Biomass Availability Scenario in India - Gaps &Challenges

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Why biomass ?

- Fast renewable resource for primary energy (solid, liquid & gaseous fuel)
- Rural economy augmentation & employment generation
- Energy Security
- Mitigation of GHG emissions
- Technology innovation & business opportunities

Biomass Resource Base

- **Energy Crops**
  - Non edible oil seeds like Jatropha, Karanja, Neem
- **Forest Produce**
  - Fuel wood, Pine Needles, Bamboo
- **Agro Residues**
  - Rice husk, Stalks, Wheat straw, Groundnut shells
- **Waste**
  - MSW, Market & Kitchen Waste, Livestock dung
- **Sugarcane & Sweet Shorghum**

Biomass Resource Potential in India

- **Biomass caters to 80% of total rural energy requirement**
- **Biomass source accounts for 54% of biofuels used in India**
- **47% of crop residues used as cattle fodder**
- **Total non-fodder crop residues available for energy estimated to be 450 MT in 2010**
- **Estimated total biomass energy potential 8.26 EJ by 2010**

(Source: NH Ravindranath, HI Somasekhar, MS Nagraja, P Sudha, G Sangeetha, SC Bhattacharya, A Abdul Salam – IISc, Bangalore)

TIFAC-NIIST Report

Availability of Indian Biomass Resources for Exploitation

A joint study by TIFAC & NIIST for understanding of biomass resources, their state-wise production and existing utilization patterns to assess surplus for conversion to **energy, fuel and value-added products**.

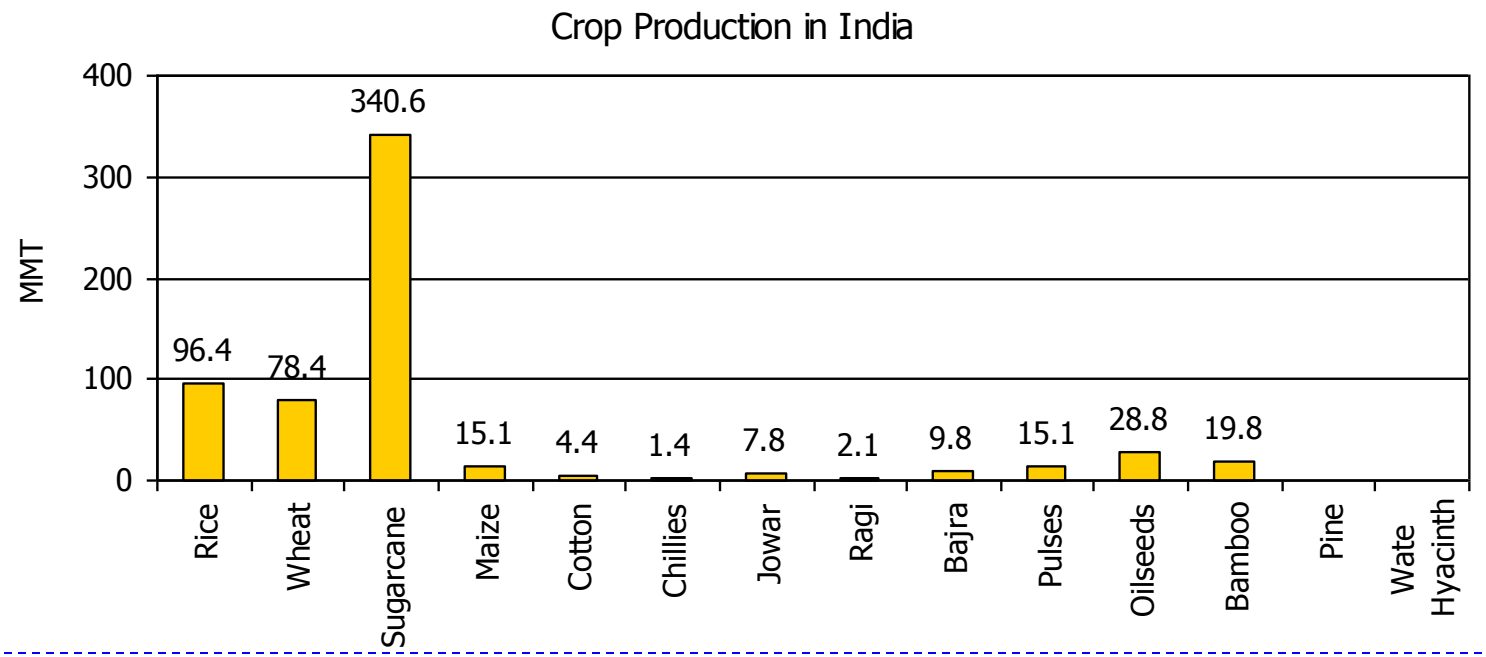
TIFAC-NIIST Report

Availability of Indian Biomass Resources for Exploitation

- State-wise data on generation and consumption of biomass
- Detailed survey on available bio-resources, storage & transport practices, procurement of biomass
- Identification & availability of select biomass resources

