

Agrivoltaics Pitch Hub - Fueling Farm to Fork Innovations

NSEFI



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Agrivoltaics for the *Turmeric* Value Chain

A 15-kW hybrid solar microgrid powering decentralized turmeric processing in Kamrup, Assam.

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01 . CHALLENGE

The Problem:

Turmeric Farmers Stuck in a Low-Value Trap



Labor-Intensive Processing

Boiling, drying, peeling & grinding done entirely by hand, taking ~1 month per acre.
High drudgery for women who perform $\approx 80\%$ of processing labor.



Unreliable Energy Access

Erratic grid power in rural Kamrup limits the use of processing machinery, cold storage, and irrigation pumps—stifling productivity.



Low Value

Farmers sell raw rhizomes at low prices due to lack of processing capacity, missing out on $3-5\times$ value from powder and packaged products.

Realization



Land and Resource Pressure

Scarce agricultural land in Northeast India cannot be diverted for standalone solar. Dual land use is essential to balance energy and food security.

A photograph of a turmeric rhizome growing in dark soil, with a green shoot emerging from the top. The image is partially obscured by a white diagonal line and text.

1 Month
Manual processing
time per acre

5× Loss
Potential value
selling raw

02 · The Innovation

Four things that are *new* here

02 · Shade-tolerant crop

Research confirms turmeric thrives under partial shade.

Evidence point — Odisha study

0.675 kWp AVS over 12 m² produced:

1,115

kWh of energy

21 kg

of turmeric

01 · Elevated agrivoltaic structure

Allows tractor access and **continuous turmeric cultivation** beneath the panels — the land keeps producing food.

03 · Farmer-owned, pay-per-use

Owned & managed by farmers via the **Rangia SHG/FPO**. Nominal fees create a sustainable stream for maintenance and operations.

04 · Islandable hybrid microgrid

PV + Li-ion / lead-acid storage powers boilers, dryers, peelers, grinders and packaging — **even during grid outages**.

03 . SYSTEM ARCHITECTURE

15 kW PV Array

Smart Hybrid
Inverter

Battery Storage

Li-ion / Lead Acid
Islandable Power

Processing Unit

Boilers, Dryers,
Peelers, Grinders

*Under Panel
Crops*

Our Solution: Decentralized Value Addition

System Design

- **Elevated Structure:** Allows tractor access & continuous turmeric cultivation beneath panels.
- **Hybrid Architecture:** 15 kW PV + Battery Storage ensuring reliable power during grid outages.

Energy End-Use

Solar pump

Grinder, Boiler, Pulveriser

Packaging Unit

Operating Model

Owned & managed by Farmers (Rangia). Farmers pay nominal pay-per-use fees for processing services, creating a sustainable revenue stream for maintenance and operations.

04 . PROCESS FLOW

Turmeric Value Chain: From Field to Market

Powered by 15 kW Agrivoltaics Microgrid

Cultivation and Irrigation

Solar-powered irrigation supports turmeric rhizome cultivation in Tulsibari & Kendukona.

Solar pump

Boiling and Curling

Rhizomes are boiled for 45–60 minutes until soft, releasing the aroma that signals readiness.

Solar cooker

Solar Drying

Solar dryers cut drying from 15–20 days to 3–5 days while retaining curcumin content.

Solar dryers

15-20 days ► 3-5 days

Peeling and Grinding

Electric peelers and grinders replace manual scraping—reducing drudgery for women farmers.

Grinder

Packaging & Branding

Branded turmeric powder and slices sold at premium prices via FPO

Packaging Unit

Energy Input

05 . SITE CONTEXT

Project Site: Kamrup, Assam

Rangia

Partner

SHGs

Established organization of smallholder turmeric and ginger growers. Ensures community ownership and local maintenance capacity.

Solar Resource

4.5 – 5.0 kWh/m²/day

High irradiation levels ensure reliable output for the 15-kW system throughout the year, supporting consistent processing operations.

