Strengthening Networking on Biomass Research and Biowaste Conversion - Biotechnology for Europe - India Integration

"SAHYOG"

Sustainable Biomass Supply in India

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SEVENTH FRAMEWORK PROGRAMME

SAHYOG

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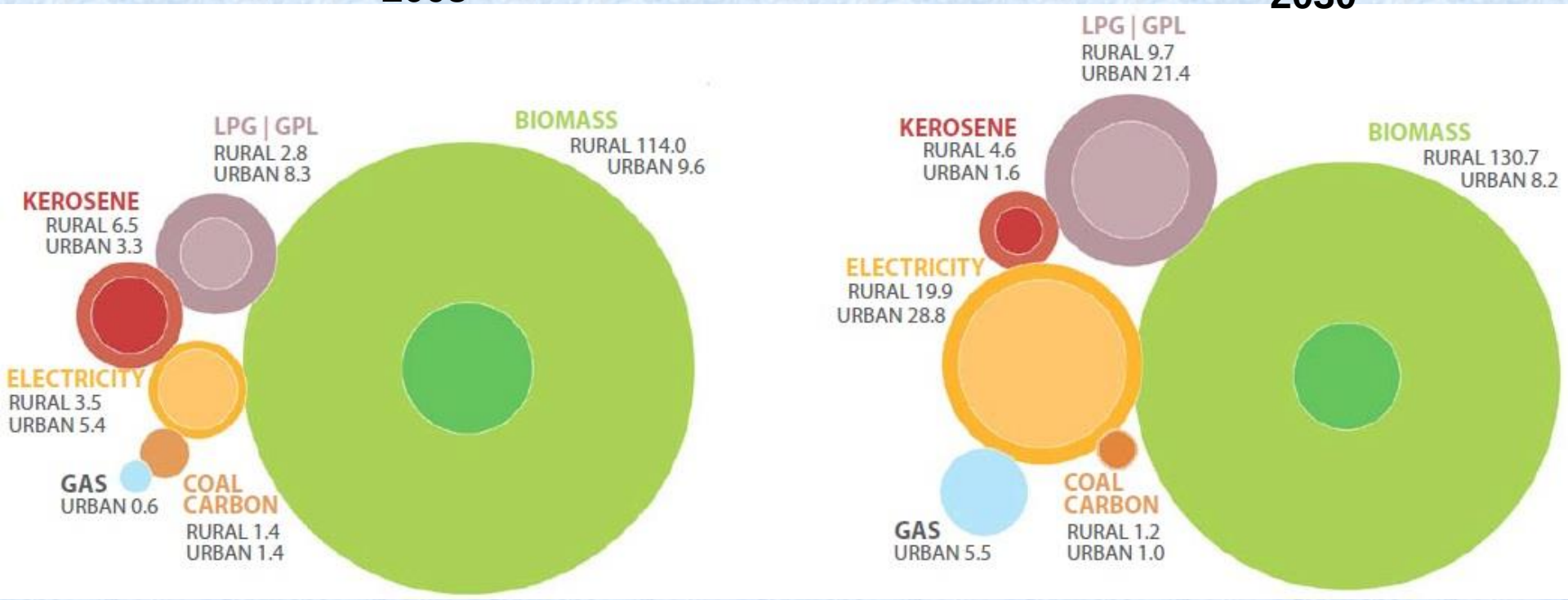
Ministry of Science & Technology
Govt. of India

Role of Biomass in Indian Scenario



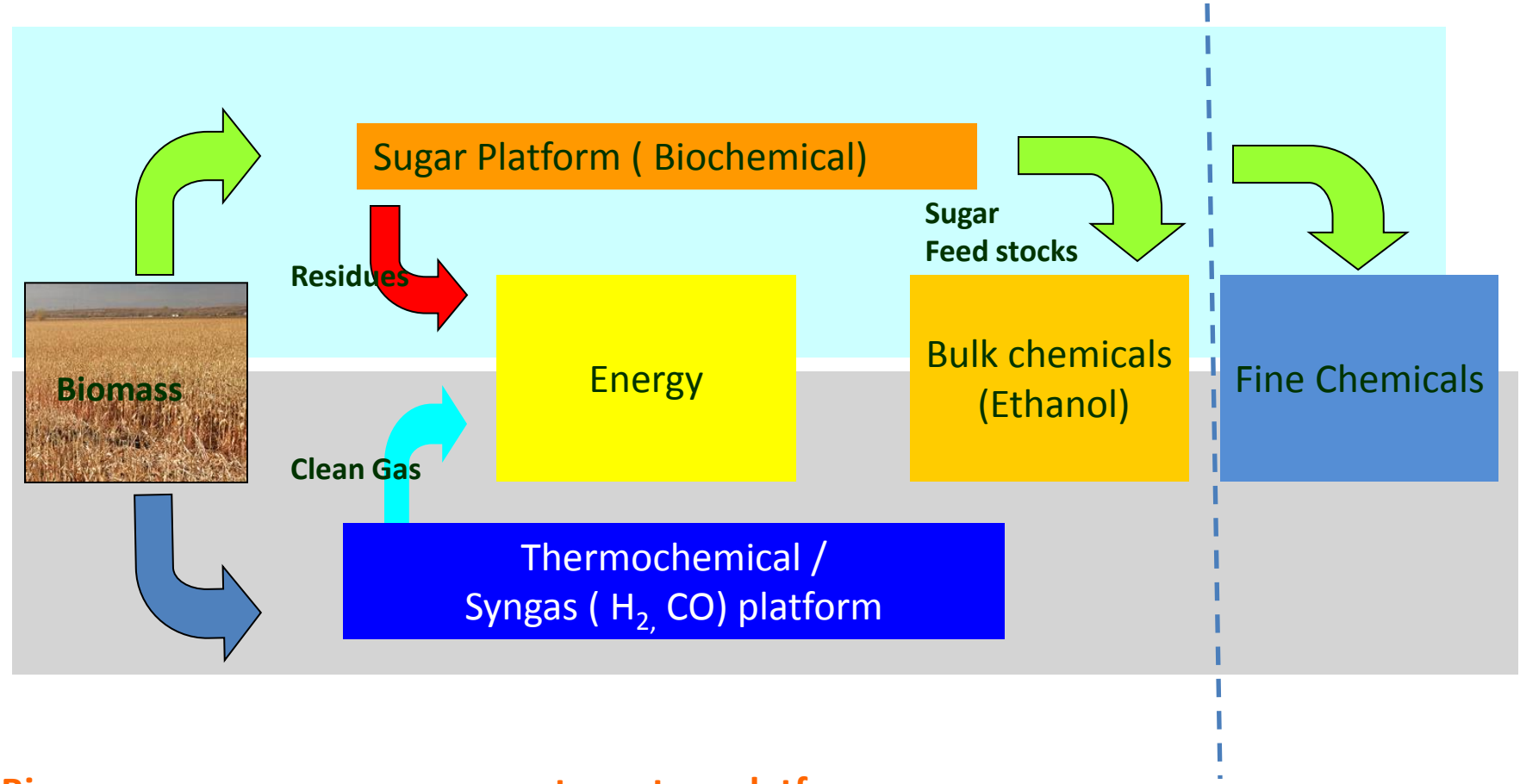
Bio energy, currently, contributes 30% of India's primary energy (750 mill TOE) & can grow to 40%.

