Alternatives to straw burning in Punjab and Haryana, India
SMP 18011

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Partners: Embassy New Delhi, VHL, Agricultural University of Haryana, Nettenergy, ECOR Composite Panels, iMVO, World bank,

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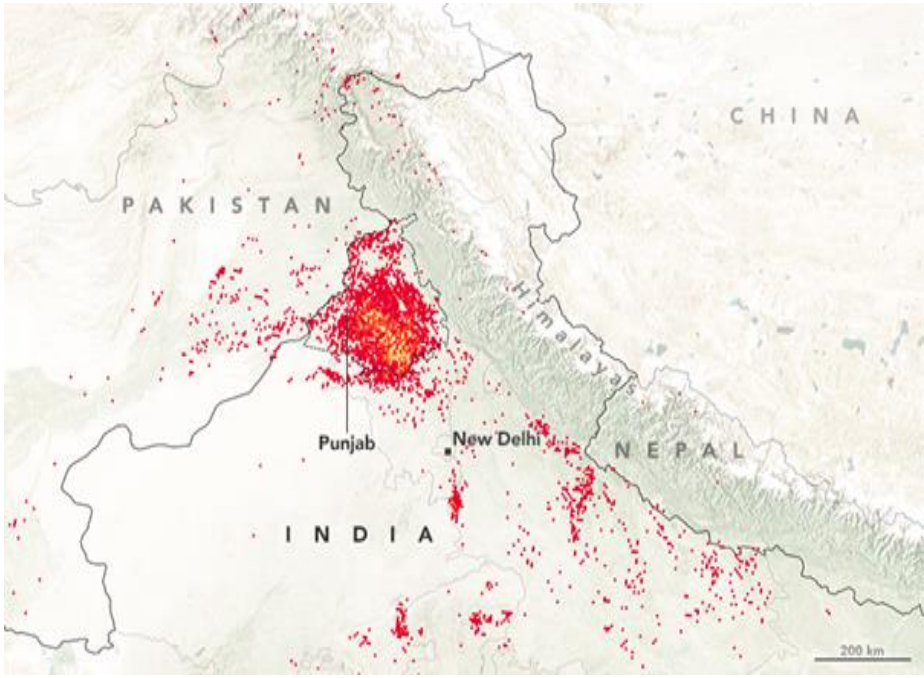
The problem

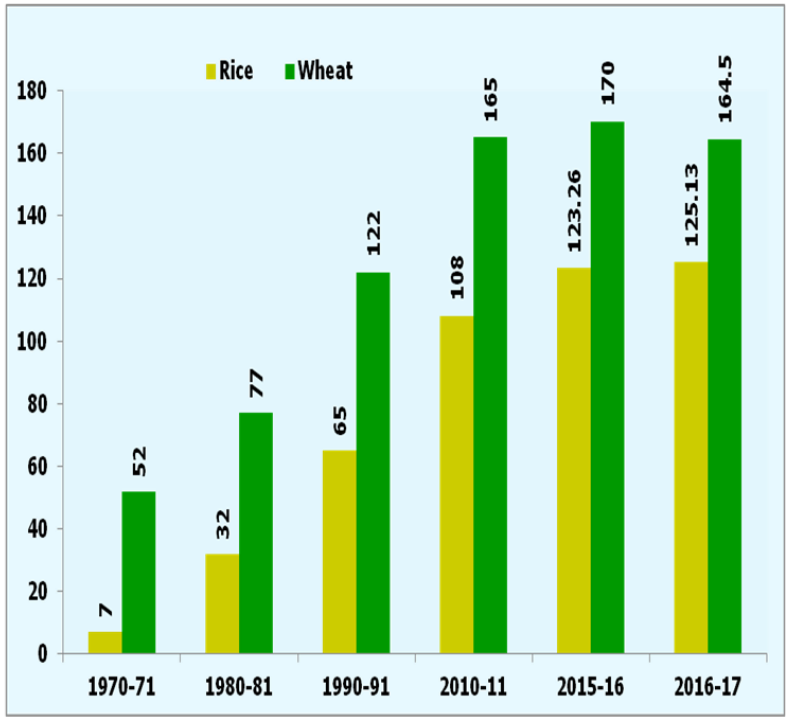
- 20 million tons of rice straw burned over a 4 week period in November/December
- Pollution levels skyrocket

