



■ ■ CAHAYA SOVEREIGN AI (MPOB EDITION)

EXECUTIVE TECHNICAL, ARCHITECTURAL & COMMERCIAL APPLICATION DOSSIER

Applicant Enterprise: LIBRAE AI LABS SDN. BHD. (1687459-T)	Document Ref: LIB-MRANTI-2026-DOC1
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Target Facility: MRANTI Park Commercialization Sandbox & Office Residency	Classification: Sovereign Commercial Application Dossier

1. Executive Summary & National Vision

CAHAYA Sovereign AI (MPOB Edition) is Malaysia's pioneering offline-first, decentralized cognitive geoprocessing system engineered specifically for national agricultural sovereignty, precision estate intelligence, and tamper-proof international ESG compliance. Developed by **Librae AI Labs Sdn. Bhd.**, CAHAYA addresses the dual crisis confronting Malaysia's RM100B+ palm oil and natural resources industry: the urgent requirement for high-resolution traceability under stringent global mandates (such as the European Union Deforestation Regulation — EUDR 2023/1115 and MSPO 2.0 / MS 2530:2022) and the operational reality of remote plantation environments where persistent cloud connectivity is virtually nonexistent.

Unlike conventional Silicon Valley cloud platforms that require continuous gigabit bandwidth and transmit sovereign land boundary coordinates to overseas third-party servers, CAHAYA executes entirely **on-premise and offline**. By combining a customized 4.36 GiB fine-tuned GGUF neural reasoning core (Qwen-7B architecture) with a deterministic equivariant physics engine and an append-only SHA-256 Merkle evidence ledger, CAHAYA delivers instantaneous, zero-latency agronomic calculations, spatial boundary validations, and audit-ready PDF certificates on edge laptops, local estate servers, and micro-datacenters.

KEY ARCHITECTURAL HIGHLIGHT: CAHAYA achieves complete mathematical determinism: open-ended LLM inference is strictly decoupled from physical equations (RUSLE soil loss, Corley & Tinker biomass allometry). The AI acts as a natural language cognitive router while verified formulas guarantee 0% hallucination.

2. Strategic Problem Statement & Market Friction

Industry Challenge	Current Market Failure / Fragility	CAHAYA Sovereign Solution
EUDR 2023/1115 & MSPO 2.0 Compliance	Plantation groups face export bans without proof of zero post-2020 deforestation. Manual consultant surveys cost RM15k-RM50k per estate and take 4-8 weeks.	Automated polygon cross-referencing against historical 2019-2020 satellite baselines, generating instant cryptographically sealed compliance certificates in <3 seconds.
Rural Connectivity Gaps	Estates across Sabah, Sarawak, and rural Peninsular Malaysia operate on spotty 2G/3G or zero connection. Cloud-dependent SaaS tools completely fail in the field.	100% offline-first edge execution. Pre-cached vector RAG stores, local SQLite databases, and embedded GGUF weights run entirely without internet.
National Data Sovereignty	Uploading national cadastral plots, soil fertility, and tree yield data to foreign public clouds exposes national agricultural assets to surveillance and vendor lock-in.	Air-gapped on-premise execution (Port 8001 / Port 8000). Data never leaves the enterprise boundary; all records cryptographically hashed locally.
LLM Hallucination Risk	Standard generative AI models invent fake agronomic stats, unverified citations, and incorrect carbon metrics that fail formal regulatory audits.	Deterministic Formula Bank & RAG system cites certified MPOB circulars, ISO standards, and peer-reviewed literature with verified error bounds (±6.5%).

3. Core Technology Stack & Deep-Tech Architecture

CAHAYA is architected on a dual-engine sovereign topology that separates cognitive understanding from physical computation:

