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DA Project 1617K on Promoting Cotton By-Products in Eastern and Southern Africa

Presentation on

India's Experience on Priority Cotton by-Product-based activity: Briquetting and Pelleting

by

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India's Experience on "Priority Cotton by-product-based activity: Briquetting and Pelleting"

UNCTAD's Technical Cooperation Project on "Promoting Cotton by-products in Eastern and Southern Africa

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Cotton Sector in India (2017-18)

- Area Under Cotton Cultivation : 10.5 million hectares
- Cotton Production : 5.88 million tonnes
- Cottonseed production : 11.5 million tonnes
- Cotton Stalk Production : 26.0 million tonnes
- Cotton Farmers : 5.0 million

Cotton Stalks and Its Commercial Utilization

Cotton Stalks: Possibility of Entrepreneurship

- **Availability: 26 million tonnes annually**
- **Utilization: About 10% commercially utilized**
- **Properties: About 60% holocellulose, 27% lignin and 6% ash,**

  Gross calorific value: 4000 kcal/kg (16.7 MJ/kg)
- **Commercial Uses: Briquettes, Pellets, Compost, Power generation and Particle Boards**
- **Under Trials: Pulp And Paper, Hard Boards, etc.**








Properties of other biomasses and its suitability

S.No.	Agro-wastes	Type	VM, %	Ash %	Fixed C%	HHV, MJ/kg	Pelletisation/Briquetting Potential
1	Cotton	Stem	70.3	6.0	19.7	16.7	Very Good
2	Soya	Stem	76.9	6.6	16.4	16.4	Good
3	Groundnut	Shell	68.0	2.8	19.1	16.7	Good
4	Sorghum	Stem	69.4	6.4	18.82	16.6	Good
5	Mustard	Stem	71.2	5.2	19.38	17.3	Good
6	Black gram	Stem	68.2	3.5	23.4	16.3	Good
7	Wheat	Stem	72.1	3.4	23.9	15.4	Good
8	Bagasse	Stem	75.8	4.2	20.1	18.1	Very Good
9	Garden lawn	Leaves	72.6	3.2	17.3	15.2	Good

Industrial Applications of Cotton Stalks

Commercial Utilization of Cotton Stalks in India

Briquetting Plants

- Installed plants: about 250
- Capacity/plant: 20-25 TPD
- Size of briquettes: 90 mm diameter
- Uses: As substitute for coal for firing boilers in industries, brick kilns, etc.

- Raw materials: Cotton Stalk (150,000 T for 4 months:); Soybean; saw dust, wood chips, bagasse, etc.,
- Benefits: Cheap-80% of Coal Price; Renewable Source,

farmers' income-US$50/ha for supply of chipped biomass

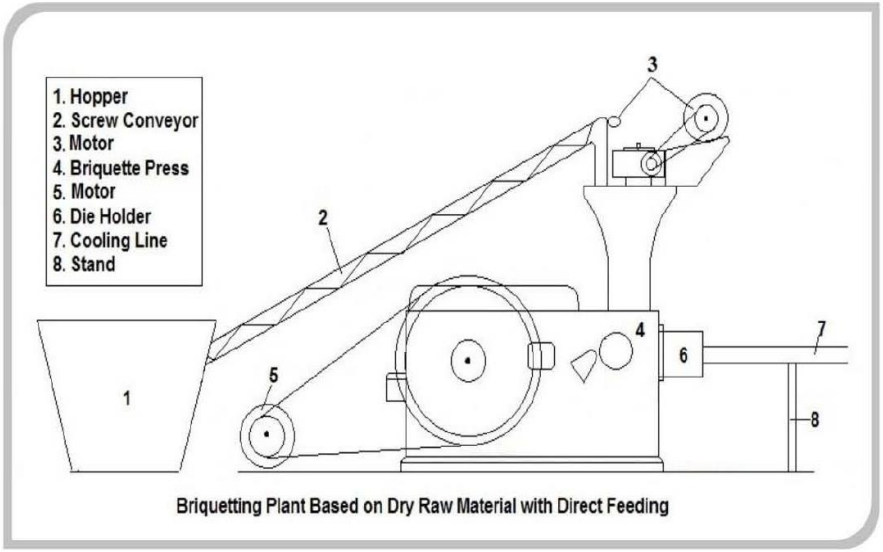
Flow Chart For Briquetting Plant

Chipped Raw Material → **Manual/ Tractor Feeding** → **Screw Conveying** → **Briquetting by Extrusion** → **Finished Product**