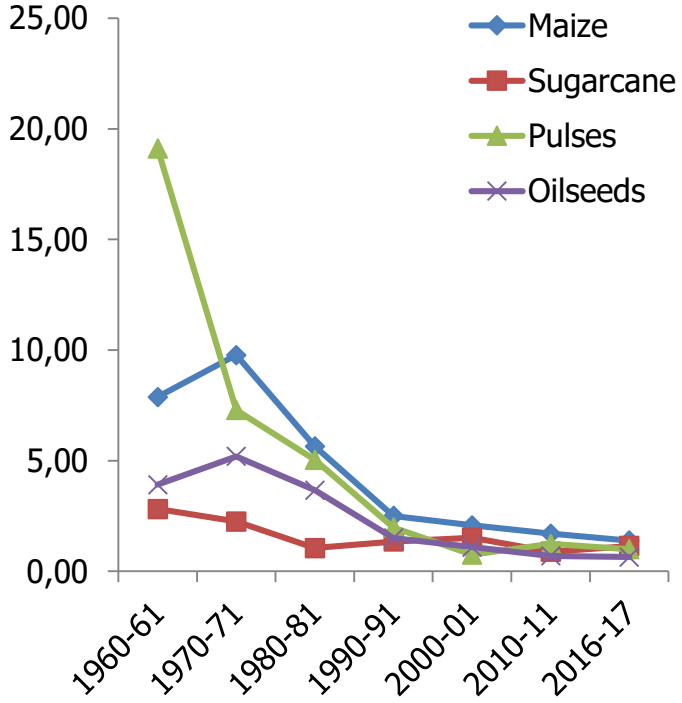
- Why?
  - Need to sow wheat → Need to clear the land fast
  - No labour for straw harvest and removal – mechanical straw harvest costly
  - No space for straw storage
  - Rice straw has low value: high ash – low quality feed and biomass. Wheat straw is better!

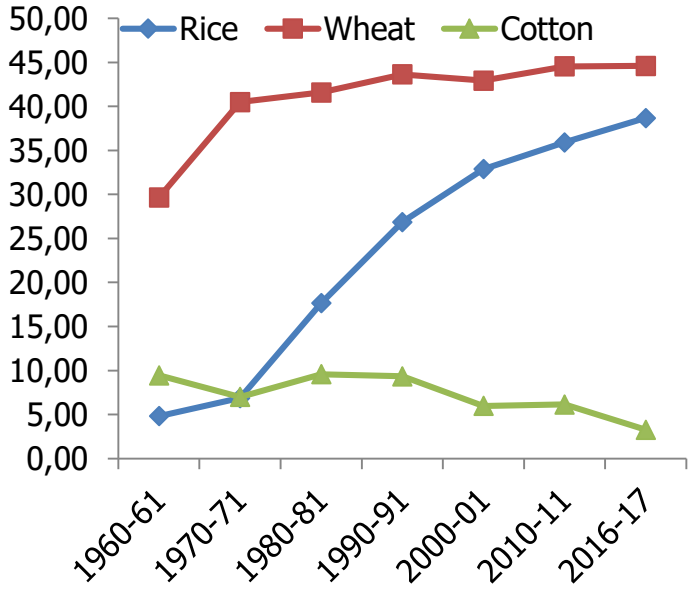


% area of rice and wheat % and total production has increased

Production of Rice and Wheat (Lakh Tonnes)