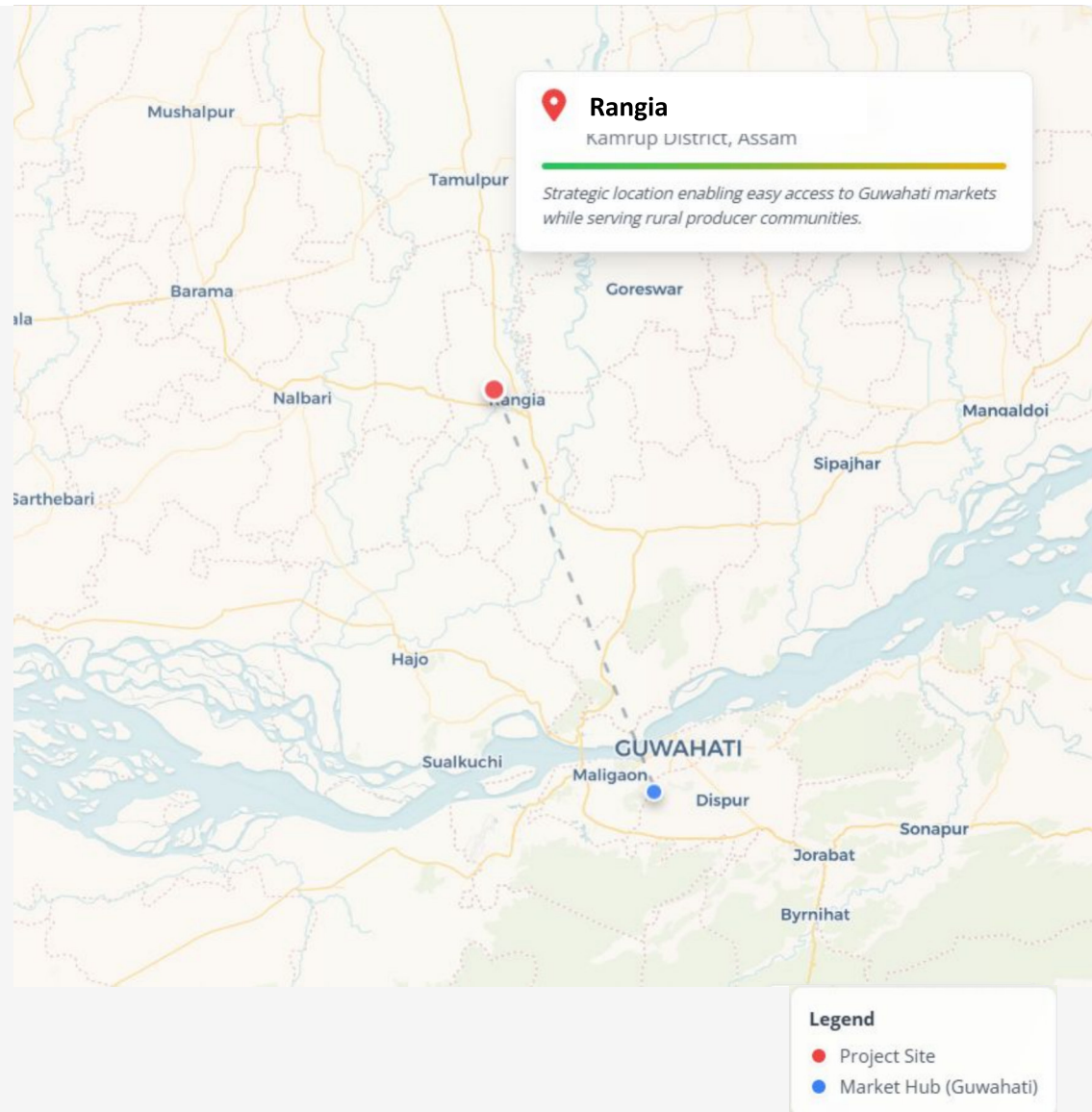
Community Context

Peri-Urban Zone

Processing Gap

~30 km from Guwahati

Critical need for decentralized processing to reduce post-harvest losses and improve market linkages for local farmers.



06 · The Solution — Market opportunity

Assam's turmeric *opportunity*

India's 7th-largest producer — with land to spare

7th

Largest turmeric producer in India — **5.3% of national output**, ahead of West Bengal and Andhra Pradesh.

0.63%

of Assam's net sown area is under turmeric today. **Land is not the binding constraint.**

1.2%

more of Assam's cultivated land needed by 2035 to hold its national share at a 7% CAGR.

