PROJECT PITCH: COFFEE-SMART

Smart Technology-Oriented Coffee Agroforestry Systems: Integrating Climate Intelligence, Spatial Mapping, and Circular Economy

Integrating Earth Observation, AI, and IoT for Resilient Agricultural Systems

Muhammad Iqbal Habibie, S.Kom, M.T., Ph.D.

Principal Applicant & Project Coordinator

Virtual Call Info & Matchmaking Session: "Climate-Resilient Smart Agriculture using AI & IoT
24 February 2026

APPLICANT PROFILE

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INSTITUTIONAL BACKBONE: BRIN

The **National Research and Innovation Agency (BRIN)** is Indonesia's central body for strategic R&D, established to consolidate national excellence into a high-impact hub.

- **Infrastructure:** High-performance computing & Earth observation systems.
- **Scope:** Earth sciences, AI, Data Analytics, and Circular Economy.
- **Integration:** Intersection of science, technology, and national policy.

Strategic Role

Functions as a **scientific integrator**, translating complex datasets into operational tools for policymakers and smallholder communities.

Key Centers

Geoinformatics, Data Science, Limnology, and Environmental Technology.

STRUKTUR ORGANISASI BRIN

BRIN
BADAN RISET DAN INOVASI NASIONAL

DEWAN PENGARAH
Ketua: unsur Dewan Pengarah BPIP
Wakil Ketua: Menkeu, MenPPN
Anggota: 6 unsur profesional dan / atau akademisi di bidang riset

KEPALA BRIN

WAKIL KEPALA BRIN

INSPEKTORAT UTAMA
- INSPEKTORAT I
- INSPEKTORAT II
- INSPEKTORAT III

SEKRETARIAT UTAMA
- Biro Perencanaan dan Keuangan
- Biro Hukum dan Kerjasama
- Biro Organisasi dan SDM
- Biro Manajemen BMN dan Pengadaan
- Biro Komunikasi Publik, Umum dan Kesekretariatan

DEPUTI BIDANG KEBIJAKAN PEMBANGUNAN
- Sekretaris Deputi
- Dit Kebijakan Pembangunan Manusia, Kependudukan dan Kebudayaan
- Dit Kebijakan Politik, Hukum, Pertahanan dan Keamanan
- Dit Kebijakan Ekonomi, Ketenagakerjaan, dan Pengembangan Regional
- Dit Kebijakan Pembangunan Lingkungan Hidup, Kemaritiman, Sumberdaya Alam dan Ketenagaruliran

DEPUTI BIDANG KEBIJAKAN RISET DAN INOVASI
- Sekretaris Deputi
- Direktorat Perumusan Kebijakan Riset, Teknologi dan Inovasi
- Direktorat Pengukuran dan Indikator Riset, Teknologi dan Inovasi
- Dit Evaluasi Kebijakan Riset, Teknologi dan Inovasi

DEPUTI BIDANG SUMBER DAYA MANUSIA ILMU PENGETAHUAN DAN TEKNOLOGI
- Sekretaris Deputi
- Direktorat Pengembangan Kompetensi
- Direktorat Pembinaan Jabatan Fungsional dan Pengembangan Profesi
- Direktorat Manajemen Talenta

DEPUTI BIDANG INFRASTRUKTUR RISET DAN INOVASI
- Sekretaris Deputi
- Direktorat Pengelolaan Koleksi Ilmiah
- Direktorat Pengelolaan Armada Kapal Riset
- Direktorat Pengelolaan Laboratorium, Fsilitas Riset dan Kawasan Sains Teknologi
- Direktorat Pengelolaan Fasilitas Ketenagaukliran
- Direktorat Kemitraan Infrastruktur Risert dan Inovasi

DEPUTI BIDANG FASILITASI RISET DAN INOVASI
- Sekretaris Deputi
- Direktorat Manajemen Kekayaan Intelektual
- Direktorat Tatakelola Perizinan Riset dan Inovasi dan Otoritas Ilmiah
- Direktorat Repositori, Multimedia dan Penerbitan Ilmiah
- Direktorat Pendanaan Riset dan Inovasi