Connected Loads & Manpower

BRIQUETTING PLANT

- **Connected load: 90 HP**
  - Screw conveyor: 3 HP
  - Press: 75 HP
  - Kuppi motor: 10 HP
  - Lubricant: 3 HP
- **Manpower requirement: 6/shift**



Briquetting Plant Based on Dry Raw Material with Direct Feeding

Logistics for Supply of Cotton Stalks

- Uprooting of cotton stalks: 3-4 manpower/acre
- Collection after 1 week sun drying: 2 manpower
- Chipping: Tractor driven chipper, capacity 2 TPH, 11 manpower, 2 tractor cum trolleys
- Transportation: within 50 km
- Total logistics Price: Rs. 1500 per tonne at factory gate (US$ 22 per tonne)

Chipping of Cotton Stalks

Shredding of Cotton Stalks

Briquetting Cost Breakup & Profit

Operations	Approximate cost per tonne (Rs.)
Uprooting	500 ($ 7.1)
Material cost	350 ($ 5.0)
Chipping	200 ($ 2.9)
Transportation within 30-40 km radius	650 ($ 9.3)
Unloading at briquetting factory site	50 ($ 0.71)
Sun drying labour cost	50 ($ 0.71)
Sub total	1800 ($ 25.7)
Weight loss @ 10%	180 ($ 2.57)
Hammer milling	175 ($ 2.5)
Briquetting	650 ($ 9.3)
Total cost	2805 ($ 40.0)
Profit: ($ 5-$10): Cost of briquettes	3200-3600 ($ 45.7-$51.4)

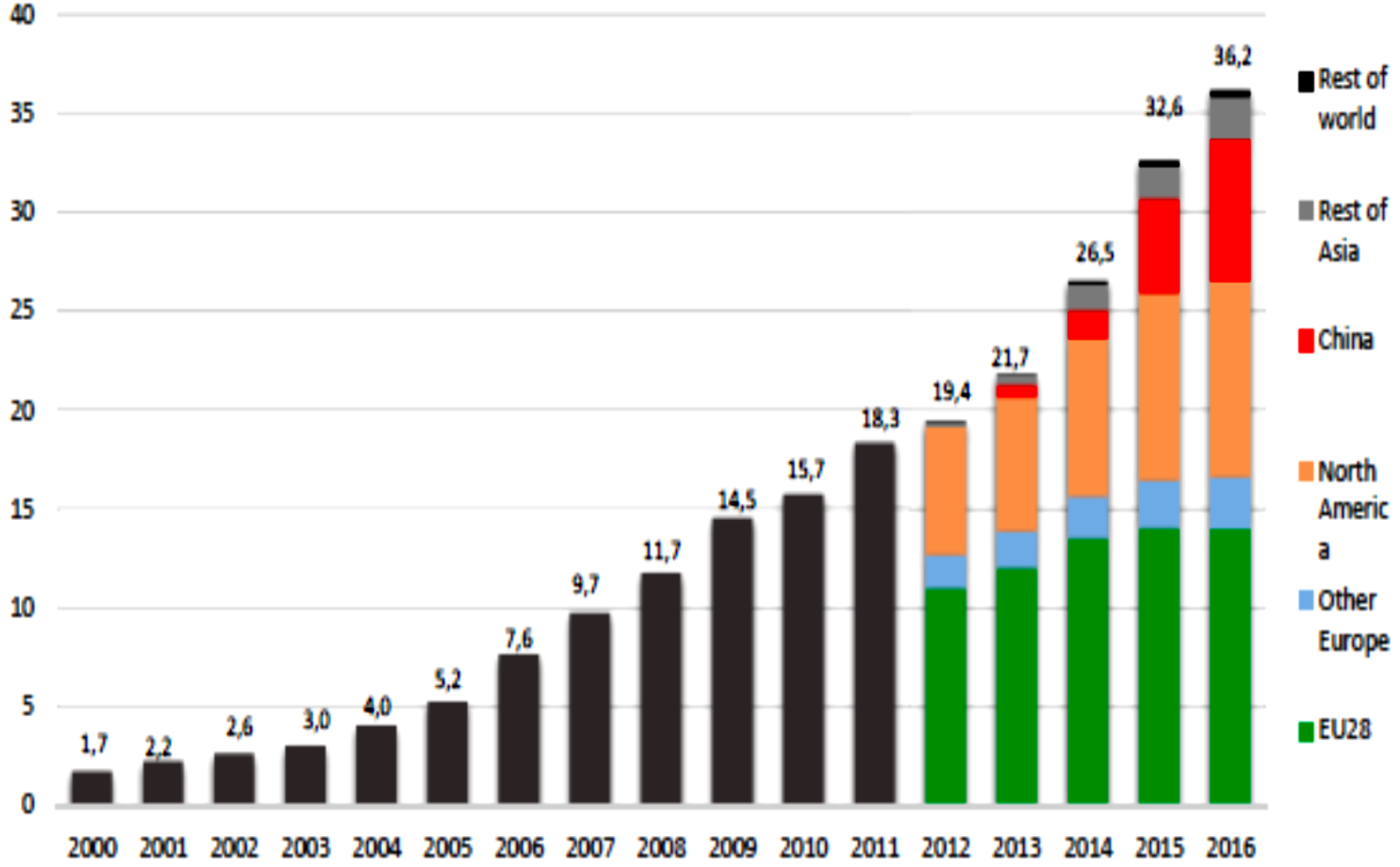
Commercial utilization: Briquetting Plant