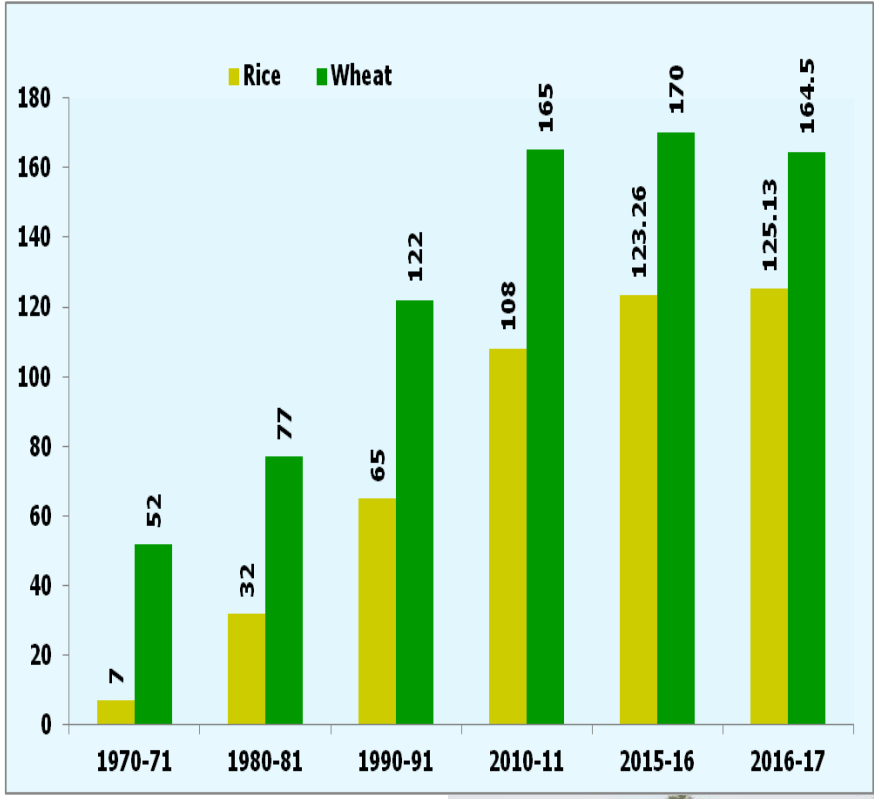


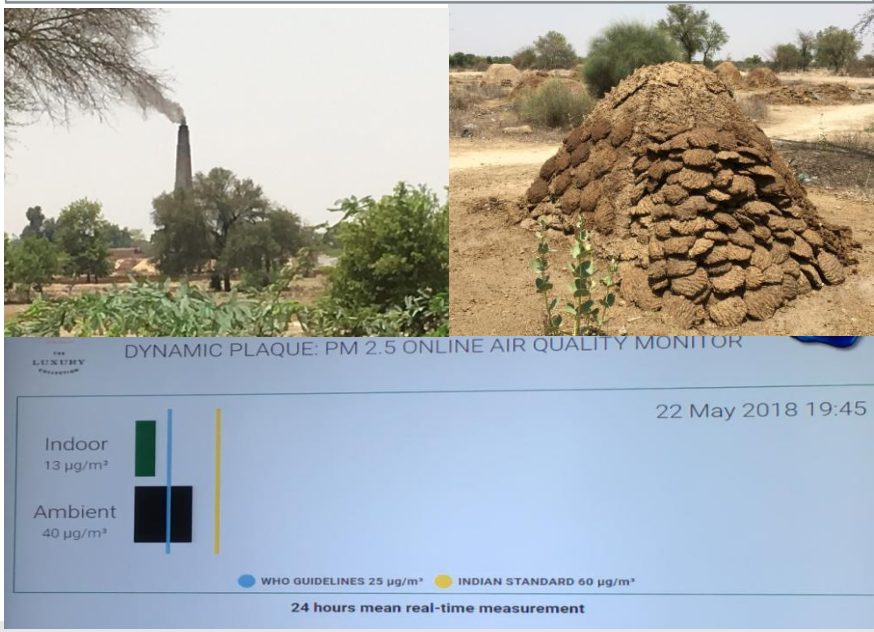


Source: Statistical Abstract of Punjab, Various Issues

How did it get so bad?

- Green revolution → higher rice and wheat production possible
- Irrigation and fertilization subsidized (water table reduced)
- Higher production per ha → much more straw
- Much larger percentage to wheat/rice rotation
- Mechanical rice straw leaves stubble in the field
- Rice straw market reduced (paper, feed, etc.)