DEPUTI BIDANG PEMANFAATAN RISET DAN INOVASI
- Sekretaris Deputi
- Direktorat Alih dan Sistem Audit Teknologi
- Direktorat Pemanfaatan Riset dan Inovasi pada Industri
- Direktorat Pemanfaatan Riset dan Inovasi pada Kementerian/Lembaga, Masyarakat dan UMKM
- Direktorat Kemitraan Riset dan Inovasi

DEPUTI BIDANG RISET DAN INOVASI DAERAH
- Sekretaris Deputi
- Direktorat Kebijakan Riset dan Inovasi Daerah
- Direktorat Fasilitasi, Pemantauan Riset dan Inovasi Daerah
- Direktorat Diseminasi dan Pemanfaatan Riset dan Inovasi Daerah

POLTEK TN | **PUSDATIN** | **PUSYANTEK**

ORGANISASI RISET

- OR Kebumian dan Maritim
- OR Hayati dan Lingkungan
- OR Pertanian dan Pangan
- OR Kesehatan
- OR Arkeologi, Bahasa dan Sastra
- OR Ilmu Pengetahuan Sosial dan Humaniora
- OR Tenaga Nuklir
- OR Tata Kelola Pemerintahan, Ekonomi dan Kesejahteraan Masyarakat
- OR Energi dan Manufaktur
- OR Nanoteknologi dan Material
- OR Elektronika dan Informatika
- OR Penerbangan dan Antariksa

SESTAMA : **Fungsi Administrasi dan Infrastruktur Perkantoran**
KEDEPUTIAN : Infrastruktur Riset dan **Layanan Publik** untuk Menghasilkan **Outcome**
OR/PR : Pelaksanaan **Aktivitas Riset u**ntuk Menghasilkan **Output**

PROJECT IDEA: COFFEE-SMART

Main Objectives

Developing a socio-technical framework to enhance resilience and sustainability of coffee agroforestry under increasing climate stress.

- **Predictive Analytics:** Predict stress conditions and evaluate management scenarios.
- **Waste-to-Resource:** Linking environmental data with circular innovations like coffee pulp composting.
- **Decision Support:** High-resolution spatial maps accessible to local cooperatives.

SOCIO-COMMUNITY TARGET

The project is built on **participatory co-design** involving farmers and cooperatives.

- **Direct Beneficiaries:** Thousands of smallholder coffee farmers in Merapi and Menoreh hills.
- **Livelihood Security:** Augmented traditional knowledge with data-driven risk reduction and adaptive management.
- **Economic Value:** New income streams from waste-to-resource innovations (Circular Bioeconomy).

BI-REGIONAL DIMENSION (SEA - EUROPE)

European Leadership

Global leadership in **Earth Observation science**, AI model optimization, and sustainability assessment methodologies.

Southeast Asian Context

Global hotspot for climate vulnerability and agricultural diversity. Heterogeneous landscapes for stress-testing refined technologies.

Mutual Learning

Moving beyond one-directional transfer toward **mutual co-development** and methodological stress-testing in real-world settings.

Landscape Complexity & Climate Stress

Yogyakarta's heterogeneous landscapes are under increasing pressure:

- **Volcanic Slopes (Merapi):** High fertility but prone to temperature shifts.
- **Limestone Hills (Gunungkidul):** Severe drought stress and water uncertainty.
- **The Gap:** Smallholders lack the digital tools to adapt productivity in real-time.