Source: International Development Policy: Energy and Development, 2011
Data: IEA, World Energy Outlook 2007

Importance of Biomass availability

- The current availability of biomass in India is estimated at about 500 millions metric tones per year
- Biomass is renewable, widely available, carbon-neutral and has the potential to provide significant employment in the rural areas
- About 32% of the total primary energy use in the country is still derived from biomass and more than 70% of the country's population depends upon it for its energy needs
- Biomass power generation in India is an industry that attracts investments of over Rs.600 crores (12 m $) every year, generating more than 5000 million units of electricity and yearly employment of more than 10 million man-days in the rural areas
- Sugar industry has been traditionally practicing cogeneration by using bagasse as a fuel
- The thermo chemical processes for conversion of biomass to useful products involve combustion, gasification or pyrolysis. The most commonly used route is combustion

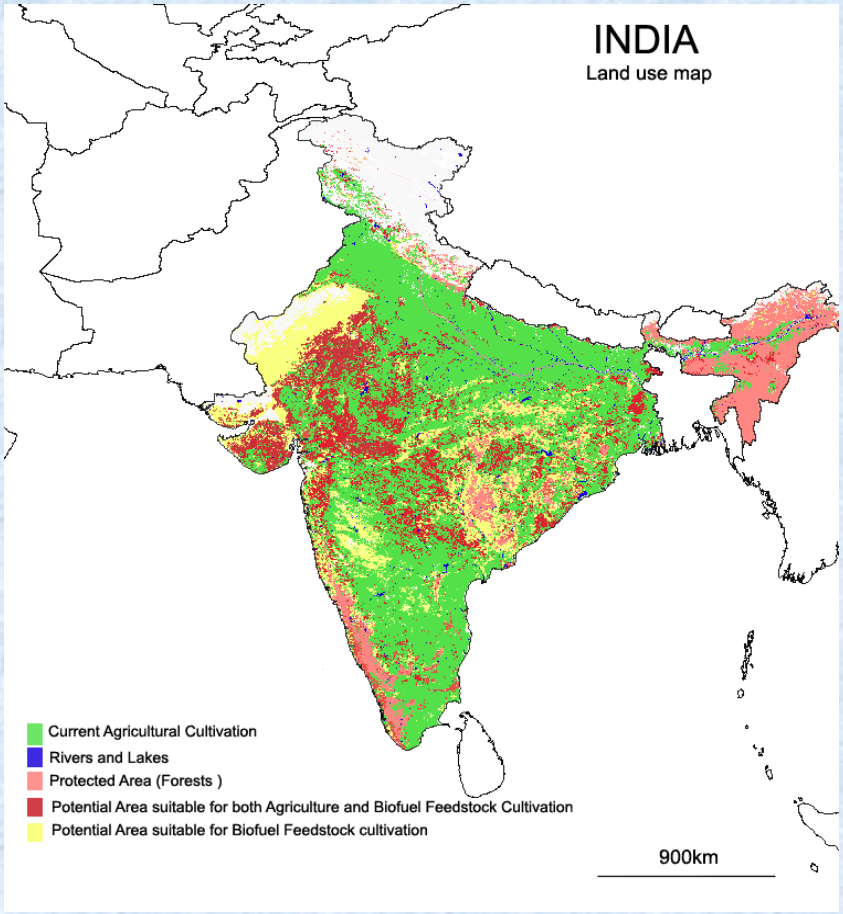
Bio-resource processes



Biomass as a resource can operate on two platforms

1. **Sugar Platform which uses biochemical conversion of biomass to fermentable sugars, followed by subsequent fermentation to yield useful products.**
2. **Thermo-chemical platform where biomass is gasified using thermo-chemical reactions to generate fuels and the byproducts are utilized.**

Why bio economy from biomass based resources?



~51 % of the land surface in India is cultivated and the cultivated lands are mostly rain-fed !!!!