Solutions

- Reduce the rice-wheat rotation system to include more diversification in crops:
  - (High Value Agricultural produce, and less water requiring crops), which should add more value and make it easier to avoid the need for fast land clearing that promotes rice straw burning
- Promotion of technology for crop residue management:
  - In situ or
  - **Removal and application**
- **Essential problem is logistics: can we set up a chain that delvers efficient collection and transport**
- → 2 case studies on supply of straw for two applications

ECOR

nettenergy

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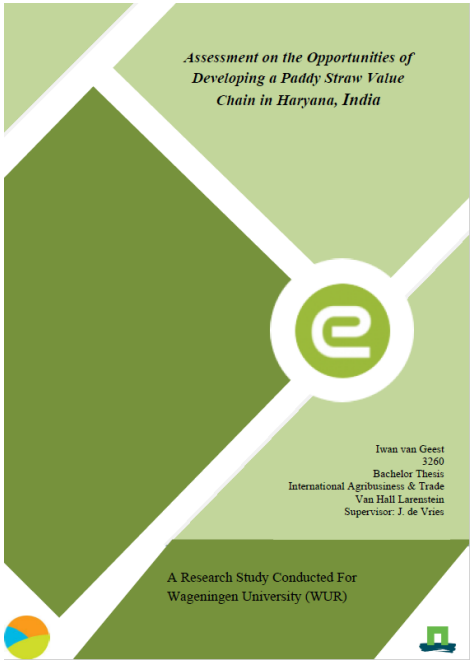
Approach

1. Fact finding mission + meeting with Indian partners and Haryana Agricultural University to arrange student placements
2. Recruit 2 students to assess rice straw supply options for 2 rice straw applications provided by NL partners:
    1. Ecor Plates
    2. Nettenergy Pyrolysis
3. Presentation + Follow-up



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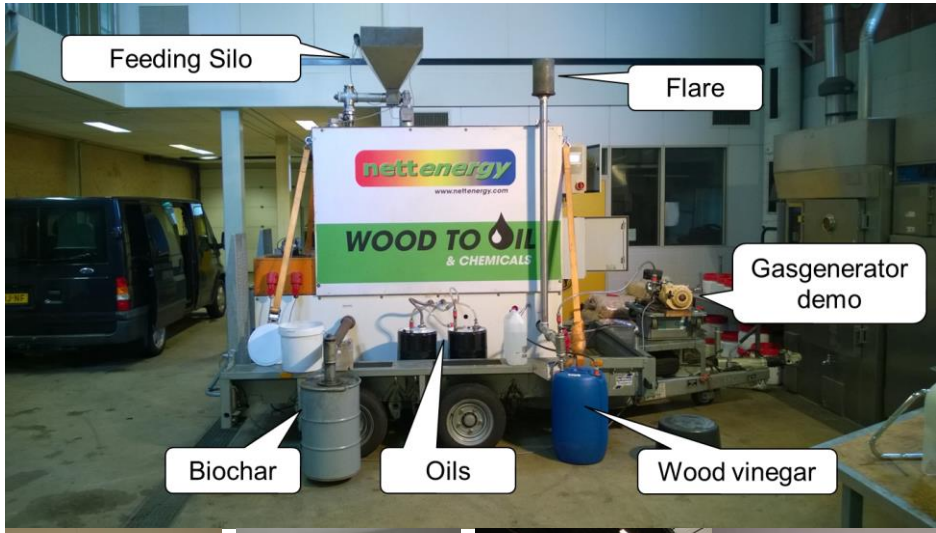
Nettenergy Pyrolysis

- Pyrolyses: 500C
- Pellet input
- Small scale: 3650 ton per year input
- Licensed in India to partner Shirke Energy (India)
  - Biochar → fuel / soil ammendment
  - Pyrolysis oil → fuel / chemicals
  - Wood Vinegar →chemicals
  - Syngas → electricity / heat

