Integrated Aerobic Systems for Rice Straw Management: A PM2.5 Mitigation Solution for Nakhon Nayok's Floating-Rice Areas

Aukrit Unahalekahka - CEO Thara Green

aukrit@tharagreen.com

For Farmers, Burning is a Necessity Driven by a Unique Challenge: ‘Floating Rice’.

Unique Crop

Floating Rice (ข้าวขึ้นน้ำ) is grown in deep water (1–5 metres). Its stalks are exceptionally long (1.5–2.0m), thick, and tough, making them extremely difficult to decompose naturally.

Post-Harvest Conditions

Harvesting occurs in the dry season. The lack of water makes traditional decomposition methods, which require flooding the fields, impossible and cost-prohibitive.

Economic Pressure

Farmers must clear large fields quickly and cheaply to prepare for the next crop before the rains. Burning is the fastest and lowest-cost option available.

The Anatomy of the Problem:
Why Floating Rice Straw Resists Decomposition

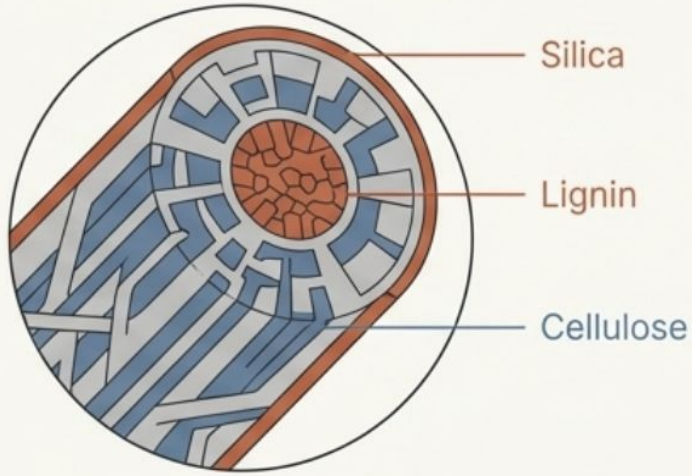
Harvesting Leaves Massive Residue

Harvested: top 50cm

Residue 1.5 – 2.0 Meter of tough straw

2-3 Meter Tall

Biologically Resistant Structure



Toughness

The straw's structure is dominated by Lignin, Cellulose, and Silica, which are highly resistant to natural breakdown.

Low Value

The straw is unsuitable for animal feed as it is hard to digest and has low nutritional value. Animals do not like to eat it.

Mechanical Failure

The sheer volume and toughness of the residue makes it difficult for standard farm machinery to till back into the soil.

The Farmer's Choice: An Equation Where Burning Becomes the Rational Answer

1. Tough, Long Residue

The floating rice straw is too long, thick, and tough for standard equipment to handle or for animals to eat (low nutritional value).

2. No Water Post-Harvest

Harvest occurs during the dry season. There is not enough water to use conventional microbial decomposers, which require flooding the field. This also rules out natural decay.

3. High Cost of Alternatives

Mechanical baling is expensive (~2,000 THB/rai), labor is scarce, and there's no market to sell the low-quality straw.

4. Urgent Timeline

Farmers must clear the fields quickly to prepare for the next crop before the rains, leaving no time for slow decomposition.

*Farmers are not choosing to burn out of convenience; they are **trapped by a system of environmental**, economic, and logistical constraints.*

A Technological Breakthrough: Aerobic Microbial Decomposition

Our solution uses advanced **Aerobic Microbial Biostimulants** to decompose rice stubble. Unlike previous methods, our technology works *with* oxygen and without the need for flooding. It is a faster, cleaner, and more sustainable method for managing post-harvest residue.

A New Approach: Thara's System to Decompose Rice Straw Without Burning or Flooding

We can change the equation with a system that is effective, affordable, and works in the dry conditions of the harvest season.

Step 1: Application

Thara's Aerobic Microbial Solution is applied directly onto dry crop residue using high-efficiency drones.

Apply within 3 days after harvesting to get enough moisture. Drone scheduling optimized through satellite mapping..

Step 2: Decomposition

The specialized microbes rapidly break down up to 80% of the tough straw in just 3 weeks, using only ambient moisture.

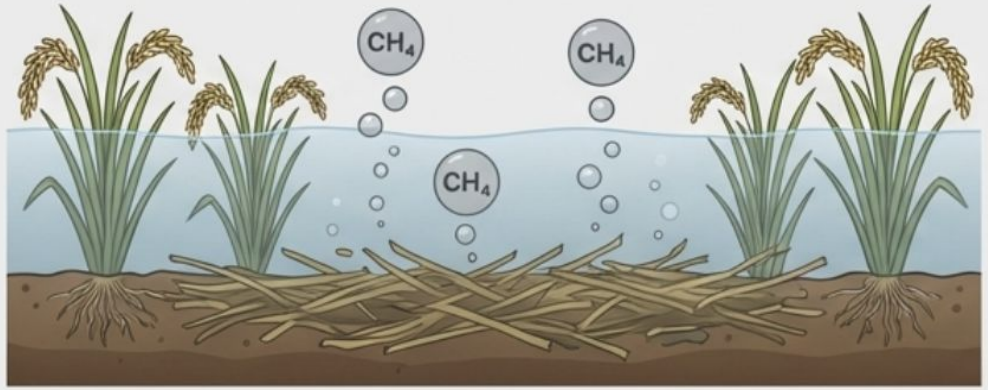
Step 3: Integration

The decomposed material is easily tilled back into the soil, enriching it with organic matter and nutrients.