The insight

The constraint is *capacity*, not land.

Assam needs only ~34,600 ha by 2035 — 1.2% of its cultivated area — to hold its national share.

3–5×

value from every added unit of processing capacity

Source: Spices Board of India — State-wise Area & Production of Spices, 2024-25 · Directorate of Arecanut & Spices Development, Kozhikode · Assam net sown area 2.81 M ha · Demand CAGR: Future Market Insights, turmeric market to 2035.

07 · The Impact

Expected outcomes & *impact*

Target year:
2026

Capacity

15 kW

Clean energy generation
Powering the value chain

Reach

60+

Farmers benefitting
About 60 SHG members

Top impact

3–5×

Income uplift
Value from processed vs raw

Efficiency

3–5 days

Drying time
Reduced from 15–20 days

Women & drudgery reduction

Processing cycle: **50% time reduction**. Drudgery reduction:
significant (women) — who perform ≈80% of processing labour.

“Mechanization not only improves income but fundamentally changes the daily lives of women farmers by reducing physical strain.”

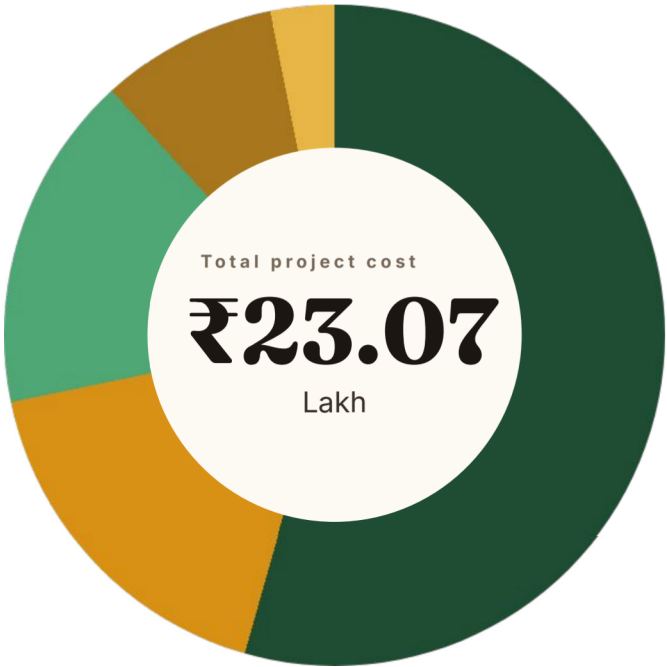
Monitoring & evaluation framework

- Continuous energy monitoring
 - Crop yield and quality data
 - FPO financial records
 - Farmer surveys
- Generating replicable evidence for scale-up across Northeast India.

08 · The Impact — Financial viability

CAPEX: *where the money goes*

Over half the investment is the solar plant + storage — the asset that powers every revenue stream.



PV system (15 kW) + Battery (~36 kWh)	₹12.55 L	54%
Contingency & escalation	₹4.00 L	17%
Processing equipment	₹3.80 L	16%
Civil / EPC / Training	₹2.00 L	9%
Irrigation pump	₹0.72 L	3%
Total project cost	₹23.07 L	100%

Figures as per project financial model.