A	Capital Investment (20 TPD Capacity)	INR in million	USD
	Land and Building (Land Area: **2 acre**; Building for Machinery: **150 sq. m**; Material storage area:**1000 sq. m** ; Office Building: **50 sq. m**)	**1.50**	**21,428**
	Plant and Equipment	**2.50**	**35,714**
	Auxiliary and Service Equipment (**Chipper: 3** & **Handling Tools**)	**0.50**	**7,142**
	Total investment	**4.50**	**64,285**
B	**Operational Expenses**		
	Raw Material Cost for 1 year (20 TPD for 300 days @ **Rs. 2800 per tonne; $40/tonne**)	**16.80**	**240,00**
	Operational cost including repair and Maintenance and other charges **(Rs. 600/tonne)** for 1 year	**3.60**	**51,429**
C	Gross Annual Income (**Rs. 4000/tonne**)	**24.00**	**342,857**
	Net annual income (Rs. 400/tonne)	**2.40**	**34,286**
D	Payback period: **23 months**	Return on investment : **43.5%**	

Recommended Briquette Applications

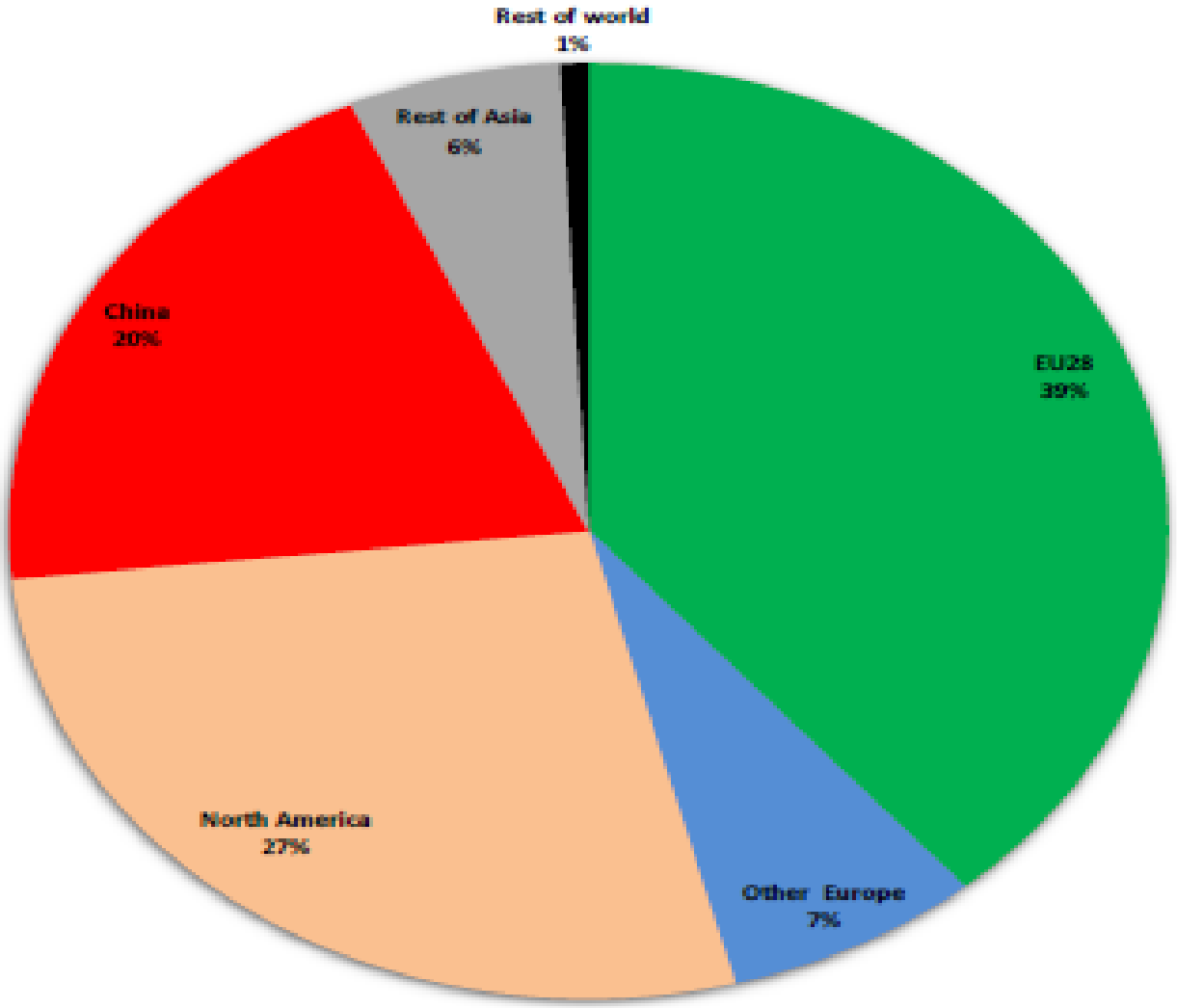
Boilers	**For steam generation**
Food processing industries	**Distilleries, bakeries, canteens, restaurants and drying etc.**
Textile process houses	**Dyeing, bleaching etc.**
Agro-products	**Tobacco curing, tea drying, oil milling etc.**
Clay products	**Brick kilns, tile making, pot firing etc.**
Domestic	**Cooking and water heating**
Gasification	**Fuels for gasifiers**
Charcoal	**Suitable for making charcoal in kilns**
Cremation	**Burning of dead beings**

Global Scenario of Pellet Production