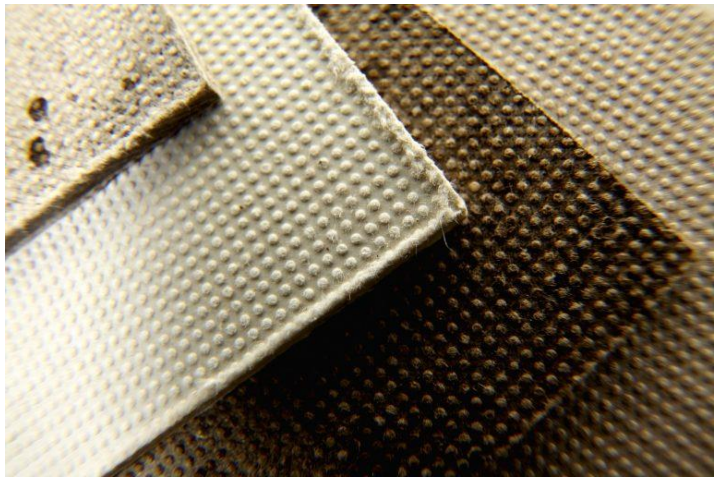


ECOR COMPOSITE PANELS

ECOR is an Advanced Environmental Composite Panel formed from the conversion of cellulose fiber, pressure, and heat.
Fibers sourced from different sources such as Old Corrugated Cardboard (OCC), Old News Print (ONP), agricultural fiber and even bovine process fiber.

ECOR was developed using principles of waste stream reduction and diversion with the goal of solving one of the world's most challenging environmental problems – waste disposal and diversion. ECOR is made from residual fiber, water and heat.

It is 100% bio-based, 100% comprised of recycled residual materials, 100% recyclable, and is cradle-to-cradle compliant.



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Straw production Haryana regions

District	Size District (Km2)	Rice production area (Ha)	Total straw production (Ton)
Karnal	2799	172,200	977,132
Kurukshetra	1530	119,400	678,879
Kaithal	2471	161,900	919,753
Fatehabad	2538	110,400	627,182
Total	**9338**	**563,900**	**3,202,946**

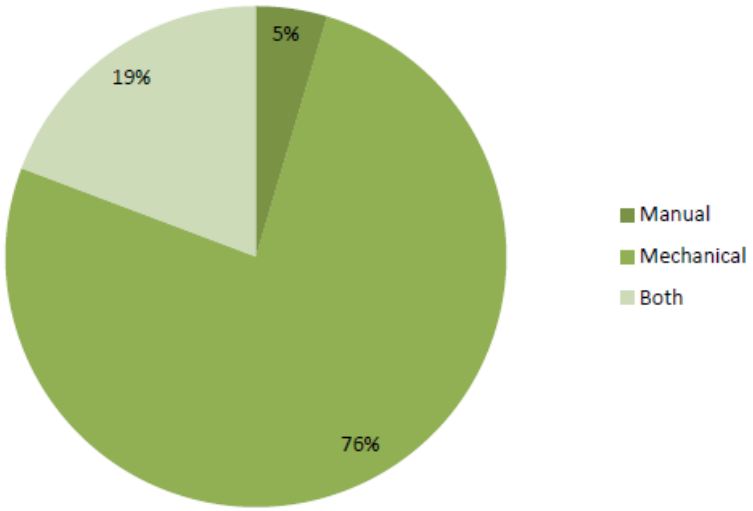
Estimated capacity ECOR board production facility: 10,000 ton per year

