Title : **AI-Driven Food Security and Climate-Resilient Agriculture in Timor-Leste: From Crop Vision to Intelligent Agricultural Decision Support**

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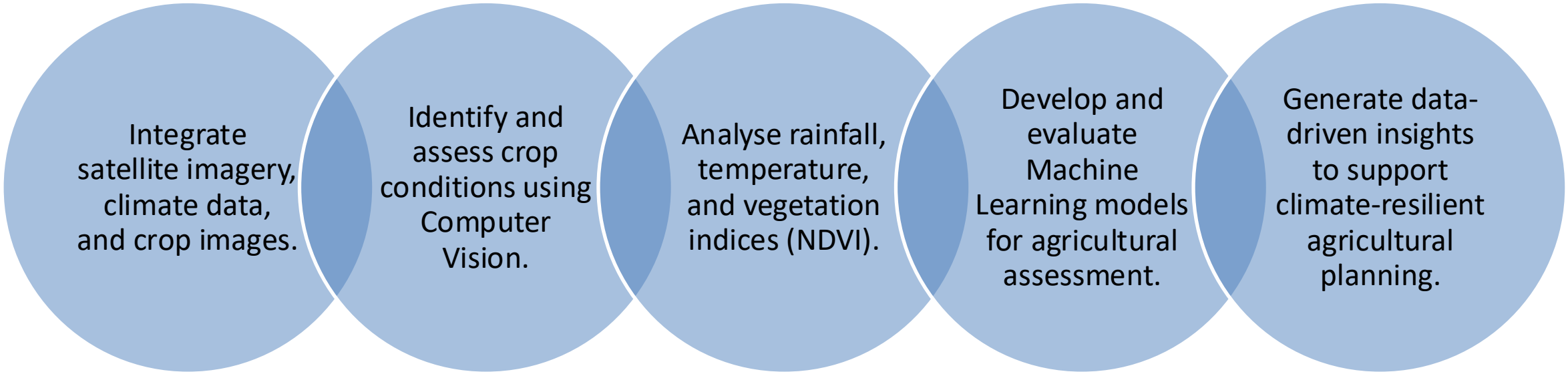
Project Title: **AI-Driven Food Security**

Background :