Crop Production in India

COLOUR CODE (ONE CROP More than 1 RESIDUE)		
Rice	Sugarcane	Maize
Rice Husk	Bagasse	Husk
Rice Straw	Sugarcane Tops	Cob
		Stover



Sugarcane, rice and wheat most grown crops in India

Crop Residue Generation

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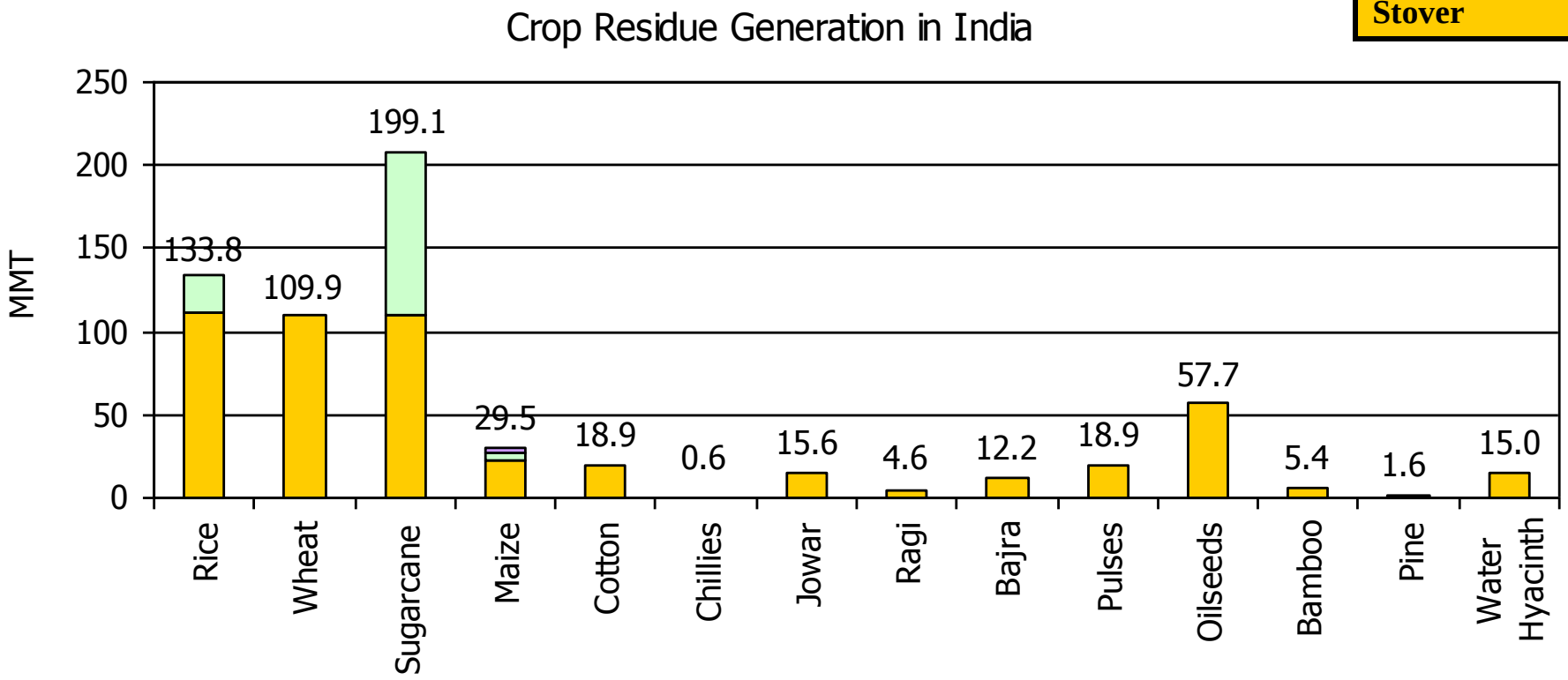