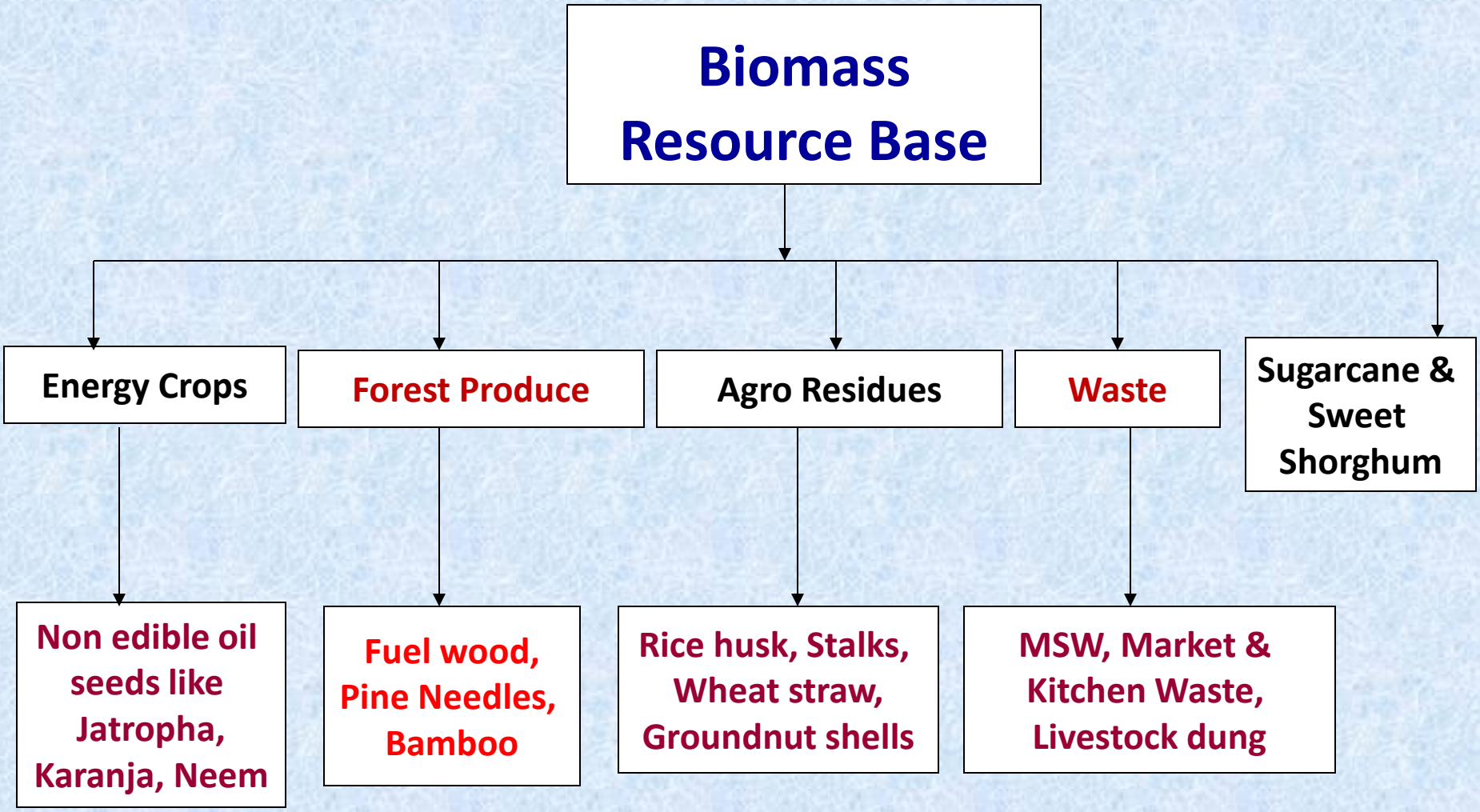
- India do not have surplus vegetable oil and biodiesel production should depend on imported oil !
- The nation does not have land resources to support the cultivation of oil crops or any energy crops at levels which can meet the production demand !
- India generates considerably a good amount of agricultural residues annually and this could be a potential feedstock for fuel production.

Sustainable availability of biomass

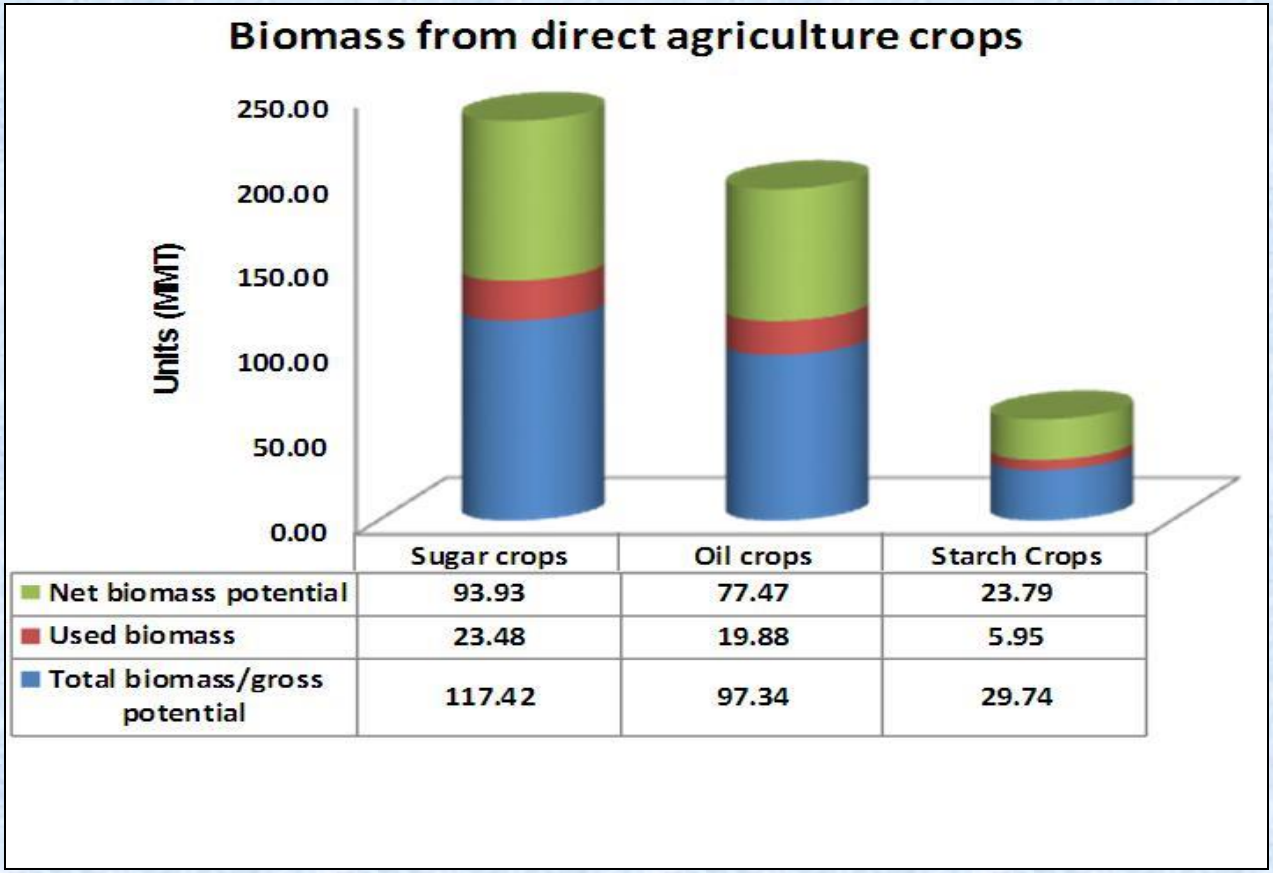
Availability of biomass feedstocks in India?

