

Integrated Straw Management Solutions for South Asia



Dr. Kanchan K. Singh
A. D. G. (Engg.)
Indian Council of Agricultural Research
New Delhi, India

Regional Workshop of Integrated Straw Management in Asia and the Pacific
12-14 December 2017, Kathmandu, Nepal



CSAM

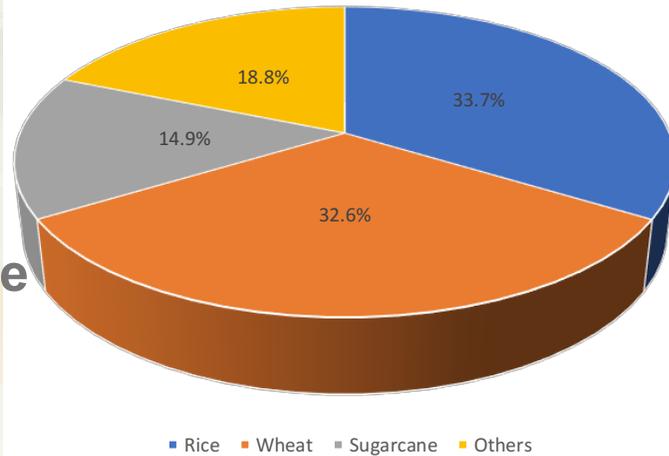


Crop straw in South Asian countries

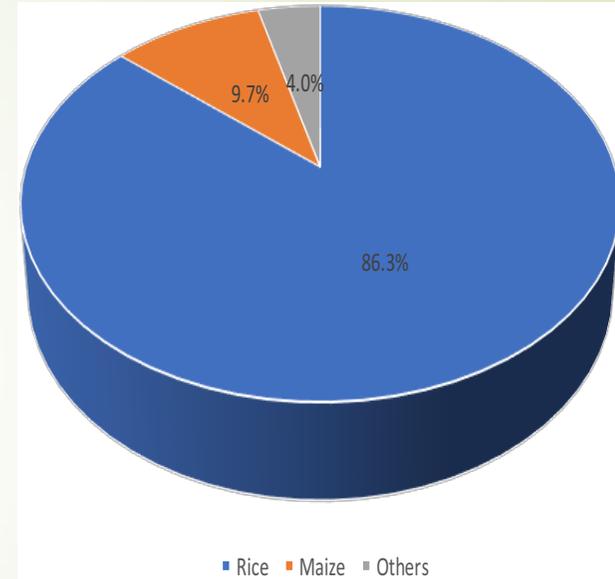
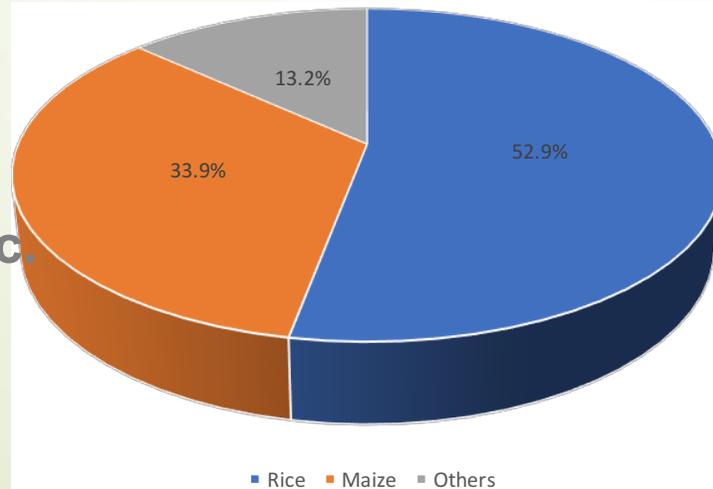
- **Crop Straw produced per year**
 - **India - 500 MT**
 - **Bangladesh - 50 MT**
 - **Nepal - 10.5 MT**
 - **Sri Lanka - 2.5 MT**

Major Crops in south Asian countries

India-
Rice,
Wheat,
Sugarcane
etc.



Nepal-
Rice,
Maize etc.



Bangladesh-
Rice,
Maize etc.