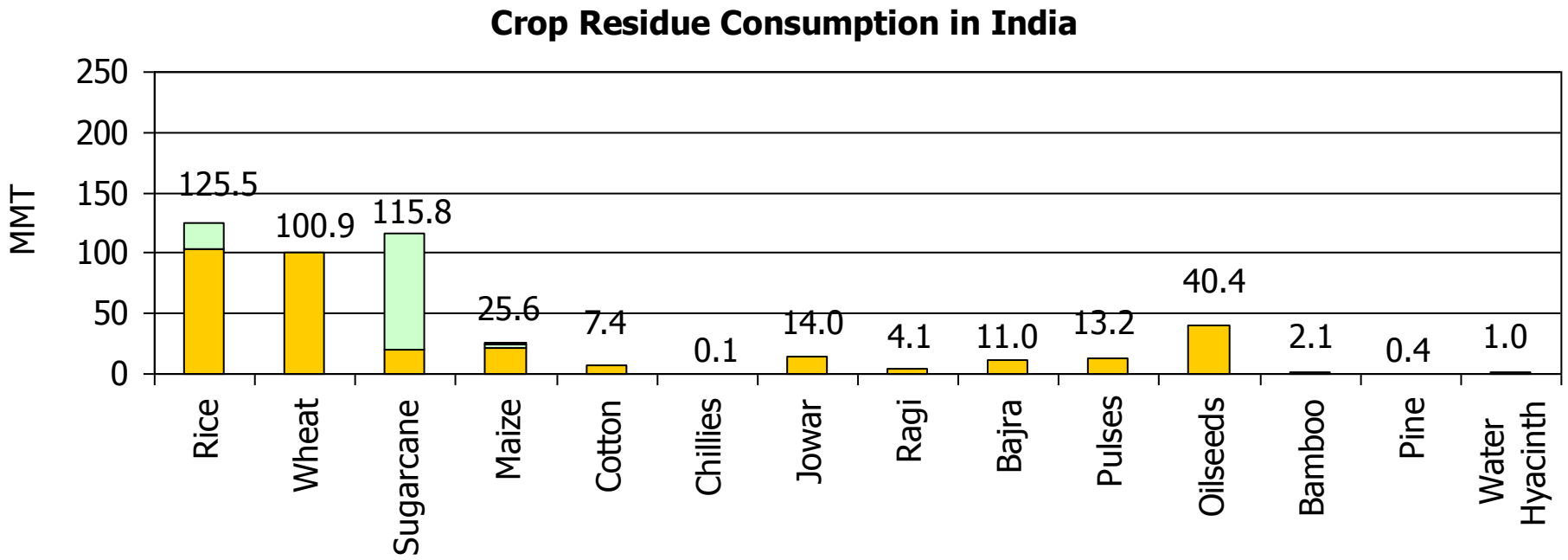
Rice straw, rice husk, wheat straw, sugarcane tops & bagasse main crop residues generated in India

Crop Residue Generation

State	Generation (MMT)	Top 3 Residues
Uttar Pradesh	138.0	Bagasse, Sugarcane tops, Wheat straw
Maharashtra	81.7	Bagasse, Sugarcane tops, Oilseeds
Andhra Pradesh	44.2	Wheat straw, Rice straw, Rice husk
Punjab	41.5	Rice straw, Bagasse, Sugarcane tops
Tamil Nadu	40.3	Bagasse, Sugarcane tops, Rice straw
Karnataka	39.1	Bagasse, Sugarcane tops, Maize Stover, Ragi Stalk
Madhya Pradesh	38.1	Wheat straw, Pulses, Oilseeds
Rajasthan	33.8	Rice straw, Bajra, Oil Seeds
Gujarat	30.9	Cotton stalk, Bagasse, Wheat straw
Haryana	29.6	Rice straw, Wheat straw, Maize Stover
Others	106.2	Wheat straw, Rice straw, Rice husk
Total	**623.4**	**Rice straw, Wheat straw, Bagasse**

Uttar Pradesh, Maharashtra, Andhra Pradesh and Punjab are top 4 states in terms of residue generation