- For the purpose of understanding the feasibility and sustainability of producing biofuels from biomass in India,
- A clear understanding of the production, current uses and excess availability ('surplus') of biomass was needed.
- Further, the storage, transportation and procurement practices of such biomass resources also need to be understood.

Resource base: Indian Context



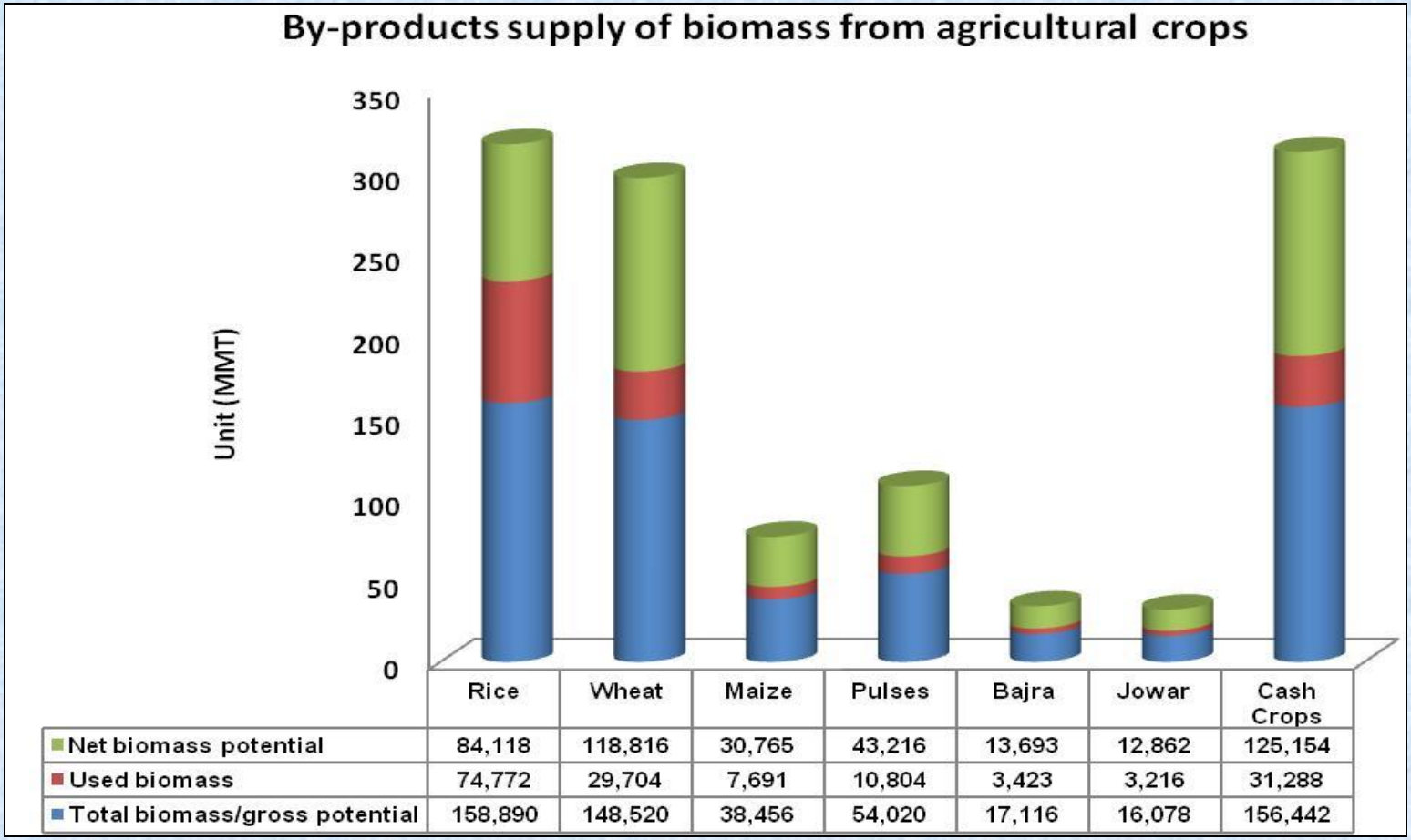
Current biomass scenario in India



	Sugar crops	Oil crops	Starch Crops
Net biomass potential	93.93	77.47	23.79
Used biomass	23.48	19.88	5.95
Total biomass/gross potential	117.42	97.34	29.74