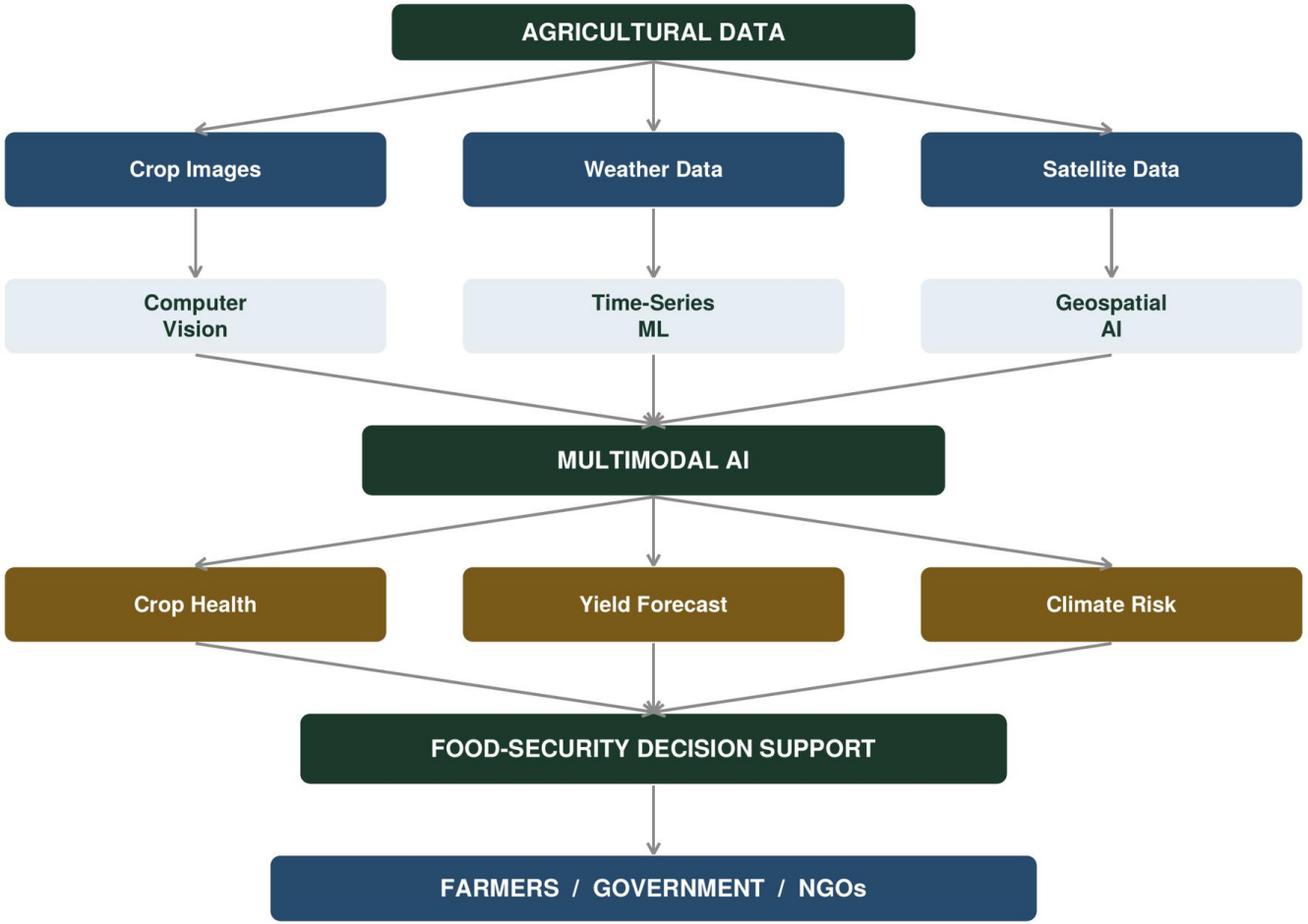
- Timor-Leste continues to face significant food security challenges driven by climate variability, low agricultural productivity, and limited agricultural monitoring capabilities.
- Approximately 70% of the population relies on agriculture for their livelihoods, predominantly through subsistence farming.
- Approximately 364,000 people were projected to experience acute food insecurity (IPC Phase 3 or above) during May–September 2024.
- Rainfall declined by more than 30% during the 2023–2024 El Niño-related drought period, negatively affecting agricultural production and water availability.
- Approximately 97% of agricultural households are smallholder subsistence producers, generally characterized by limited agricultural inputs and low productivity.
- The Challenge of this research Limited integration of climate, satellite, and crop data, Low agricultural productivity and high dependence on cereal imports, Insufficient localized data for continuous crop monitoring.
- Based on this study we will Proposed to Integrating satellite imagery (Sentinel-2/MODIS), climate data, and crop images using Computer Vision and Machine Learning to develop an intelligent agricultural decision-support framework for climate-resilient agriculture and food security in Timor-Leste.

Project Title: **AI-Driven Food Security**

Targets:



Proposed Method: **Layered AI Pipeline (1/3)**



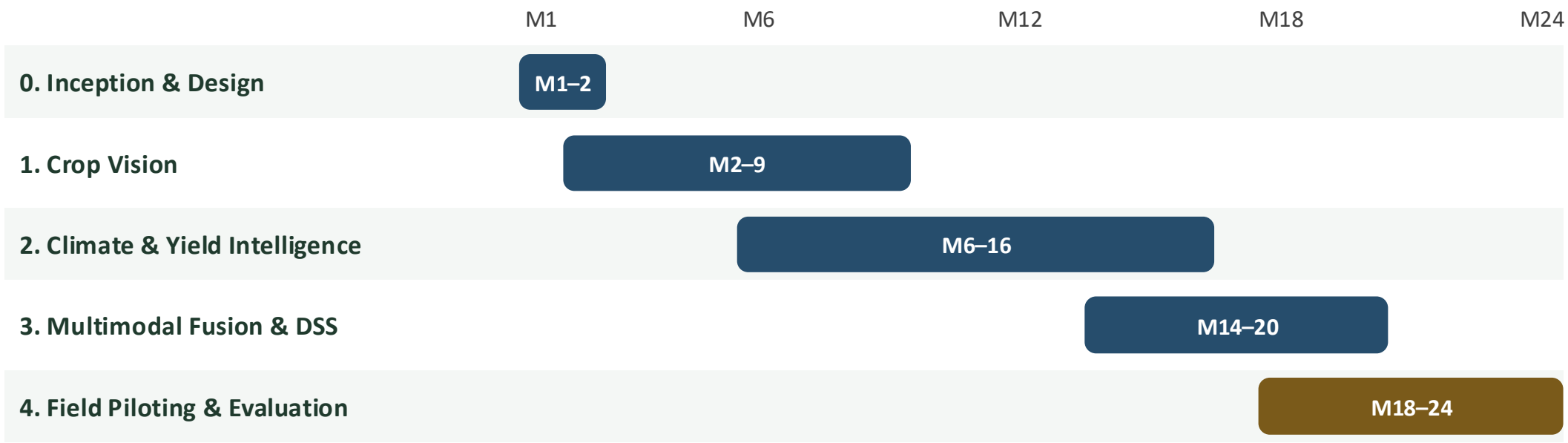
- **Match, then fuse:** one AI method per data source, combined in a multimodal layer
- **Single-modality models:** CNN / ViT (crop images), LSTM / Transformer (weather), geospatial CNN on NDVI (Sentinel-2, MODIS)
- **Fusion and outputs:** cross-attention network with classification and regression heads for crop health, yield and climate risk at suco level