Strategic Call Alignment

Climate Mitigation

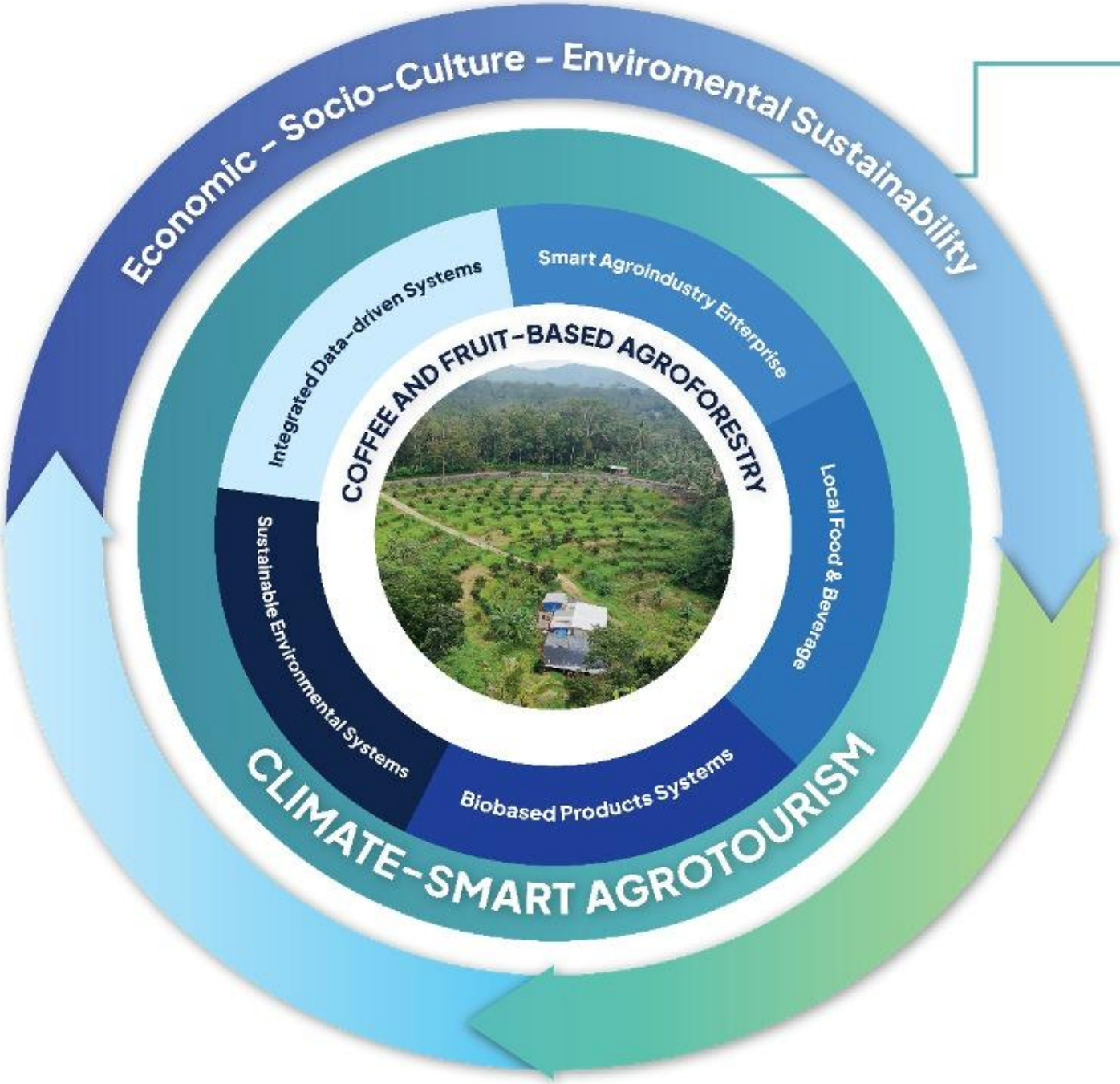
Focusing on adaptive land management and microclimate regulation through agroforestry rather than just carbon accounting.

Digital Innovation

Transforming traditional farming with high-resolution mapping, IoT sensing, and Machine Learning predictive analytics.