The major biomass sources which comes direct from agricultural land consist of Sugar crops (117.42 MMT) followed by Oil crops (97.3 MMT) and Starch crops (29.74 MMT)

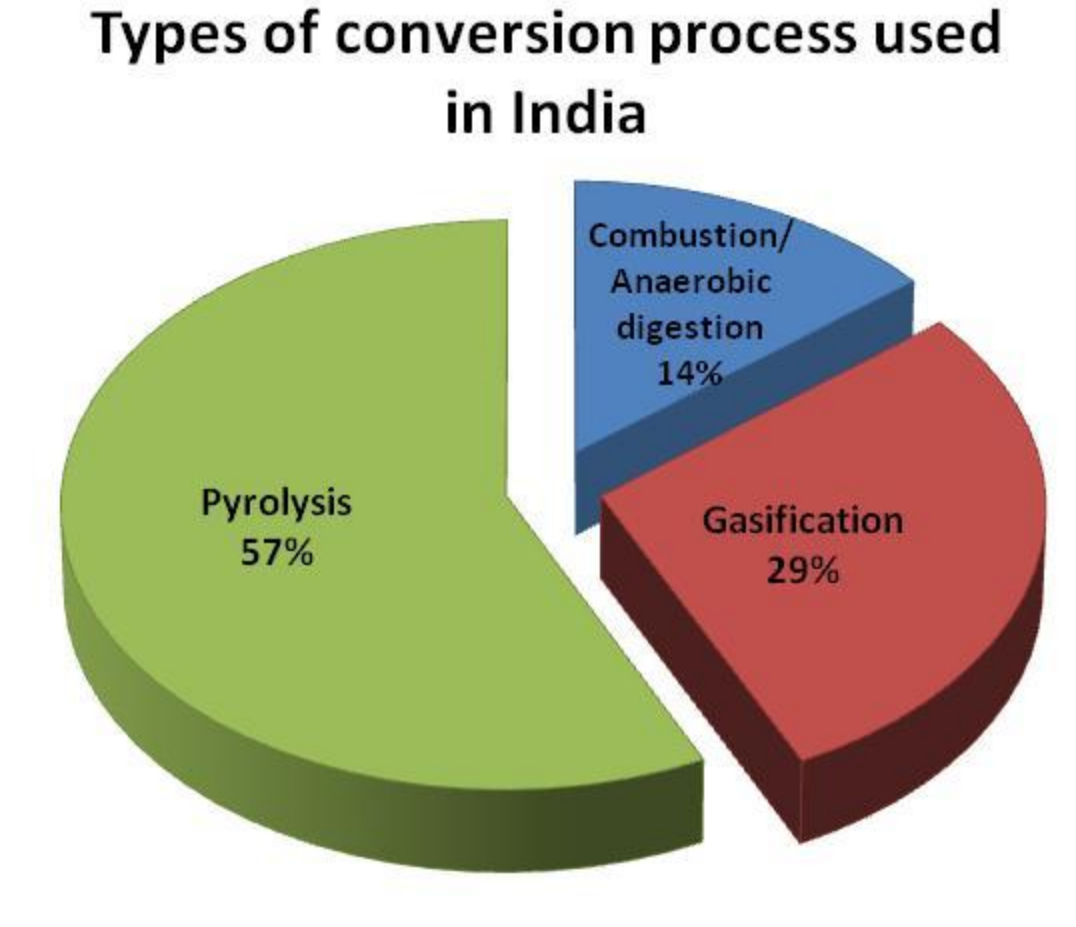
Over all Biomass scenario in India



	Rice	Wheat	Maize	Pulses	Bajra	Jowar	Cash Crops
Net biomass potential	84,118	118,816	30,765	43,216	13,693	12,862	125,154
Used biomass	74,772	29,704	7,691	10,804	3,423	3,216	31,288
Total biomass/gross potential	158,890	148,520	38,456	54,020	17,116	16,078	156,442

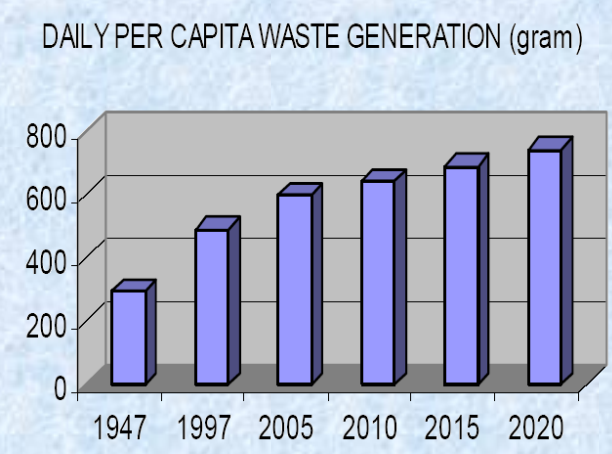
The crops which mainly constitutes for high biomass were Rice (158.89 MMT), Wheat (148.52 MMT) and several Cash crops (156.44 MMT) apart from other sources like Maize, Pulses, Bajra and Jowar which also contributes significantly

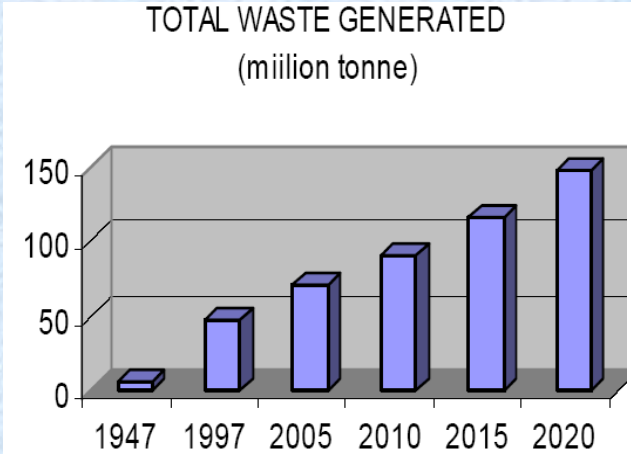
Typical applications for available biomass