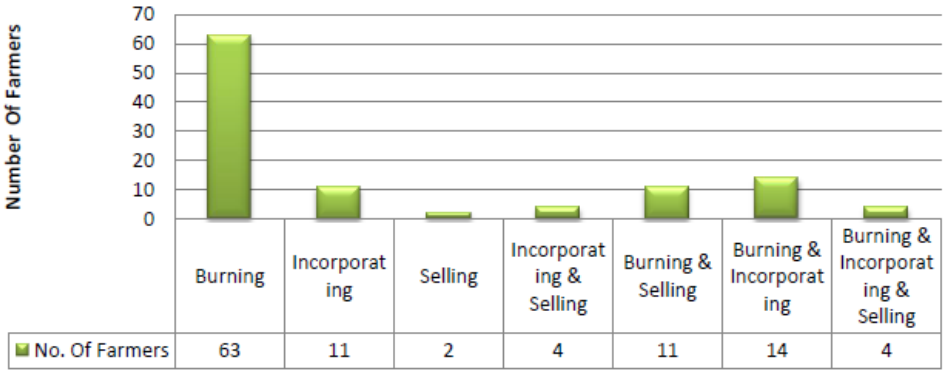
Nettenergy requires 3650 ton per year

There is enough rice straw for all applications!!

Assessment of rice straw supply now

- Interviews with 109 farmers and 4 contractors showed:
- 76% of rice is harvesting mechanically
- Basmati straw is often sold (manually harvested)
- Manual harvest is 2.6 times more expensive
- Only 15% of farmers are not burning straw
- Farmer gets €21 per ton rice straw
- Rice straw sold for: bedding, fodder, fuel and cardboard, paper, energy

