From Pollution to Power: Converting Paddy Residue into Biogas

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UCL

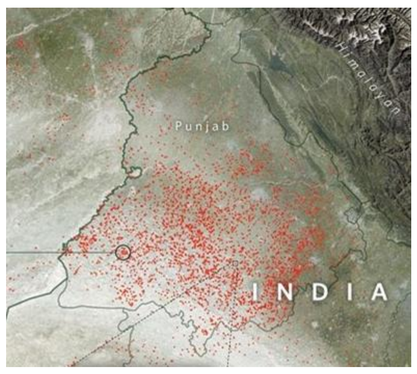
Overall Problem Content

Problem Statement : Crop-Burning

- Crop burning in Punjab, Northern India, contributes to **50% of Delhi's pollution** [1,2]
- Crop burning poses environmental and health risks to local and neighbouring communities [3]

Current Situation and Challenges

- Non-burning alternatives like PRANA or HARIT machinery technology have been introduced to tackle this issue [4,5]
- **Small-scale farmers** face obstacles in adopting this technology due to machine unaffordability and time management [2,6]



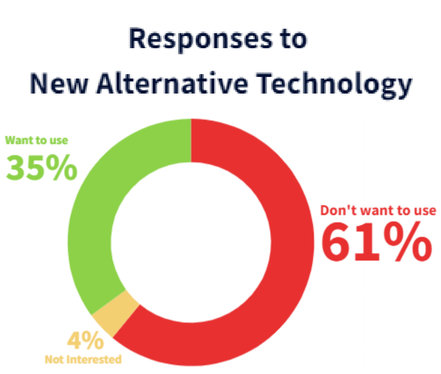


Figure 1. Each Red dot represents a crop-burning case © 5W Infographics

Why Gurdaspur District?

200K Ha Estimated Crop Burning Area

58% Percentage of Small Farm Area

3rd Crop-Burning Cases Ranking in Punjab

63% Usage of Solid Fuel

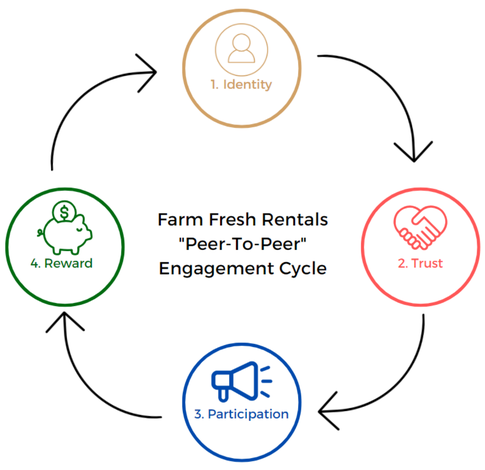
One of the most Tech-friendly district

Activating the Adoption of Alternative Machinery Methods

Marketing Strategy 1 : Digital and Physical Outreach

- Utilization of a **digital flyer sent** via email to residents of Punjab
- Printed and **physically mailed flyers** to individual small-scale farmers in the region
- Distribution of flyers to farming and pollution organizations for **wider reach**
- Ensuring comprehensive coverage and access to information **for the concerned population** of Punjab
- **Utilizing website** to improve accessibility and machine management

Figure 2. Digital flyer



Marketing Strategy 2 : Sustainable Farming Advocacy and Reward Program

- Focused on **peer-to-peer** marketing
- **Incentives** offered for farmers who **introduce** a specified number of fellow farmers to the program
- Contribution to a **greener India** and earning credits towards advantages
- **Win-win situation** that rewards commitment to sustainable farming practices

Biogas Generation

Why Biogas?

- Biogas is a **cleaner alternative** to solid fuels.
- Biogas from paddy residue provides a **renewable energy source**
- Biogas can be used for cooking, heating, electricity, and transportation
- Biogas production creates **local economic opportunities**
- **Job creation** and economic growth

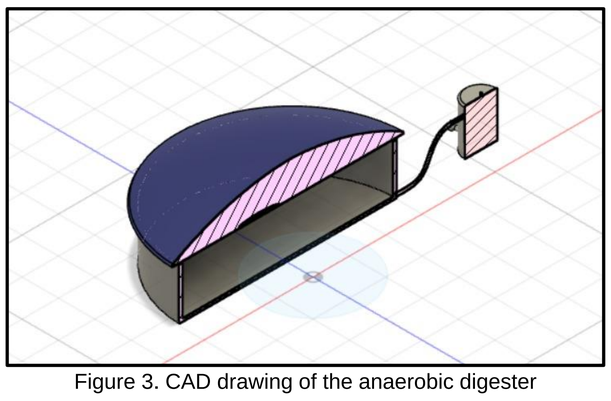


Figure 3. CAD drawing of the anaerobic digester

About the Anaerobic Digesters

- **Advantage**: **No pre-treatment** required of crop residue is required when using an adiabatic digester
- **Implication**: on-farm and off farm operation
- **5 stage process** : collection, packing, handling, transportation and processing
- **Efficiency** : **Produce £ 25 worth of biogas** per 1 metric ton of crop residue