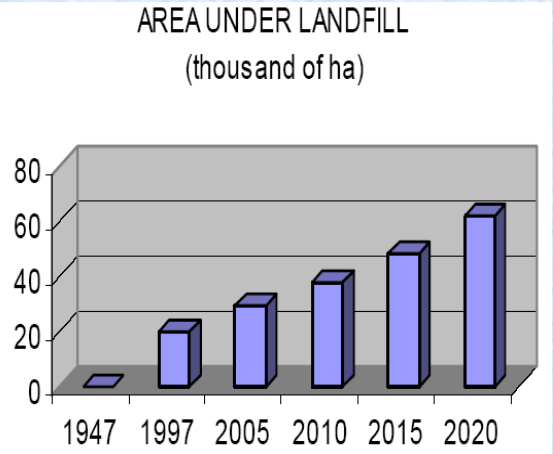


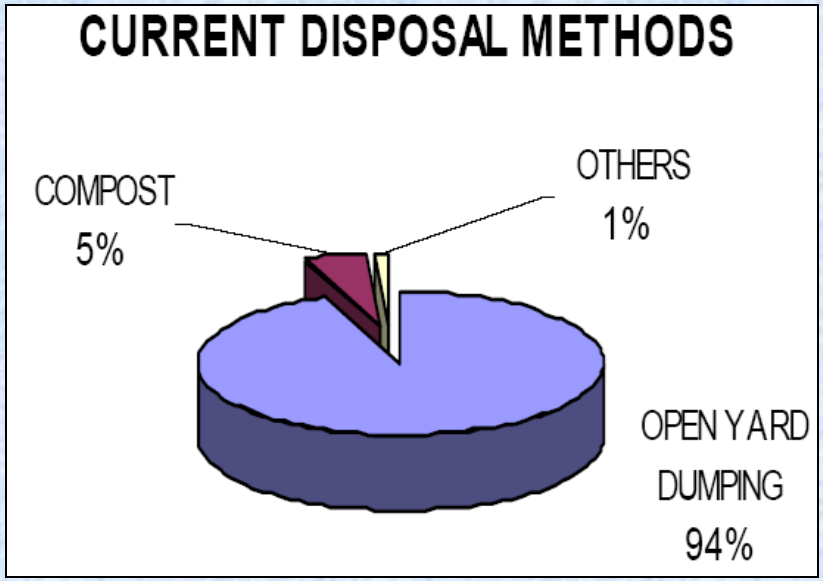
The type of conversion processed used for conversion of the biomass to energy as identified in India were mainly Pyrolysis (57%), Gasification (29%) and Combustion / Anaerobic digestion (14%)

