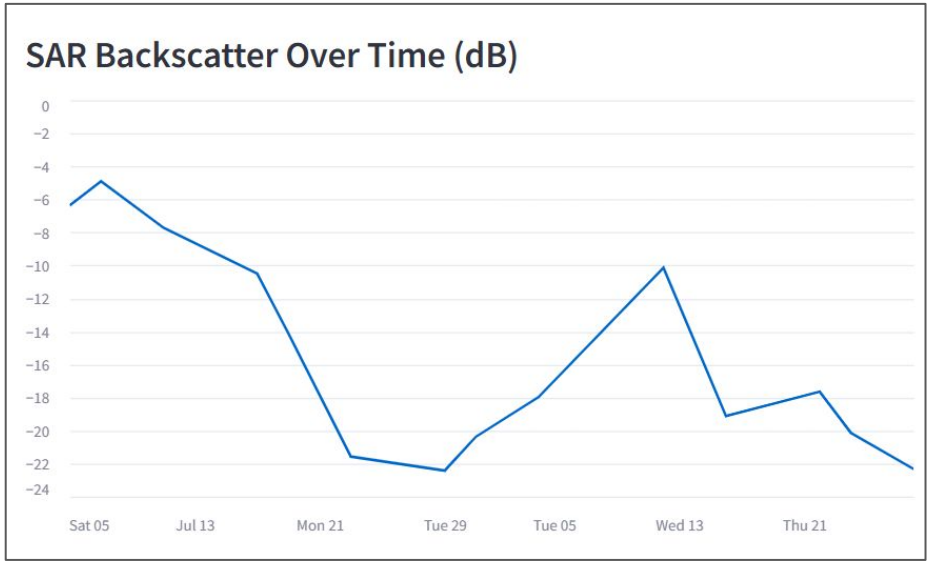
Analytical Engine

Multi-Sensor Data Fusion

A farmer's handwritten notebook cannot definitively prove to an auditor that a field was drained to the exact 10–15 cm threshold required by the JCM. Subjective photos leave millions exposed to reviewer doubt.

Our engine replaces subjective trust with orbital physics. By cross-referencing precise decibel drops in SAR backscatter with local CHIRPS rain data, we pinpoint the exact moment floodwaters cross that threshold, while preventing false non-compliance flags caused by natural thunderstorms.

This multi-sensor approach fundamentally changes Shell's position during a JCM review. By presenting regulators with a mathematically verified, cross-referenced dataset, Shell eliminates the single points of failure that plagued previous methodologies. We shift the burden of proof away from subjective farm logs, ensuring every generated credit is undeniably backed by hard data.



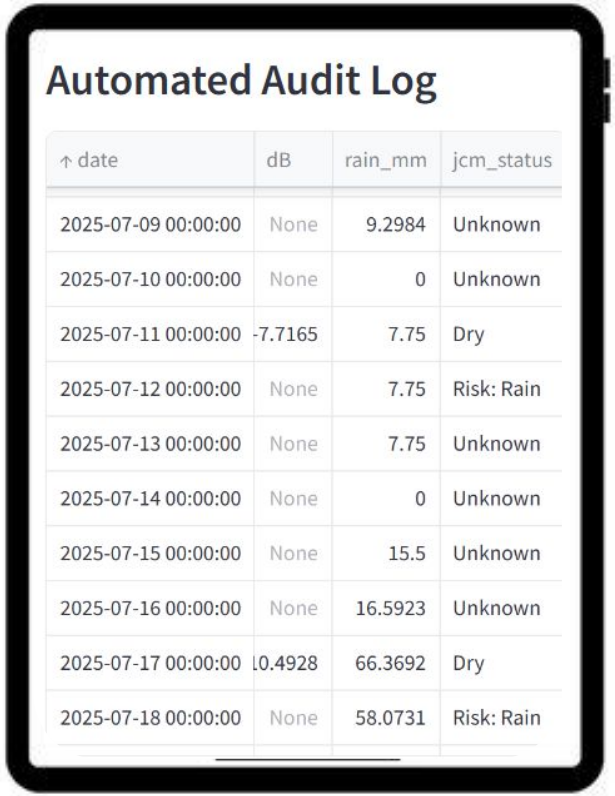
Regulatory Output

Generating immutable, audit-grade evidence for JCM Reviewers.