Inclusive Growth

Strengthening local capacities and resilience of smallholder coffee communities in vulnerable landscapes.

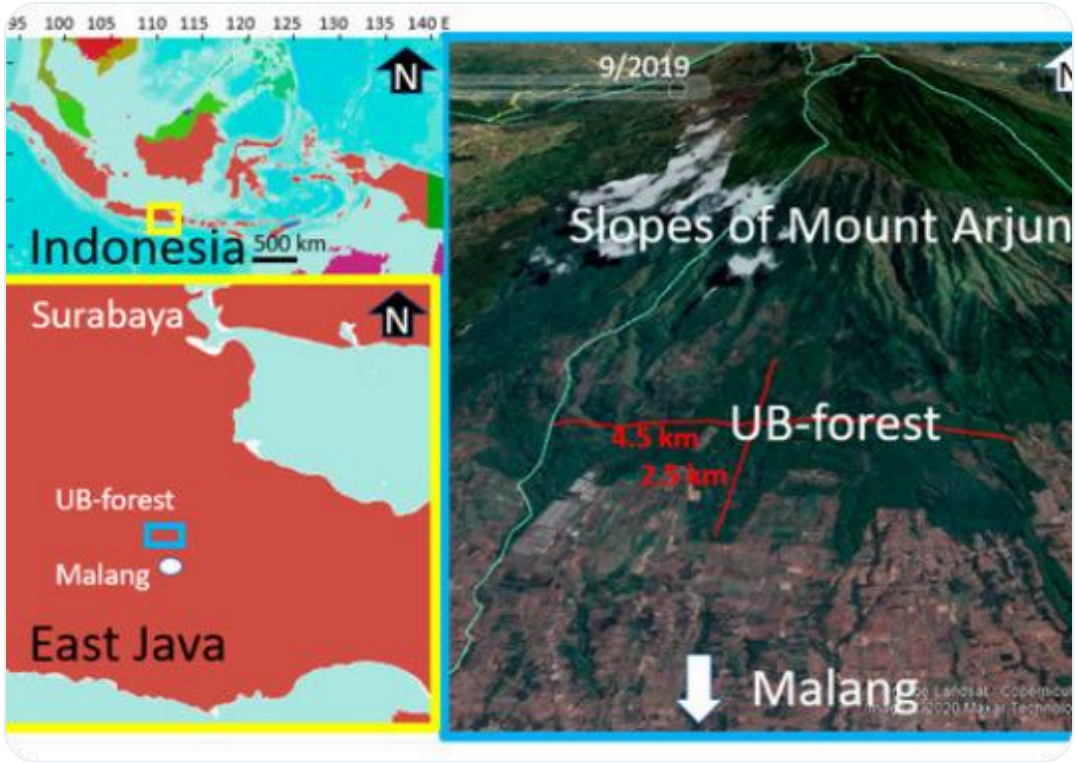


Final Transition
from Agroforestry toward
Climate-Smart Agrotourism (CSAT)

CSAT SUB SYSTEMS:

1. Integrated Data-driven System
2. Smart Agroindustry Enterprise
3. Local Food & Beverage
4. Biobased Products Sytems
5. Sustainable Environmental System

Innovation: State-of-the-Art



What is New?