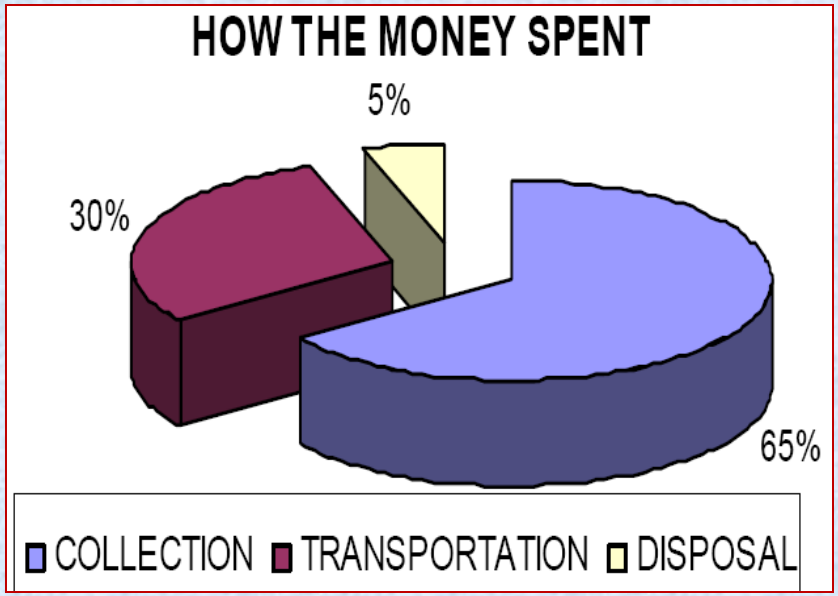
Municipal solid waste: a resource









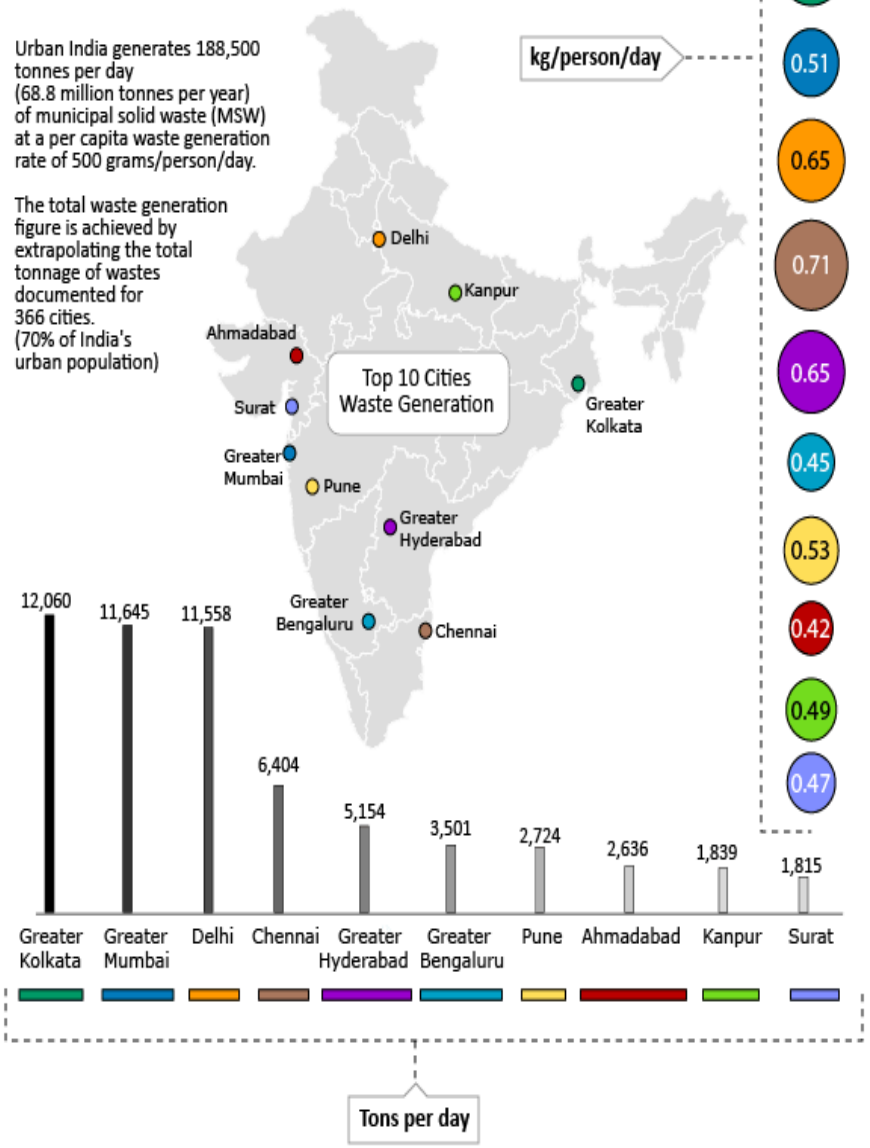


- Energy content in waste is not being efficiently used

Municipal Solid Waste Generation Quantity in Indian Cities

Urban India generates 188,500 tonnes per day (68.8 million tonnes per year) of municipal solid waste (MSW) at a per capita waste generation rate of 500 grams/person/day.

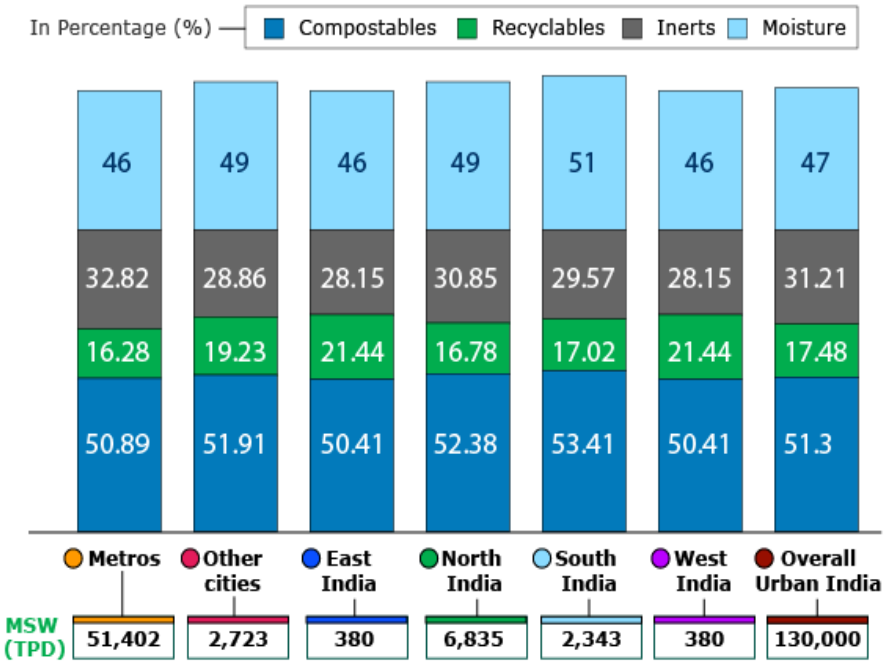
The total waste generation figure is achieved by extrapolating the total tonnage of wastes documented for 366 cities. (70% of India's urban population)

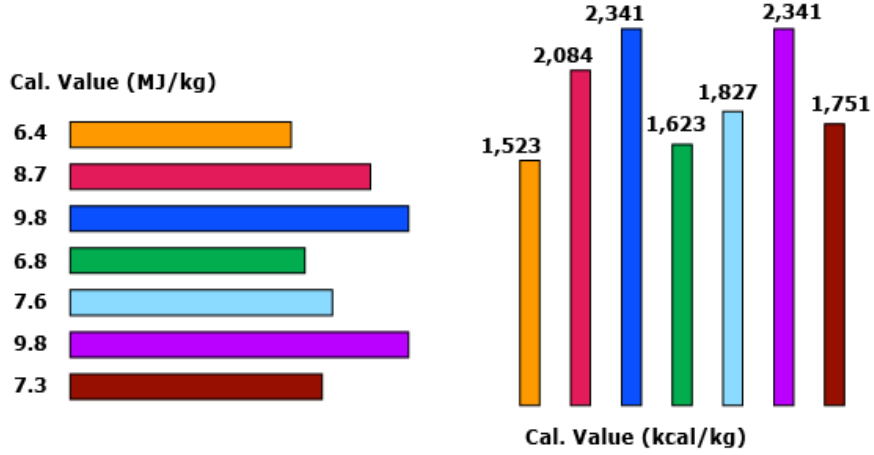


Source: Sustainable Solid Waste Management in India (Jan 10, 2012) - Ranjith Kharvel Annepu

Graph: GreenArth

Composition of MSW in India and Regional Variation





Note: The actual percentage of recyclables discarded as waste in India is unknown due to informal picking of waste which is generally not accounted.