To protect this new $4 million portfolio, Rice-Radar is calibrated strictly to the parameters of the JCM PH_AM004 methodology. We do not simply provide Shell with raw satellite imagery; we translate orbital physics directly into the exact compliance format regulators demand.

By continuously cross-referencing SAR backscatter decibel drops with local precipitation data, our engine automatically classifies the daily drainage status of every hectare. This creates an immutable audit log that tracks the mandatory 10–15 cm water threshold without human intervention.

The voluntary carbon market has proven that weak data integrity is the fastest way to lose a premium asset. By submitting 100% automated, satellite-verified evidence, Shell closes the reporting gap, bypasses auditor skepticism, and guarantees the issuance of the high-integrity credits required by today's markets.



Risk Management

De-Risking the Deployment

Regulatory Risk: Auditor Acceptance

The Challenge: JCM registry auditors are inherently conservative and may initially hesitate to replace traditional ground-truth smartphone photos with 100% automated satellite models.

The Mitigation: We leverage the fact that the JCM PH_AM004 methodology explicitly allows for remote sensing integration, provided that sufficient accuracy is mathematically proven to the registry.

The Execution: We will run Rice-Radar as a "shadow audit" alongside Green Carbon's manual data for one full season. This dual-track approach proves our accuracy baseline to regulators risk-free, transitioning SAR into the undisputed primary source of truth for all future credit issuance.

Technical Risk: Micro-Farm Resolution

The Challenge: Sentinel-1 operates at a 10-meter spatial resolution, which could theoretically struggle to isolate precise drainage events on extremely fragmented, sub-hectare smallholder plots.

The Mitigation: We solve this physical limitation through multi-sensor data fusion, mitigating resolution limits by aggregating backscatter data across massive 50,000-hectare grids rather than relying on single-pixel isolation.

The Execution: By automatically cross-validating radar spikes with CHIRPS precipitation data, we filter out natural weather events. This eliminates false-positive compliance flags, ensuring Shell only submits mathematically bulletproof data that auditors cannot challenge.

Pilot Impact

Mindoro proves it and Southeast Asia scales it.

A successful Rice-Radar deployment on Mindoro Island does **more than protect $4M** in carbon credits. It proves something the entire Southeast Asia JCM rice market has **never seen before**, that AWD rice methane reductions can be independently verified at scale, continuously, through any weather condition, with documentation that holds up under the strictest bilateral audit framework in existence.

Every government in the region is tightening NDC commitments. Every Japanese corporation is competing for high-integrity bilateral credits they cannot find enough of. **The bottleneck has never been demand**, it has been the absence of a verification infrastructure credible enough to support large-scale project registration.

Once the methodology is validated on 50,000 hectares in the Philippines, the same SAR engine, the same JCM PH_AM004 compliance pipeline, the same audit-grade documentation system deploys across Vietnam and Indonesia. Shell doesn't just protect one project. It becomes the operator that **cracked the verification problem no one else has solved.**

Projected Impact

Southeast Asia's $500M rice credit market is waiting.

The global voluntary carbon market for rice and agricultural methane credits is one of the **fastest growing segments in climate finance**. Article 6 of the Paris Agreement has unlocked bilateral trading between countries, creating an entirely new class of high-integrity credits that corporations and governments are actively competing to acquire. **Demand is already outpacing supply**, and quality projects are commanding premium prices.

Shell's Philippines project is the first step into a **$300–500M Southeast Asia JCM rice credit market spanning the Philippines, Vietnam, and Indonesia**. Every government in the region is tightening NDC commitments and actively looking for credible bilateral projects to register. **The infrastructure doesn't exist yet. Rice-Radar builds it.**

Once Mindoro passes its first audit clean, the methodology is proven. The same SAR validation engine, the same JCM PH_AM004 compliance pipeline, the same audit-grade documentation, redeployed across every rice methane project Shell wants to run in the region. What costs **$36,000 to protect $4M today** becomes the infrastructure that safely unlocks **hundreds of millions in verified credits tomorrow**.