Crop Residue Consumption

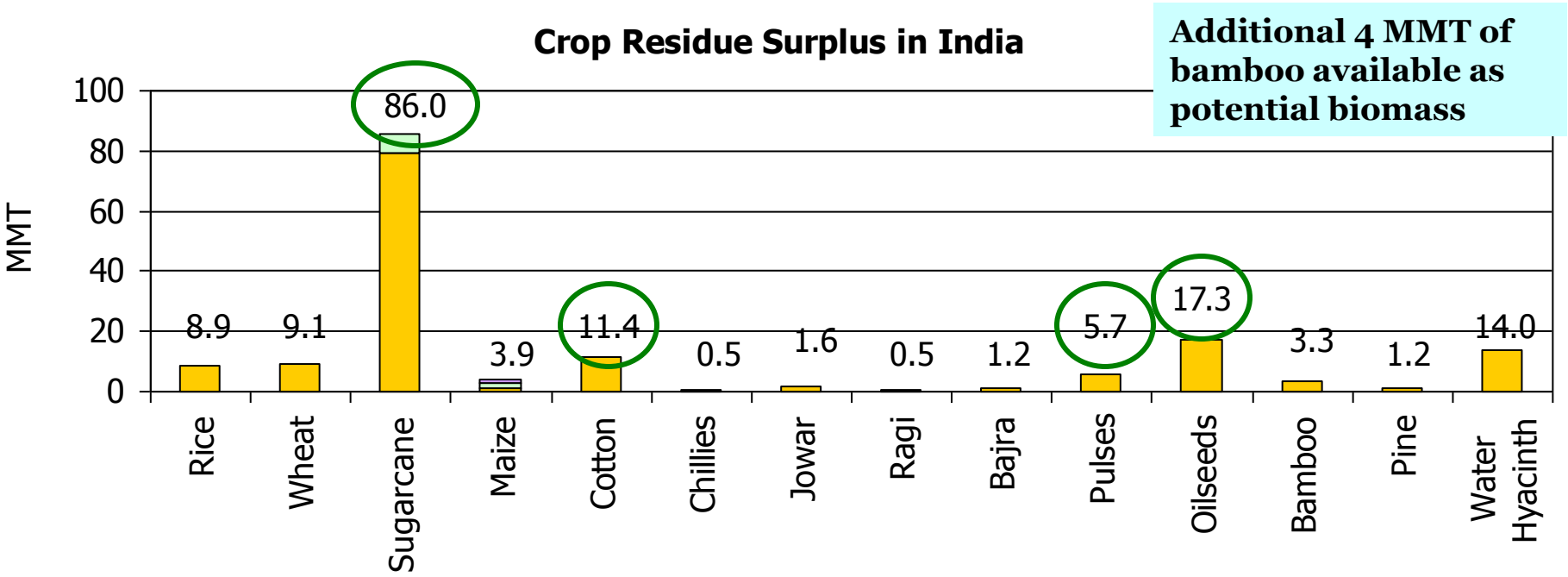


- ***Rice, Wheat, Maize, Jowar, Ragi & Bajra*** **residues used as cattle fodder**
- ***Cotton, Chilli, Pulses, Oilseeds*** **residues used as fuel for household needs**
- ***Rice husk*** **used in boilers & bagasse for power/paper production**

Crop Residue Consumption

Crop	By-Product	Generation (MMT)	Self Use + Other Farmers (MMT)	Other Commercial Uses (MMT)	Total (MMT)
Rice	Straw	112.0	92.7	10.8	103.6
	Husk	22.4	2.2	19.7	22.0
Wheat	Straw	109.9	98.9	1.9	100.9
Sugarcane	Tops	97.8	19.6	Negligible	19.6
	Bagasse	101.3	0.0	96.3	96.3
Maize	Stover	22.7	21.5	Negligible	21.5
	Cob	4.2	2.5	Negligible	2.5
	Husk	2.7	1.6	Negligible	1.6
Cotton	Stalk	18.9	7.4	Negligible	7.4
Chillies	Stalk	0.6	0.1	Negligible	0.1
Jowar	Stover	15.6	14.0	Negligible	14.0
Ragi	Stalk	4.6	4.1	Negligible	4.1
Bajra	Stalk	12.2	10.4	Negligible	11.0
Pulses	Waste	18.9	13.2	Negligible	13.2
Oilseeds	Waste	57.7	40.4	Negligible	40.4
Bamboo	Top, Root, Leaves	5.4	0.3	1.8	2.1
Pine	Needle	1.6	0.3	0.1	0.4
Water Hyacinth	Whole	15.0	0.8	0.2	1.0
Total	-	623.4	330.1	131.5	461.6
		100%	52.9%	21.1%	74.0%