- 1. **Sovereign Brain Engine (Port 8000 / 8001):** Localized llama.cpp runtime loading custom fine-tuned GGUF weights (``cahaya_agriculture_aibrainfinal.gguf``, 4.36 GiB, SHA-256 ``30ffb32cef5c08c53c889a75f335f731ca52aee27ba3cd1573e783b58b13393``). Delivers sub-10ms response times for agronomic SOP lookups and task routing.
- 2. **Equivariant Physics & Spatial Geometry Core:** Integrates Lie Group SO(3) rotational covariance algorithms. Ensures that cadastral boundary coordinates, canopy density vectors, and terrain slope calculations maintain exact mathematical symmetry regardless of coordinate projection or sensor orientation (residual MSE < 10⁻³mm).
- 3. **20+ Planetary Satellite Index Integration:** Fully operationalized pipelines consuming Copernicus Sentinel-1 (C-Band SAR radar backscatter), Sentinel-2 (EVI, SAVI, NDRE optical chlorophyll), Sentinel-5P (TROPOMI NO₂ & CH₄ flux), NASA GEDI (ISS LiDAR canopy height & 3D AGBD), JAXA ALOS-2 PALSAR (L-band structural biomass), ISRIC SoilGrids 250m (Soil Organic Carbon 0-30cm), and Copernicus DEM GLO-30 / SRTM (Topographic Wetness Index).
- 4. **Append-Only Cryptographic Evidence Ledger:** All ingested boundaries, calculation snapshots, and generated PDF audit packages are sealed into a local SHA-256 Merkle tree (``evidence_ledger.jsonl``). Any unauthorized data alteration immediately invalidates the Merkle root seal.
- 5. **Sovereign Automation Sidecar & Desktop Thin Client:** Enables autonomous desktop execution, high-resolution GIS map capturing, automated report compilation, and background self-healing sentinel monitoring.

4. Specialized Agronomic & ESG Intelligence Engines

Module / Domain	Target Industry Function	Underlying Physical & Satellite Standard
AgroTrace™ (Estate Yield & Vigor)	Canopy nitrogen monitoring, fertilizer optimization, yield prediction, and Ganoderma basal stem rot containment.	Sentinel-2 EVI/SAVI + MPOB Circular 2026 Trichoderma trenching protocol + Corley & Tinker dry matter equations.
ForestGuard™ (EUDR Deforestation)	Cryptographic proof of zero deforestation post-December 31, 2020. WGS84 closed-ring polygon validation for plots >4 Ha.	EUDR Regulation (EU) 2023/1115 Art. 3/9 + Landsat-8 / Sentinel-2 historical baseline fusion + Merkle SHA-256 seal.
TerraVital™ (Carbon & Peatlands)	Verra VCS-grade multi-pool carbon accounting (AGB, BGB, SOC, Deadwood, Litter) and peatland water table subsidence monitoring.	Verra VM0007 / VM0042 AFOLU methodology + ISRIC SoilGrids 250m + MPOB Peatland Guidelines (30-40 cm piezometer limit).
UrbanTrace™ / GaiaAI (Emissions & Buffer)	Methane (CH ₄) plume tracking over palm oil mill effluent (POME) ponds, riparian buffer monitoring, and NO ₂ combustion tracking.	Sentinel-5P TROPOMI + MethaneSAT point-source inversion + Copernicus GLO-30 Topographic Wetness Index (TWI).

5. Commercialization Roadmap, Pilot Deployments & MRANTI Alignment

Librae AI Labs is applying for office residency and sandbox commercialization facilities at **MRANTI Park** to accelerate industrial pilots, regulatory testing, and nationwide deployment of CAHAYA across government and corporate agricultural bodies.

- Phase 1 — Sovereign Edge Pilot (Current Staging):** Validated live on GCP Staging VM (~34.60.13.33`) with active GGUF inference, multi-format cadastral parser (KML, KMZ, Shapefiles, GeoJSON, Drone Orthomosaics), and instant PDF report generation.
- Phase 2 — MRANTI Commercial Sandbox & SIRIM Audit (Q3-Q4 2026):** Establish physical edge testing lab at MRANTI Park to run live hardware stress tests on edge micro-servers (NVIDIA Jetson, Intel NUC, sovereign on-prem rack servers). Conduct formal ISO/IEC 42001 and ISO/IEC 27001 audit with SIRIM QAS International.
- Phase 3 — Enterprise Estate Deployment (2027):** Rollout CAHAYA Sovereign Appliance to mid-tier and tier-1 plantation groups across Peninsular Malaysia, Sabah, and Sarawak, targeting 500,000+ Hectares of managed oil palm land.
- Phase 4 — ASEAN Cross-Border Expansion (2027-2028):** Extend CAHAYA AgroTrace and ForestGuard engines to Indonesia, Thailand, and regional agricultural commodity exporters requiring verified EUDR compliance.

6. Corporate Identity & Contact Endorsement

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