Implementation Plan

Rice-Radar is fully deployed before Shell's first audit cycle.

Month 1/2 — Ground Truth:
Before any satellite runs, we map Mindoro Island's 50,000 hectares, field boundaries, drainage infrastructure, and flood cycles. This will is the foundation everything else is built on.

Month 3/4 — Shadow Audit:
Rice-Radar runs silently alongside Green Carbon's manual logging for one full season. Every SAR reading cross-validated against farmer logs, mathematically proving our accuracy baseline to JCM regulators before we take over.

Month 5/6 — Full Deployment:
Rice-Radar becomes the primary verification layer across all 50,000 hectares. Real-time anomaly alerts go live. Shell enters its first audit cycle with complete, satellite-backed, JCM PH_AM004-compliant documentation.

Month 7-12 — Southeast Asia:
Mindoro passes its first audit clean. Methodology redeployed across Vietnam and Indonesia JCM rice projects. What started as protecting $4M on Mindoro becomes the infrastructure for Shell's entire $300–500M regional market.

Incentives

Rice-Radar turns Shell's biggest liability into their strongest proof point.

Asset Protection: Shell's Mindoro project carries **$1.5M–$4M** in carbon credit assets over 10 years. **One failed audit wipes it entirely**. This isn't hypothetical, Shell has already lived through invalidation once, and the damage was immediate and irreversible.

Reputational Firewall: The 2022 China rice farming scandal cost Shell **~2 million customers** and forced the sale of their UK and German energy businesses. A project that mirrors the exact same methodology gap puts Shell in the same position again. **They don't get a third chance with the market**.

First-Mover Credibility: Being the first to SAR-validate a JCM rice project turns Shell from a **greenwashing liability into a market leader**. Every major corporation is under pressure to prove their carbon claims are real, Shell has the opportunity to be the company that actually does it. In a VCM under intense scrutiny, **that story is worth more than the credits themselves**.

Customers

Japan needs 3x more credits than it can produce.

Shell's carbon credits are sold to corporations actively seeking high-integrity, JCM-verified offsets to meet their own net-zero commitments. Japan has aggressive NDC targets to meet and a serious shortage of high-quality bilateral credits to meet them with, making buyers like **Isuzu Motors, Tokyo Gas, and Toshiba** actively competing for exactly the kind of credits Shell's Mindoro project generates. These buyers are paying a **$10–20 USD/tCO2e premium** specifically because JCM methodology is one of the most credible bilateral frameworks in existence. That premium is entirely contingent on the credits surviving audit. The moment data integrity is questioned, the credits lose their JCM designation, **the premium collapses**, and Shell loses not just the asset but the corporate buyers who came specifically for that quality guarantee.

By independently validating every field against JCM PH_AM004 requirements, Shell can guarantee to its buyers that every credit they purchase is **satellite-verified, audit-grade, and will never be revoked**. In a voluntary carbon market where greenwashing accusations are destroying corporate reputations overnight, that guarantee is what **separates a premium credit from a liability**.

ISUZU

TOKYO GAS

TOSHIBA

About us

Kaden Yeung

Kaden is a builder focused on intelligent detection systems across hardware and software. He has interned at an **AI healthcare startup** and a bank, founded a robotics education program, and built systems spanning wildfire detection and desalination automation.

Naman Jain

Naman is a first-principles thinker exploring how artificial intelligence can improve decision-making in complex systems. He has interned at an **AI data startup** and is developing AI-driven tools in the legal space aimed at making legal processes more accessible and efficient.

Kevin Theivendran

Kevin is an innovator in the clean energy space focused on leveraging geospatial machine learning and economic policy to advance the energy transition in the Global South. He has worked with a **clean energy startup** in Uganda and attended the Villars Institute Ecopreneurship Program

Thank you!

We are truly grateful for the opportunity to explore the complexities of the voluntary carbon market, we became even more inspired by the potential impact our solution could have in advancing your goals.

We look forward to the possibility of bringing Rice-Radar to life with Shell.

Kaden | Naman | Kevin

Learn more

Appendix

Rice Methane

MRV

AWD

Project Overview

China Case Study

JCM

Rice-Radar

Codebase

Economics