Sustainable Solid Waste Management in India (Jan 10, 2012) - Ranjith Kharvel Annepu

Graph: GreenArth

Biowaste scenario in India

- **The four geographical regions in India, Northern India generates the highest amount of MSW (40,500 TPD or 14.8 million TPY) constituting around 30% of all MSW generated in India. Among the states, Maharashtra (22,200 TPD or 8.1 million TPY) tops the list**

- **Total available biodegradable fraction of waste that can be generated from the country would be estimated at 2.5 TPY**

- **Total sewage sludge generated in Indian came to be 1420.8 TPD and its expected Power potential estimated was 226.94 MW**

Sustainable supply of bio-resource for sustaining bio-economy

Potential Bio-resource availability

- **Sustainable Bio Resources, linked to land & coastline are summarized in chart below**

SOURCE	AVAILABILITY (million hectares)	BIO RESOURCE	APPLICATIONS
Forests Land	70.0 overall 28.8 open forest	(a) Fast growing bamboo/tree species (under National Mission for Greener India) (b) Forest residues, lantana, etc., that can be sustainably harvested/collected	(i) Cooking/Heating fuel (ii) Feedstock for Boilers/Gasifiers (iii) Pyrolysis for Liquid BioFuels (iv) Medicinal and high value products
Agriculture Land	141.0 nett cropped ≅ 200.0 gross cropped ≅ 55.0 lying fallow for 6 months.	(a) 120 million tons of Agro Processing units residues (bagasse, husk) (b) 600 million tons of agricultural residues (c) Short cycle leguminous/silage crops cultivated when land is fallow.	(i) Feedstock for Boilers/Gasifiers (ii) Pyrolysis for Liquid BioFuels (iii) Feedstock for Bioethanol/Biogas Plants.
Grazing/Fallow Land	≅ 50.0 overall	(a) Non edible oil seeds (b) Algae with high lipid content (c) Appropriate species of bamboo/trees (d) Short cycle leguminous/silage crop (e) Algae which gives high Biomass yield	(i) Production of SVO/Bio diesel (ii) Cooking fuel (iii) Feedstock for Gasifier/Boilers (iv) Feedstock for Bioethanol/ Biogas plants (v) Pyrolysis for Liquid BioFuels
Coastline	7517 km (including Islands)	Algae with high lipid content or with high biomass yield.	(i) Production of Biofuels through Bio Ethanol Refineries or Hydro treatment. ii) Pyrolysis for Liquid BioFuels iii) High Value products

Potential from plantations (Forest resource)

- ***State of Forest Report 2009***
  - Out of India's 70 million hectares forest land, about 28.83 million hectares is "open" forest lands (tree cover of canopy density, between 10-40%)
  - 0.28 million hectare of scrub land (tree cover of canopy density less than 10%).

- ***National Mission for Greening India***
  - Aims at increasing forest / tree cover on 5 million hectare forest / non forest lands and
  - improves quality of forest cover on another 5 million hectare which will be taken up on degraded forest land.

- This indicates **2.0 million hectare** lands, for "Plantations", *(subject to enabling policy guidelines framed by the Ministry of Environment & Forest and Ministry of Rural development)*

Case Study – Bamboo plantations

The bamboo is now cultivated from tissue culture and then micro propagated. As a result, each tissue culture sapling is identical, asexual, non evasive, non flowering and has a density a density of 5 times greater than any other species of bamboo. It can be cultivated in all types of soil and requires 20 litres of water per day.

12 week old saplings

One Year old

Two Year old

Four Year old
(12 poles - 25ft High)

Potential from manure management of livestock

India has 283 million bovine animals, India, annually, produces 120 mill tons Milk → 200 mill tons (by 2020)

India has 500 million poultry birds, with high CAGR (eg Namakkal district)

(in lakhs)

Average strength of layer birds in Namakkal zone in the last 10 financial years

2000 - 01	171.18
2001 - 02	212.71
2002 - 03	225.42
2003 - 04	219.19
2004 - 05	234.49
2005 - 06	307.34
2006 - 07	339.79
2007 - 08	367.35
2008 - 09	398.62
2009 - 10	407.34
2010 - 11	447.19
2011 - 12	500*

*average strength after expansion

1250 million tons/year manure (18% DS)

10 million tons/year dry manure (75% DS)

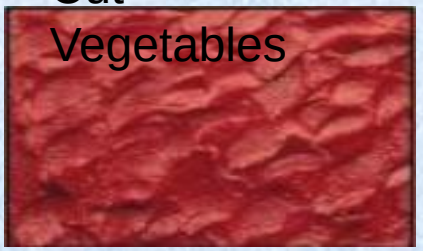
Horticulture/food based Bio waste processing

India's Horticulture output is 210 mill MT against NHM target of 350 mill MT → waste (30 to 40% of output, which can be processed to produce biogas + organic fertiliser)

Cold Storage

- **Indian farmers tend to cultivate grains (even with sub optimal returns, rather than vegetables) as they are not perishable.**
- **Food Processing/Preservation infrastructure would**
  (a) stimulate non grain farming
  (b) enhance farmers income
  (c) meet nutrition needs of the community
  (d) open up significant opportunities for exports
- ***Organic fertliser is well accepted in horticulture sector & will increase yield***

Cut Vegetables



Tomato Puree

Mango Pulp

Limited information: non efficient resource managements

One of the major limitations is the non-availability of central databases for biomass/bioresources availability in India

The information on availability of surplus biomass or bio-waste for its valorisation was not available in any central database

Due to deficit and government policy, forest resource can not be tapped even for non timber applications

Documentation of residues from SMEs (sawmilling, woodworking, furniture industry, by-products of the pulp and paper industry, processed wood-fuel, food, fruit processing and fishery bio-waste is largely missing

Thank You