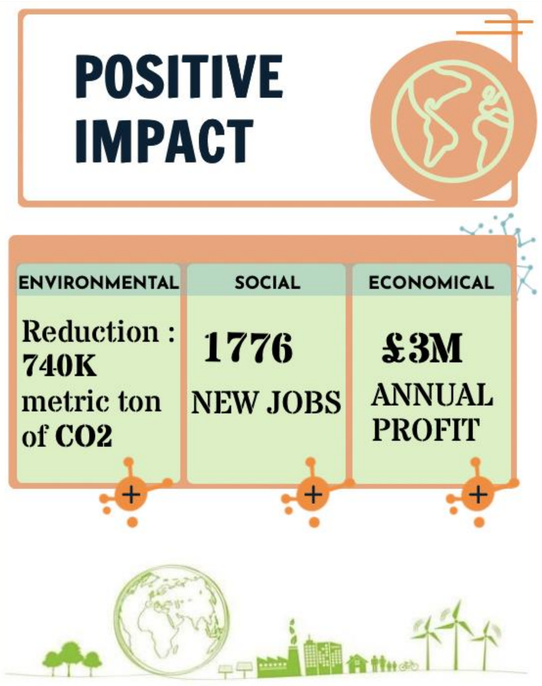
Micro-Scale Case Study

Case Study of Harpura Village	
Demographic	
Total Crop Land	600 Ha
Total Population	2,864 person
Residue Collecting Machine	
Machine Efficiency	4.2 Ha / day
Required Number of Machine	10 machine
Cost of One Machine	£ 3350
Total Cost of Machine	£ 33.5 K
Biogas Plant	
Paddy Yield	2,505 metric ton
Paddy Residue	4,260 metric ton
Biogas Yield	1,703,400 m^3 / yr.
Energy Production	10,220 MWH
Total Annual Energy Consumption	4,875 MWH
Energy Surplus	5,345 MWH
Estimated Income	£ 34.0 K

Brief Summery of the Case Study

- **Surplus biogas** generated by the plant exceeds village consumption
- Excess biogas is sold, **generating profits**
- Profit covers residue collecting machinery cost
- **Free machinery rental** provided to farmers
- Promotes **wider adoption** of sustainable practices

Potential Impacts : Paving the Way for Sustainable Change



Improve air quality, **reduce respiratory issues**, and **promote better health** by replacing solid fuels with clean biogas, reducing crop burning.

Provide affordable and clean energy by using paddy residue for biogas production, replacing solid fuels for cooking and heating in rural areas.

Foster sustainable communities through biogas plant implementation, reducing reliance on traditional energy, creating jobs, and stimulating local profits.

Tackling Constraints

- Minimizing Financial Burden: **Affordable solution** for farmers, reducing financial constraints
- Sustainable Alignment: Solution supports sustainable goals, **attracting funding opportunities**
- Government Friendly: **Aligned with government initiatives**, increasing support and cooperation
- Low Maintenance: **Easy-to-maintain biogas plant**, minimizing training and operational challenges

The Way Forward

2024 : Fundamental Research
- Conduct research on **specific data** for a represented village in Gurdaspur.
- **Secure funding** from the government and organizations.
- Establish cooperation with **machine manufacturers**.

2025 : Biogas Plant Implementation
- **Develop and finalize** the marketing plan for the biogas plant.
- **Implant the biogas plant** in the represented village in Gurdaspur.

2030 : Expansion in Gurdaspur
- Expand the biogas plant project to **cover 60% of small farms** in Gurdaspur.
- **Establish partnerships** with local farmers to implement biogas technology.

2040 : Multiple Districts
- Extend the project to the **neighbouring districts** in Punjab.
- **Increase awareness** among parents, elders, and patients.
- Collaborate with schools, hospitals, and nursing homes.
- Negotiate with neighbouring District Councils.

2050 : No Crop Burning
- Achieve the goal of **no crop burning** in Punjab.
- Implement **widespread adoption** of biogas technology.
- **Monitor and evaluate** the impact of the biogas plant project.

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