Proposed Method: **Technical Framework (2/3)**

Layer	AI techniques / models	Technology stack
Data	Field/drone image capture; API-based weather ingestion; satellite tiling	Android app + GPS tagging; weather station feeds; Sentinel-2 / MODIS
Single-modality AI	CNN / Vision Transformer (images); LSTM / Transformer (weather); NDVI-based geospatial CNN	PyTorch / TensorFlow, scikit-learn, Google Earth Engine
Multimodal AI	Feature-fusion / cross-attention neural network	PyTorch fusion pipeline, feature store
Output	Classification + regression heads: crop health, yield, climate risk (suco level)	Model-serving API (FastAPI / TorchServe)
Decision support	Rule-based recommendation engine + templated / LLM-assisted messaging	SMS/USSD, low-bandwidth mobile app, web dashboard

Lightweight models and low-bandwidth delivery channels suit a resource-constrained national context.

Proposed Method: **Implementation & Pilot (3/3)**



Phases overlap deliberately: development, validation and platform integration run in parallel.

Pilot sites & validation

Baucau, Bobonaro and Ainaro; ground-truth validation of the yield-forecast and climate-risk models.

Field testing (M18–24)

Farmer co-design workshops, full-season field pilot, staff training and impact evaluation.

Impact: **Societal & Institutional (1/2)**

Food security & livelihoods	Climate resilience	Institutional capacity
• Earlier, more accurate crop-health and yield information • Timelier planting and input decisions • Fewer avoidable losses for smallholder households	• Localized drought and flood-risk alerts • Anticipatory action ahead of El Niño droughts and tropical cyclones • Climate-risk indicators at suco level	• Trained Ministry, extension and community personnel • Able to operate, interpret and sustain the system independently • Municipal extension offices as active users and data contributors

Impact: **Scientific & Collaborative (2/2)**

Data & scientific infrastructure

- Reusable open national agricultural dataset (imagery, yield, climate)
- Supports future research and policy planning
- Released as shared digital public infrastructure via open APIs

Collaboration & integration

- Ministry of Agriculture and Fisheries as primary counterpart and long-term owner
- Coordination with FAO and WFP monitoring to avoid duplicated data collection
- Regional universities for validation and agronomic expertise

Regional replicability

- Architecture adaptable by other small island and climate-vulnerable states
- Open APIs let early-warning systems, crop insurance and ASEAN-level adaptation platforms build on it

Output/Outcome: **Expected Results (1/2)**

Scientific	• Validated crop-vision, yield-forecast and climate-risk models • Multimodal fusion model and integrated decision-support platform
Societal	• Open datasets (crop imagery, geospatial, climate-risk) via open APIs • Field advisories (SMS/USSD, mobile app), municipal dashboards and program-planning reports
Collaborative	• Trained Ministry, extension and community personnel; post-pilot handover to MAF • Scale-up roadmap and co-funding with development partners

Output/Outcome: **Milestones & Deliverables (2/2)**

M2	M9	M16	M20	M24
Inception report and M&E framework	Validated crop-vision model and data-collection app	Yield-forecast and climate-risk models	Integrated decision-support platform	Pilot results, trained personnel and scale-up roadmap

Beyond 24 months: post-pilot handover to the Ministry of Agriculture and Fisheries, models retrained locally, open APIs for future initiatives, and co-funding with development partners.

Conclusion: **From Crop Vision to Decision Support**

Targets

Build vision, weather and satellite AI models, fuse them, and turn the outputs into localized, actionable advice for farmers, government and NGOs.

Method

Layered pipeline: matched AI per data source, multimodal fusion, then decision support; piloted in Baucau, Bobonaro and Ainaro over 24 months.

Scientific & societal impact

Earlier crop-health and yield information, localized climate-risk alerts, and an open national agricultural dataset.

Capacity & next steps

Trained Timorese partners, handover to the Ministry, co-funding, and replication by other climate-vulnerable states.

Thank you · Questions & Discussion