(FAOSTAT, 2014)

Distributions of main crop straw in South Asia Countries

Countries	Straw distribution regions
India (Rice, wheat, maize, sugarcane etc.)	West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab, Orissa, Bihar, Chhattisgarh, Tamil Nadu, Assam, Haryana, Madhya Pradesh, Bihar, Maharashtra, Rajasthan states
Bangladesh (Rice, maize etc.)	Barisal, Chittagong, Khulna, Rajshahi and Rangpur Divisions
Nepal (Rice, maize, wheat etc.)	Eastern, Western and Central regions
Shri Lanka (Rice, maize etc.)	Anuradhapura, Kurunegala, Polonnaruwa, Hambantota, Ampara, Monaragala, Badulla, Matale, Puttalam and Trincomalee districts

Crop straw management pattern

➤ Straw used as **fertilizer**

- Straw poorly utilized for fertilizer.
- In India, crop straw left in field (15-20%) after harvesting is directly incorporated by ploughing.
- Only 5-10% straw recycled back to the field as compost manure or as decomposed material.
- Combine harvested paddy field, in-situ incorporation of straw using chopper, demonstrated in few fields since 3-4 years.
- In other south Asian countries, situation almost same.

Crop straw management pattern contd..

- Straw used as **fodder**
- Wheat straw and chopped maize stalk - most favoured fodder for animal in India and Nepal.
- Paddy straw and maize stalk also used as fodder crop for animals
 - South, East and N-W parts of India
 - Almost all parts of Sri Lanka and Bangladesh
- Ground nut and sorghum stalk- as fodder in Western and north-western parts of India.

Crop straw management pattern contd..

- Straw used as **industry material**
- About 30% of India's paper is made from agricultural residue and / or non-wood fibers (Jain et al., 2005; Anonymous, 2017).
- In Sri Lanka 2-3 % of paddy straw used in paper industry (Jayasuriya, 1983).
- In Bangladesh, paper industry uses mostly bamboo and mixed hardwood.

► Straw used as New Energy Resource

Biomass Power/Co-generation Projects in India (MW) (MNRE, India, 2016)

State	2003-12	2012-13	2013-14	2014-15	2015-16	Total
Andhra Pradesh	363.25	17.5				380.75
Bihar	15.5	27.92				43.42
Chattisgarh	249.9		15	15		279.9
Gujarat	20.5	10	13.4	12.4		56.3
Haryana	35.8	9.5				45.3
Karnataka	441.18	50	112	111	158	872.18
Madhya Pradesh	8.5	7.5	10	9		35
Maharashtra	603.7	151.2	185.5	184	96.38	1220.78
Odisha	20					20
Punjab	90.5	34	16	15		155.5
Rajasthan	83.3	10	8	7		108.3
Tamil Nadu	532.7	6	32.6	31.6	39	626.9
Uttarakhand	10		20	20	13	50
Uttar Pradesh	644.5	132			93.5	842
West Bengal	16	10				26
Total	3135.33	465.6	412.5	405	400	4831.33

•In Bangladesh, biomass based power generation capacity <1 MW (Ahmed and Tanin, 2013).

Overall Status / Use of paddy straw

- In South Asia, **only 20% of rice straw** used for fodder, paper, production of ethanol, fertilizers etc.
- The rest **80% of rice straw** – removed, burnt, piled up, incorporated in soil, spread out or used as mulch for following crop (Hanafi et al., 2012).

Straw burning problems

Crop straw burnt (>5%) by farmers in south Asian countries

Country	Crop straw	Main reason	Major negative impact
India	Rice and wheat	Easy & quick method of disposal	Polluting air Harmful to human health Loss of nutrients Damage soil micro organisms
Sri Lanka	Rice and Maize		
Bangladesh	wheat		
Nepal	Wheat		

Straw burning problems contd..

- India : major problem in Punjab, Haryana, western Uttar Pradesh
- Punjab and Haryana - about 23 MT of paddy straw (out of 30 MT) is burnt in field - easy and quick disposal.
- Burning straw causes atmospheric pollution, huge nutritional loss and physical health deterioration to the soil.
- Time available between rice harvesting and wheat sowing is 20-30 days.