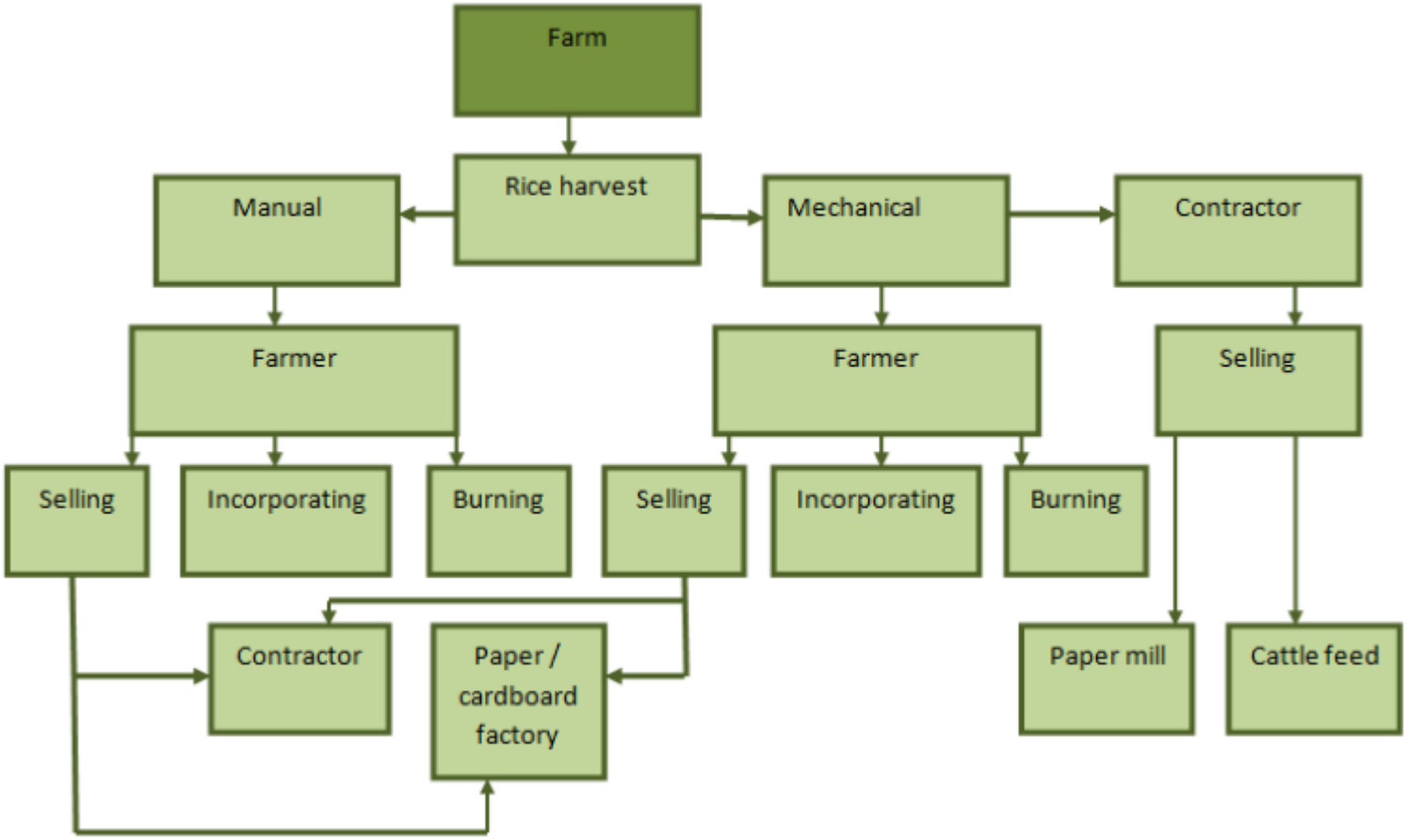




Assessment of rice straw supply for NETTENERGY

- Nettenergy needs pellets
- Different supply options assessed based on 3650 ton rice straw (pellets) per year
- Supply cost was estimated at €136,- per ton rice straw pellet

Current supply chain paddy straw for ECOR case



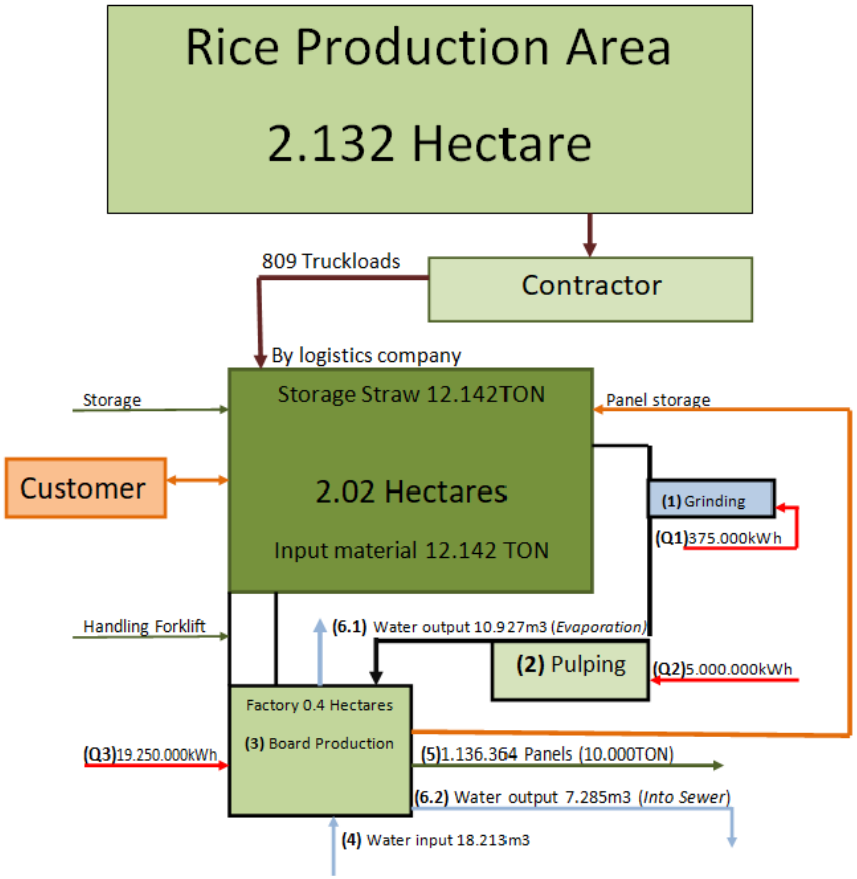
Scenarios rice straw board production

- Scenario 1: Board production unit will use only rice straw as raw material. Rice straw is partly pulped to obtain the necessary strength properties