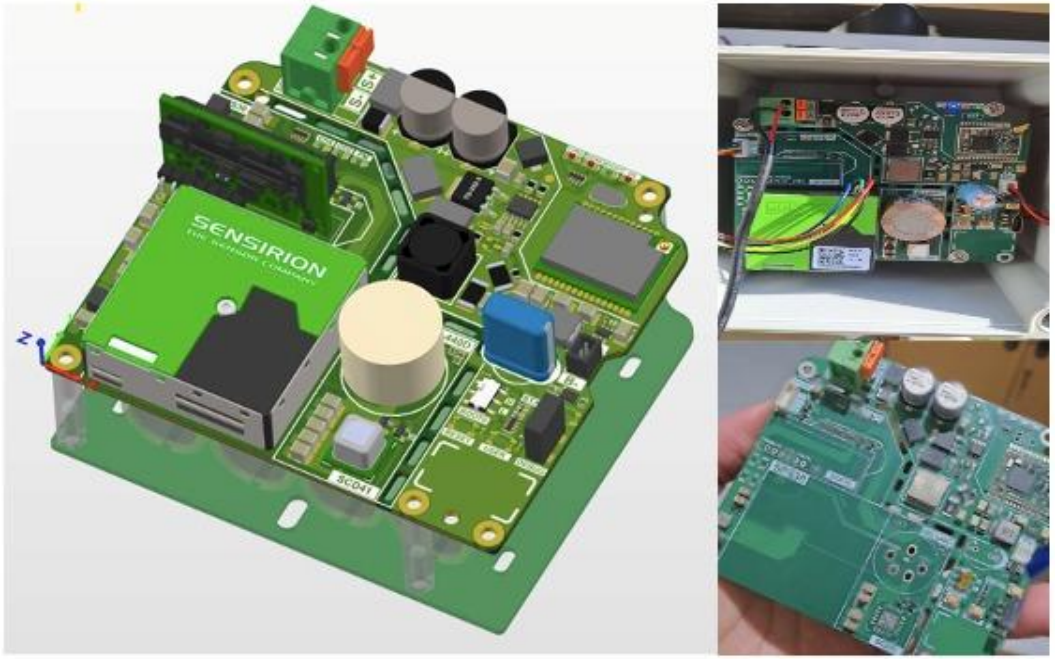
Previous studies are static. We use **real-time IoT data** to capture microclimatic variability *under* the canopy—something satellite data alone cannot do.

Circular Economy Engine

We link water optimization, nutrient cycling, and biomass residue management directly into the ML predictive framework.

1.1 Installation of RTMS at Agroforestry Fruit Plantation with **New Integrated Node Configuration**

July 2024



- ***First trial of RTMS at the agroforestry fruit plantation*** was carried out in July 2024 to identify any obstacles and required improvements
- ***Enhanced with LoRa systems and a signal amplifier***, a modified and improved version of RTMS was installed at the fruit plantation
- ***One integrated node with multiple sensors*** (temperature, humidity, CO2, CH4, particulate matter) and the addition of solar panels and hardware cover
- ***Addition of new sensors SPS30,*** CO2, PM 005/010/025/040/100 concentration, and PM010/025/040/100 mass concentration
- ***The integrated node*** is programmed to ***send readings every five minutes*** to an online dashboard

October 2024

The second field trial was carried out on 17 October 2024 to check the suitability of the **new improvements** and **set up** to prepare the installation at the agroforestry fruit plantation

TECHNOLOGY READINESS (TRL)

CURRENT: TRL 3

Experimental proof of concept. Fragmented components (spatial algorithms, bio-fertilizer labs) validated in isolated environments.

TARGET: TRL 6

Demonstrated in relevant operational context. Active Spatial Map dashboards and "Circular Bioeconomy Hubs" in Yogyakarta plantations.

THE CONSORTIUM

BRIN (Coordinator)

System integration, satellite data processing, spatial analysis, and Machine Learning development.

UGM & NGOs

Field implementation, community engagement, circular economy pilots, and capacity building.

European Partners

Advanced analytics, cross-validation of models, and international dissemination leadership.

Knowledge flows bidirectionally between digital innovation and field realities.

CALL TO ACTION

We are seeking expertise in:

- AI for Earth Observation & Climate Impact.
- Circular Bioeconomy technologies.
- Sustainability & Carbon certification.
- Agri-food business model innovation.

What we offer

Access to a **living laboratory** in a major coffee region, high-quality multi-source datasets, and a collaborative international network.

Thank You

Very much for your attention!

Muhammad Iqbal Habibie

Pusat Riset Geoinformatika - BRIN

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