Free Fertilizer! Also help increase crop yield from straw nutrient.

The Technological Breakthrough: Aerobic vs. Anaerobic Decomposition

Conventional Method (Anaerobic)

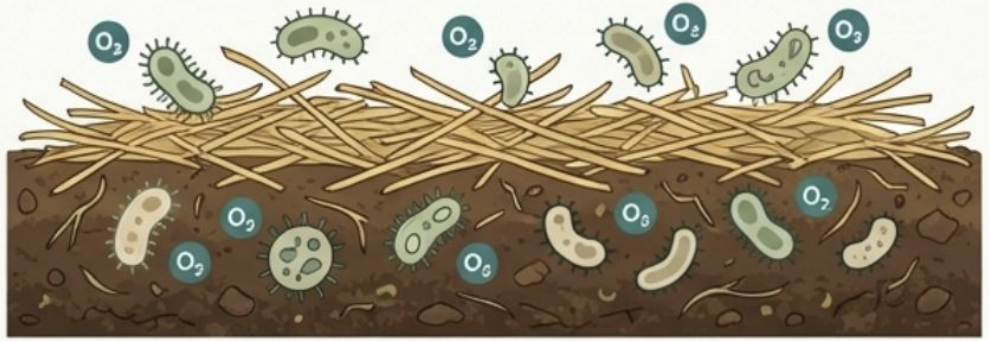


- Requires flooding the field.
- Uses anaerobic microbes (don't need oxygen).
- Process leads to fermentation and rotting.

Result: Releases high levels of Methane (CH_4), a potent greenhouse gas.

Limitation: Impractical in dry season; high water cost.

The Thara Solution (Aerobic)



- Works in dry or moist conditions (no flooding required).
- Uses aerobic microbes (require oxygen).
- Process is a clean, rapid decomposition.

Result: Significantly reduces methane emissions.

Advantage: Perfectly suited for post-harvest conditions; improves soil structure.

Proceeding under severe dry-season constraints intentionally tests real-world robustness

Optimal Conditions

- 0–5 days post-harvest
- 60–80% moisture
- Soft plant tissues

Actual Pilot Conditions

- 4 weeks post-harvest
- 10–20% moisture
- Hardened, hydrophobic cell walls

Very Dry and Thick! →

The Constraint: Most participating plots had been harvested four weeks prior to mobilization. Straw moisture had plummeted to 10–20%, plant cell walls had hardened, and surfaces became hydrophobic.

The Strategic Decision: Rather than postpone to a future season, the project deliberately proceeded under these worst-case conditions.

The Value: This approach provides a rigorous, conservative assessment of the system's viability for Farmers who lack optimal timing or irrigation infrastructure.

Adaptive science secured microbial activation in low-moisture environments

1

Night/Early Morning Spraying

Operations restricted to 21:00–09:00 to leverage peak ambient humidity and natural dew formation.

2

Microbial Pre-Activation

Formulations metabolically activated for 1–2 hours prior to flight to stimulate spore germination before contact with dry straw.

3

Adjusted Intensity

Increased microbial powder concentration while maintaining an 8-liter per rai spray volume to compensate for slower biological diffusion.

4

Surfactant Additives

Incorporated into the mixture to break surface tension and improve adherence to hydrophobic plant fibers.

Drone operations achieved 100% targeted coverage across clustered floating-rice plots

Jan 26 - Feb 2, 2026

Mobilization

Field teams verified plot boundaries, secured non-burning commitments, and mapped access routes for roughly 30 farmers.

Deployment

50-liter UAV units executed the adapted night-spraying protocol across spatially clustered farmland to maximize aerial efficiency.

Verification

Strict GPS logging, photographic records, and continuous field supervision guaranteed complete coverage across the planned 801 rai.

Farmers show strong environmental interest but remain pragmatically cautious

Interest Level:	High. Farmers acknowledge regulatory PM2.5 pressures and actively want viable non-burning alternatives.
Primary Concern:	Effectiveness of decomposition under dry, non-flooded conditions, based on past failures with anaerobic products.
Ultimate Adoption Drivers:	The decision to adopt will not rely solely on environmental benefits. It requires proven ease of ploughing (no machinery clogging) and clear cost feasibility.

The Strategic advantage for Bangkok and anticipated co-benefit for other provinces

Solves the Root Cause

Provides a cheaper and easier alternative, directly reducing the primary incentive for farmers to burn.

Aligns with Climate Policy

Significantly cuts methane (CH_4) emissions, supporting Bangkok's "Low-Carbon City" vision and unlocking future access to Climate Finance and Green Budgets.

Enables Data-Driven Policy

Offers an immediate, low-risk pilot project to gather concrete data before large-scale commitment.

Creates a Scalable National Model

The system is standardised and quality-controlled by Thara, ready for nationwide expansion.

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Thank you

aukrit@tharagreen.com
Line: aukritu