IASF 2026 Project Abstract: CoolRoofX

1. Title Page

Project Title: CoolRoofX – Sustainable Passive Cooling Paste from Agricultural Waste
Team Name: CoolRoofX
College Name: Anurag University, Hyderabad
IUCEE Student Chapter: Anurag University IUCEE Student Chapter

2. Chosen SDG Target

- **SDG 11**: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

- **SDG 12**: By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.

3. Problem Statement

In many Indian households, especially in semi-urban and rural areas, rooftops made of cement or metal trap heat, making indoor environments unbearably hot during summers. Existing cooling solutions like synthetic paints only reflect sunlight temporarily and degrade quickly.

Simultaneously, agricultural waste such as rice husk, coconut shells, and eggshells is often dumped or incinerated, adding to pollution and wasting potentially valuable materials. India's urban heat island effect causes city temperatures to rise 4–8°C above surrounding areas, increasing dependency on electrical cooling devices.

4. Abstract

CoolRoofX presents a sustainable passive cooling paste made from agricultural waste, designed to be applied directly onto existing rooftops. This eco-friendly coating reduces indoor temperatures by reflecting sunlight and insulating against heat, without the need for electricity or major construction.

The paste is created from powdered rice husk ash, coconut shell ash, eggshells, lime, and cement, forming a durable layer that outlasts conventional paints and performs significantly better in harsh climates. Targeting rural homes, schools, and small businesses, CoolRoofX offers a cost-effective, long-lasting, and environmentally conscious alternative to traditional cooling methods.

5. Proposed Solution & Objectives

Proposed Solution:

- Most cooling paints rely on synthetic materials, offer surface-level cooling only, and degrade within a couple of years.
- CoolRoofX uses biodegradable agricultural waste mixed with lime and minerals to form a paste that is both reflective and insulating.
- The paste binds strongly to cement, concrete, or metal roofs and remains effective for multiple summers.
- It is applied like standard paint but with superior performance, durability, and sustainability.

Objectives:

- Lower indoor temperatures by 4–10°C through passive cooling
- Replace synthetic cooling paints with natural, long-lasting paste
- Promote waste reuse and circular economy through agricultural byproduct upcycling
- Minimize energy consumption and improve comfort in heat-affected communities

6. Detailed Explanation of the Solution

The CoolRoofX paste is developed by finely grinding rice husk, coconut shells, and eggshells, and mixing them with lime, clay, and minimal cement. The resulting bio-composite paste is water-resistant, thermally insulating, and highly reflective.

Workflow:

1. Collect and clean agricultural waste
2. Process into ash or fine powder
3. Blend with lime and cement to form paste
4. Apply over rooftops using brushes or rollers
5. Monitor temperature changes with sensors

Interdisciplinary Elements:

- Materials Science: Composite formulation and testing
- Environmental Engineering: Waste reuse and emissions reduction
- IoT: Arduino-based temperature monitoring

Design Thinking:

User feedback from rural communities highlighted the need for affordable, low-maintenance, and DIY-friendly solutions. Our iterative design ensured that CoolRoofX is simple to apply, cost-effective, and scalable across regions with diverse climates and roof types.

7. Proof of Concept

CoolRoofX is practical for grassroots implementation with minimal tools and cost. A prototype was created using locally sourced materials and applied to a test roof. Arduino sensors tracked an indoor temperature drop of 4–6°C, confirming the cooling effect.

Technology Stack:

- Arduino UNO
- DHT11/DS18B20 temperature sensors
- Grinding & mixing tools
- Paint rollers/brushes for application

Estimated Cost: Under ₹10,000 including materials and sensors

Why CoolRoofX is Better than Traditional Cooling Paints

- Dual Action:
  - Traditional paints only reflect sunlight
  - CoolRoofX both reflects sunlight and insulates against heat

- Long-Lasting Durability:
  ▸ Cooling paints typically last 1–2 years, then peel or fade
  ▸ CoolRoofX stays effective for 4–5+ years without degradation

- Eco-Friendly Composition:
  ▸ Paints contain synthetic chemicals and may release VOCs
  ▸ CoolRoofX is made from biodegradable agricultural waste: rice husk, coconut shell, and eggshell

- Strong Surface Compatibility:
  ▸ Cooling paints often need a primer or smooth surface
  ▸ CoolRoofX directly bonds to cement, concrete, and metal roofs

- Cost Efficiency Over Time:
  ▸ Paints require frequent reapplication, increasing long-term costs
  ▸ CoolRoofX is a one-time solution with minimal maintenance

- Environmental Impact:
  ▸ Paints don't contribute to waste reduction
  ▸ CoolRoofX upcycles agricultural waste, aligning with SDGs 11 & 12

- Scalability for Rural India:
  ▸ Paints depend on urban supply chains
  ▸ CoolRoofX is DIY-friendly and can be made & applied locally

8. Expected Outcomes

- Indoor temperature reduction by 4–10°C in field applications
- Lower usage of fans and coolers, especially in rural homes
- Repurposing of agricultural waste into value-added construction material
- Improved health and comfort in heat-stressed regions

Long-Term Benefits:

- Scalable to mass housing and schools
- Encourages eco-conscious local entrepreneurship
- Contributes to climate-resilient infrastructure

9. Resources Required

Materials: Rice husk ash, coconut shell powder, eggshells, lime, clay, cement
Technologies: Arduino board, sensors, mixing tools, rollers
Estimated Budget: ₹10,000 for prototype and test setup

10. Team Details:

Team Lead: Thanughna - Computer Science Engineering (4th year)

Team Members:

- Sayyad - Electronics and Communication Engineering (3rd year)

- Rishi - Information Technology (3rd year)

- Theerdha - B. Pharmacy (3rd year)

11. Faculty Mentor

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