09 . PROJECT EXECUTION

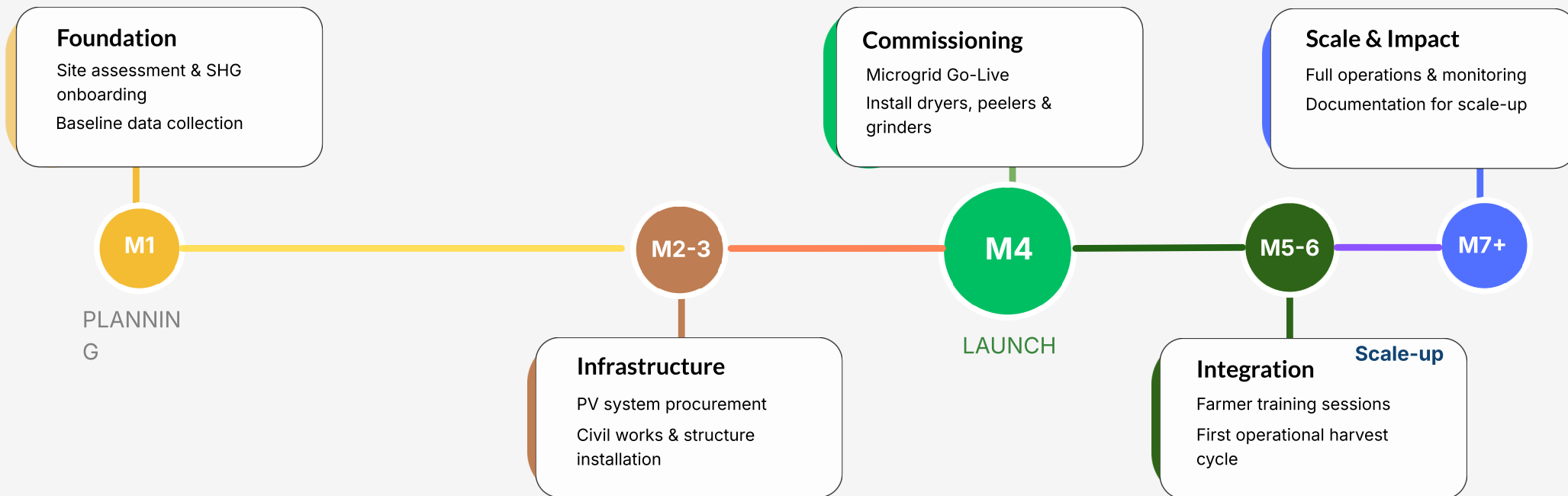
Implementation Roadmap

12-Month Timeline: From Assessment to Scale-up

● PLANNING

● DEPLOYMENT

● OPERATIONS



10 · The Impact — Financial viability

Annual revenues & *returns*

REVENUE	₹ / YEAR
Revenue from product sale	₹1,50,000
Revenue from power & processing services	₹72,000
Total revenue per year	₹2,22,000
COST OF PRODUCTION	
Raw material cost	(₹20,000)
Manpower — 3 persons × 2 months	(₹72,000)
Miscellaneous	(₹50,000)
Total cost of production	(₹1,42,000)

Net income per year

₹80,000

₹2,22,000 revenue – ₹1,42,000 cost

Payback*

4.75 yrs

on processing
equipment

Utilisation

~2 mo/yr

turmeric season

* Payback calculated on processing equipment share of CAPEX (₹3.80 L) against annual net income. Processing unit utilised ~2 months per year. Figures as per project financial model.

11 · The Impact — Off-season utilisation

Beyond turmeric season — *10 months of untapped capacity*

The 15 kW microgrid and processing suite (boiler, dryer, peeler, grinder, packaging) sit idle ~10 months/year. Under a pay-per-use model, that idle time becomes recurring SHG and farmer revenue against an already-capitalised processing equipment CAPEX of ₹3.80 L.

Four utilisation routes

Route A · Drying

Drying-as-a-service for spices, vegetables, herbs, fruits.

*≈ 15 kg / batch community capacity
(Meghalaya SHG reference)*

Route B · Boiling for ginger

Same boiler, 45–60 min pathway.
Ginger pairs naturally with turmeric.

*Drying pathway documented (hybrid-solar
ginger study)*

Route C · Bay Leaf Drying

Drying aromatic tejpat leaves for
retail and wholesale spice markets.

*Native to NE India — fits low-temperature
drying*

Route D · Milling + packaging

Fee-for-service milling and
retail-packaging for neighbouring
FPOs.