- Total Production: 36.2 million tonnes.
- Europe and Northern America, global production (62% and 34%) and consumption (81% and 15%)

Global Scenario of Pellet Production



Applications of Pellets

- In the Netherlands, Belgium, and the UK, pellets are used mainly in large-scale power plants
- In Denmark and Sweden, pellets are used in large-scale power plants, medium-scale district heating systems, and small-scale residential heating system
- In Germany, Austria, Italy, and France, pellets are mostly used for small-scale residential and industrial heating purposes
- In USA, 60% pellet production is used for residential heating white 40% is exported particularly to EU nations
- In India, Pellets are used for boiler firing as well as for cooking of meals in restaurants (35% of commercial gas cost)

Applications of Pellets

Commercial Utilization of Cotton Stalks in India (Contd.)

Pelleting Plant

- Installed Pelleting plants : 500
- Capacity/plant: 3 TPD & 60-80 TPD
- Size of pellets: 6, 8 and 10 mm diameter
- Uses: Boilers and Cooking in Restaurants

- Raw materials: Cotton Stalk (200,000 T for 4 months:); Soybean; saw dust, wood chips, bagasse, etc.
- Benefits: Cheap- half the commercial LPG prices; farmers' income-Rs. $ 50 per ha for supply of chipped biomass

Large Pellet Plants

Biomass collection

↓

Shredded to 50 mm by a shredder

↓

Drying, if required

↓

Hammer Mill (powder to 3 mm)