Crop Residue Surplus



Additional 4 MMT of bamboo available as potential biomass

- **Sugarcane tops most surplus residue burnt in the fields**
- **Other fuel crops like Cotton, Chilli, Pulses & Oilseeds do not have much other use apart from fuel**
- **Low surplus from fodder crops, used mostly as cattle feed**

Crop Residue Surplus Density

State	State Area	Biomass Generation Density (MT/km²)	Biomass Consumption Density (MT/km²)	Biomass Surplus Density (MT/km²)
Uttar Pradesh	238,566	578.6	417.7	160.9
Haryana	44,212	669.7	554.5	115.1
Tamil Nadu	130,058	309.9	207.2	102.7
Punjab	50,362	823.7	731.0	92.7
Maharashtra	307,713	265.6	173.0	92.6
West Bengal	88,752	299.8	259.0	71.4
Karnataka	191,796	203.8	143.8	60.1
Gujarat	196,024	157.7	102.2	55.5
Andhra Pradesh	275,068	160.7	118.2	42.5
Bihar	94,164	221.6	185.4	36.1
Others	1,668,264	-	-	-
Total	**3,284,979**	**189.8**	**140.4**	**50.1**

Conclusion & Recommendations

- Non-fodder crops (*Sugarcane tops, Cotton, Chilli, Pulses and Oilseeds & Bamboo residue*) to be focused for biofuel production
- Residues typically burnt in fields or used to meet household energy needs
- To provide farmers with suitable alternatives for fuels & fodder sources
- 61 MMT of fuel crop residue and 242 MMT of fodder crop residue consumed by farmers
- Co-operatives or other local bodies encouraged to collect and supply fixed amount of crop residues over sustained period

TIFAC INITIATIVES

Bioprocess & Bioproducts Programme

To address critical technology needs & catalyze technology development activities towards development of active pharmaceutical ingredients, neutraceuticals, phyto-chemicals, building block chemicals & bio-fuels, the national level programme launched in January 2007

Ten technology development & demonstration projects launched under the programme in partnership with academia, R&D and industries

Projects Launched

Centre for Biofuels
(NIIST, Trivandrum)

- **Cutting edge research in bio-refinery technologies**
- **Optimization of process parameters for lignocellulosic ethanol in pilot plant for Indian biomass varieties**
- **To evolve leading centre of knowledge & pedagogy**

Detoxification of jatropha seed cake & recovery of residual hydrocarbons by enzymatic process
(Osmania University & Naturol Bioenergy Ltd., Hyderabad)

- **Removal of toxic contents (phorbol esters) by dioxygenase**
- **Use of seed cake as fodder**

Technology Assessment Study

Biomass Derived Bioproducts – Assessment of Technology Trends, Gaps & Opportunities for India

- TIFAC specialized study for comprehensive assessment of sector published in Oct. 2010
- Technology gap analysis for India vis-à-vis developed countries
- Important *Technology Dossier* for biotech industries

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Biomass Utilization - A Technology Foresight

Broad Technology Areas

- Agronomy of agricultural, algal & marine biomass
- Bio-chemical conversion
- Thermo-chemical conversion
- Bio-materials & bio-polymers
- Industrial enzymes
- Pharmaceuticals & nutra-ceuticals
- Process design & development

Biomass Utilization - A Technology Foresight

Exercise to focus on

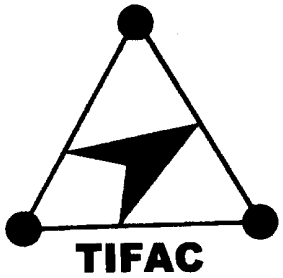
- Analysis of current technology mix from 1st. to 2nd. generation bio-fuels to advanced technology stage
- Assessment of technological needs for implementation of fully integrated but flexible bio-refineries in India
- Roadmap for investments in R&D (biotech & agronomy) and generation of bio-resources

Biomass Utilization - A Technology Foresight

Exercise to focus on

- Standards & regulations for bio-fuels/bio-products
- Understanding *'best practices'* globally for biofuels and other high-value products : bio-chemicals & bio-polymers
- Key challenges for commercialization of bio-products : markets, value cycles, transportation, infrastructure…

Thank You



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