Grinder + packaging unit already on site

Three annual-revenue scenarios · illustrative envelope

Conservative

~₹45,000 / yr

~30 operating days × ~₹1,500 / day

*Baseline enrolment — Rangia SHG members, drying
only*

Moderate

~₹1,08,000 / yr

~60 operating days × ~₹1,800 / day

Spillover from 1–2 adjoining FPOs, ginger-led

Ambitious

~₹2,64,000 / yr

~120 operating days × ~₹2,200 / day

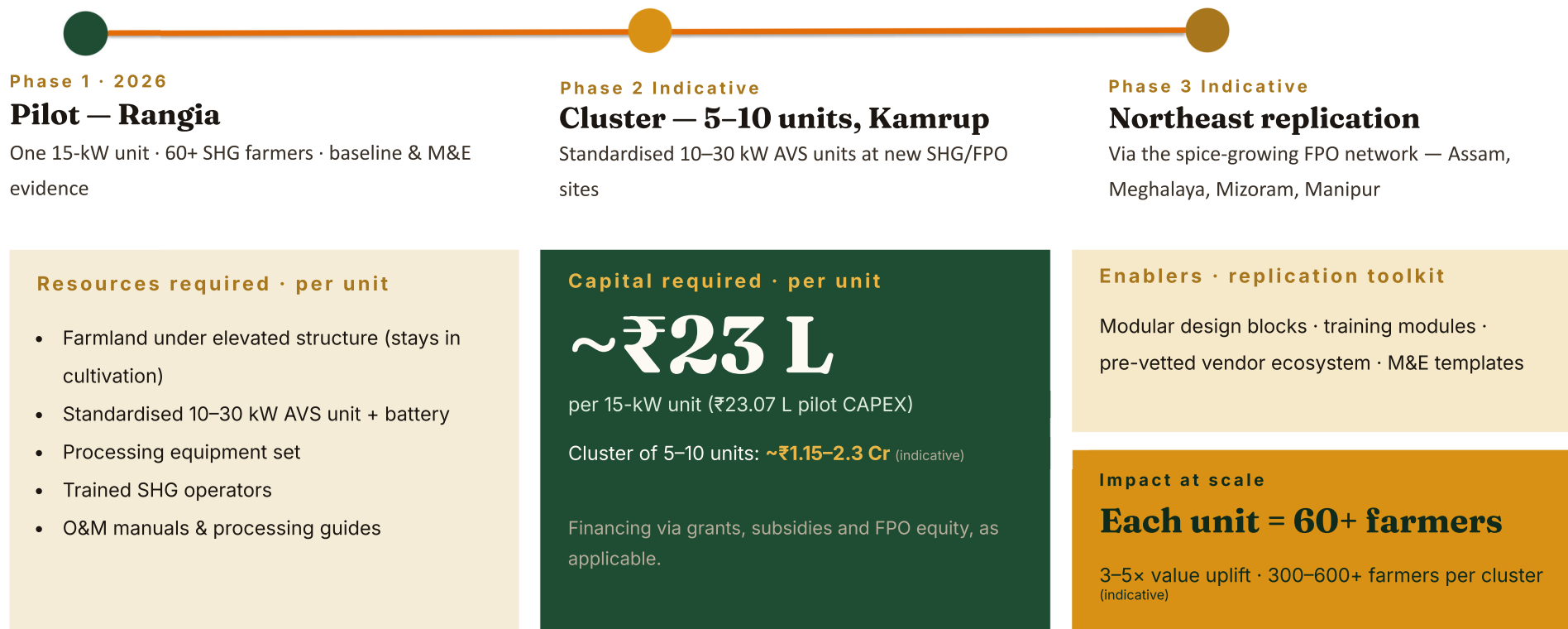
Multi-crop calendar, multiple FPO customers

Capture structure — Equipment CAPEX (₹3.80 L) is already paid. Off-season margin = revenue – incremental cost. *Additive* to the ₹80,000 net. Net uplift split per FPO bylaws set during pilot.

Indicative envelope — calibrate per-kg pay rates during pilot. Sources: GHE (SHG solar dryer capacity) · Spices Board India (processing & post-harvest scope) · PMC (hybrid-solar ginger drying).

12 · Scale-up Plan

From one pilot to a *Northeast blueprint*



Indicative items are planning estimates extrapolated from pilot figures (₹23.07 L CAPEX, 60+ farmers per unit). Policy tailwind: Assam Solar Power Generation Promotion Policy 2025 — 3,500 MW by 2030, with an explicit push for agrivoltaics.



Joining the agrivoltaics movement

Let's take this pilot to *every turmeric cluster* in the Northeast.

Partner with us on the Rangia pilot and the Kamrup cluster — same land, more food, clean power, and 3–5× value for 60+ farmers per unit.

Get in touch

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