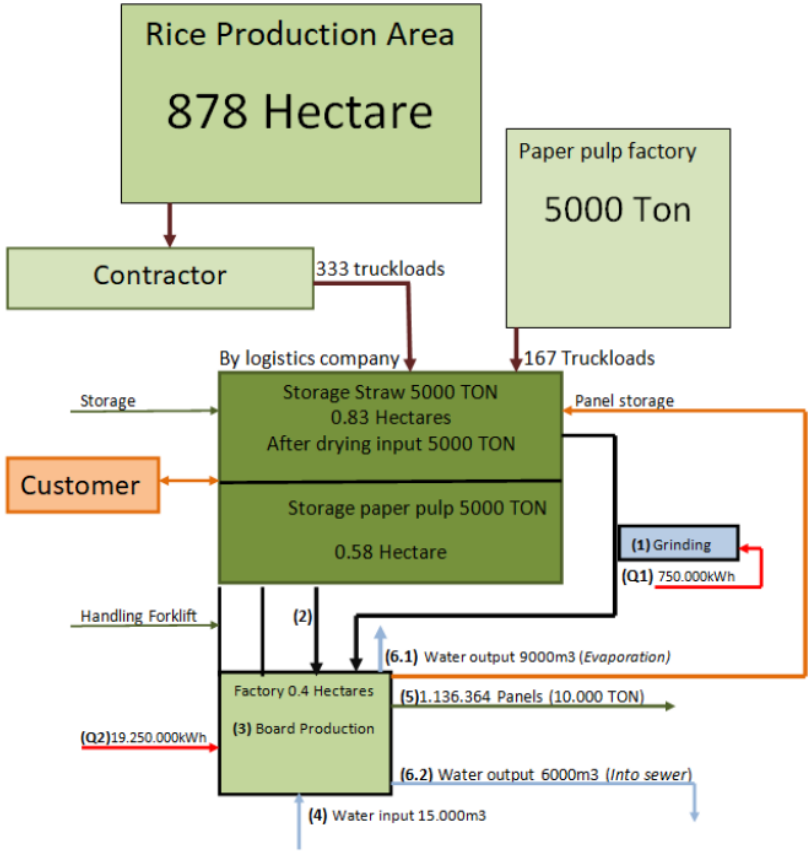
- Scenario 2: Board production unit will use 50% rice straw, 50% wood pulp obtained from local paper industry

Scenarios rice straw board production

Scenario 1



Scenario 2



Economical assessment (India)

Total capital investment	Scenario 1	Scenario 2
Purchased equipment	€665,756.00	€45,756.00
Installation costs	€982,634.00	€68,634.00
Delivery charges	€66,575.60	€45,756.00
Start-up expenses	€233,014.60	€57,195.00
Construction expenses	€199,726.80	€13,726.80
Water connection charges	€ 2,356.00	€2,356.00
Contractor's fee	€58,586.53	€7,320.96
Depreciable capital investment	**€2,224,649.53**	**€240,744.76**
Fixed capital investment	**€2,224,649.53**	**€240,744.76**
Working capital	€805,511.22	€825,644.20
Total capital investment	**€3,030,160.75**	**€1,066,388.96**

Economical assessment (India)

	Scenario 1	Scenario 2
Fixed costs	€1,032,699	€211,543
Variable costs	€3,871,535.13	€5,572,563.38
Total	**€4,904,234**	**€5,784,106**

Break-even price	**Scenario 1**	**Scenario 2**
Total fixed costs	€1,032,696	€211,543
Total variable costs	€3,871,535.13	€5,572,563.38
Total costs made	€4,904,234	€5,784,106
Panel production per year	1136363.63	1136363.63
Break even price	**€4.32**	**€5.09**

Follow-up

- ECOR + iMVO: development of market for straw plate in India and abroad replacing scarce forest wood and contributing to emission reduction

- Starting point for NETTENERGY with Shirke Energy (India) partner.

- Opportunities for other NL companies:
  - DahlmanStraw to electricity
  - AVANTIUM: (ZAMBAZI) technology for straw conversion to 2e generation sugars → fuels and chemicals
  - DMT Environmental Technology: Biogas to transport fuel
  - Etc

- WFBR: projects on residue valorization in India + development of technological solutions (Ahmedabad, Haryana)

- More detailed study on feasibility / is rice straw competitive?

Thank you for your attention!

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