↓

Batch Mixture

↓

Pelletisation

↓

Cooling

↓

Bagging and Transportation

Small Pellet Plants

Chipped & Milled Cotton Stalks

Manual Feeding

Pelleting by Extrusion

Connected Loads & Manpower

Small Pelleting plant

- Connected load: 25 HP
- Manpower requirement: 3/shift

Large Pelleting plant

- Connected load: 200 HP
- Manpower requirement: 8/shift

Commercial utilization: Pelletting Plant

A	Capital Investment (3TPD Capacity)	INR in million	USD
	Land & Building: (Land Area: **0.5 acre**; Building for Machinery: **100 sq. m** ; Material storage **area:500 sq. m** ; Office Building: **50 sq. m**)	**0.50**	**7,692**
	Plant and Equipment	**1.00**	**15,385**
	Auxiliary and Service Equipment (Chipper: 1 & Handling Tools)	**0.20**	**3,077**
	Total investment	**1.70**	**26,154**
B	**Operational Expenses**		
	Raw Material for 1 year (3 TPD for 300 days @ Rs. 2800 per tonne)	**2.52**	**38,770**
	Operational cost including repair and Maintenance and other charges (Rs. 2950/tonne) for 1 year	**2.66**	**40,923**
C	**Gross Annual Income (Rs. 7500/tonne: $107.1/tonne)**	**6.75**	**103,846**
	Net annual income (Rs. 1000/tonne: $14.3/tonne)	**0.54**	**8,308**
D	Payback period: **33 months** Return on investment : **30.3%**		

Pellet Fuel Standards

Germany Austria New European Standards

				
				
	Unit	**DIN plus[4]**	**DIN 51731[5]**	**Ö NORM M 7135[6]**
Diameter	mm	4 - 10	4 - 10	4 - 10
Length		< 5 x D	< 50 mm	< 5 x D
Density	Kg / dm^3	> 1.12	1.0 - 1.4	> 1.12
Water content	%	< 10	< 12	< 10
Abrasion	%	< 2.3	--	< 2.3
Ash content	%	< 0.5	< 1.5	< 0.5
Energy content	MJ / kg	> 18	17.5 – 19.5	> 18
Sulphur content	%	< 0.04	< 0.08	< 0.04
Chlorine content	%	< 0.02	< 0.03	< 0.02
Nitrogen content	%	< 0.3	< 0.3	< 0.3
Heavy metals	%	regulated	regulated	not regulated

Normative properties according to EN 14961-1:

Diameter, D and Length, L:	D06 6 ± 1; 3,15 ≤ L ≤ 40
Moisture, M:	M10 ≤ 10
Ash, A:	A1.0 ≤ 1,0
Mechanical durability, DU:	DU 96.5 ≥ 96,5
Fines, F:	F1.0 ≤ 1,0
Additives:	1 % (starch)
Bulk density, BD:	BD600 ≥ 600
Net calorific value, Q:	Q16.5 ≥ 16,5

Informative properties according to EN 14961-1

Nitrogen, N:	N0.5 ≤ 0,5
Sulphur, S:	S0.05 ≤ 0,05
Chlorine, Cl:	Cl0.03 ≤ 0,03
Ash melting behaviour, DT:	DT1200 ≥ 1200

Pellet Standards of Pellet Fuel Institute, Seattle

Sample	Properties		
	PFI Premium	PFI Standard	PFI Utility
Bulk density (kg/m^3)	640- 770	610-770	610-770
Diameter (mm)	5.84-7.25	5.84-7.25	5.84-7.25
Pellet Durability Index (PDI)	≥ 96.5	≥ 95.0	≥95.0
Fines % (at the mill gate)	≤ 0.5	≤ 1.0	≤ 1.0
Inorganic ash %	≤ 1.0	≤ 2.0	≤ 6.0
Length % greater than 1.5 inches	≤ 1.0	≤ 1.0	≤ 1.0
Moisture %	≤ 8.0	≤ 10.0	≤ 10.0
Chloride, ppm	≤ 300	≤ 300	≤ 300
Heating Value	NA	NA	NA

Briquetting

Pelleting

Conclusions

- Cotton stalks can be effectively used as Renewable source of energy : Briquettes and Pellets

Thank You

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