Options: Integrated Straw Management

- **In situ crop residue management - Mulching and incorporation in the soil**
- ***Feed block making for animals***
- ***Biomethanation of straw for biogas production and recycling compost in the soil***
- ***Rapid composting of straw and recycling in the soil***
- ***Mushroom cultivation***
- ***Production of Bio-ethanol***
- ***Utilization of straw for power generation***
- ***Utilization of straw as other industrial raw material***

Pilot sites and partners in South Asia

- Country: **India**- major agricultural country in South Asia region
- Pilot Sites: **Punjab Agricultural University, Ludhiana**
 - Establish straw management technology
 - Strong scientific research strength, 22 KVKs, laboratory facilities.
 - Punjab worst affected by straw burning.
- Co- Partner: **C.I.A.E., Bhopal**
 - Leading National institute, AICRPs
 - Rich experienced scientists and technical staff
 - Design and implement pilots and related tasks.

In situ crop residue management

- **Straw mulching and sowing:** combine harvester fitted with Super Straw Management System and Happy Seeder
- **Straw chopping and incorporation in soil and sowing seed** with normal seed drill / planter

Straw mulching and sowing for Rice-Wheat cropping system

- Attachment of Super Straw Management System in Existing Combines
- Wheat sowing with Happy Seeder directly in combine harvested rice fields
 - Straw management rotor to cut and chop straw in front of furrow openers and guide the cut material between the sowing tynes thus leaving a clear space for sowing while leaving the chopped straw as mulch in between the seed rows.



Viabile and scalable solution for Rice-Wheat cropping-

Combine harvester with Super SMS and Happy Seeder





Wheat crop sown by happy seeder –
yield at par with conventional sowing

Removal/collection of paddy straw

➤ Farm residue collector

- Field capacity of 0.3 ha/h



➤ Baling of paddy straw

- Field capacity: 0.36-0.39 ha/h
- Weight of bales: 15 to 35 kg

(depending on moisture content of straw and length of bales).



Straw incorporation for Rice-Potato / vegetable or rice-wheat cropping

- ➔ **Paddy straw Chopper-cum-spreader + Reversible Mould Board Plough + Rotavator + Sowing**





Other Options

Animal Feed Block Formation Machine

- **Capacity : 250 kg/h**
- **Power : 25 hp electric motor**
- **Inputs: Crop residues, essential nutrients**
- **Advantages:**
 - **Shelf life - one year**
 - **Saving in transport cost**
 - **Saving in storage space**



Mobile Animal Feed Block Machine

- **Easy transport**
- **Capacity : 1-1.2 kg/h**
- **Power : 6.5 hp diesel engine**
- **Bulk density of blocks – 400 kg/m³**



Animal feed block making plant at a Milk Chilling Centre, Adaspur, Cuttack (Odisha)

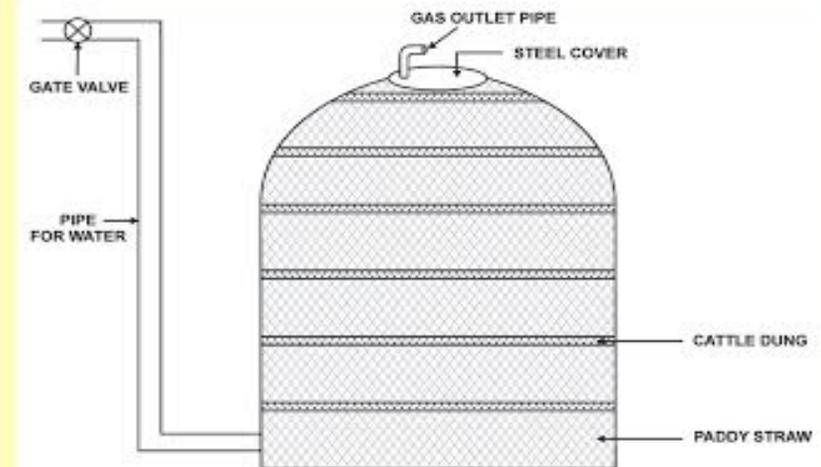


PADDY STRAW BASED BIOGAS PLANT

Bio-Gas plant for dry fermentation of Paddy Straw



Installation cost = Rs.1,20,000/-



Sequence of filling paddy straw and cattle dung

Biomass input:

- * Paddy straw = 1.6 t
- * Cattle dung = 0.4 t
- * Water = up to saturation

Biogas output:

- * 4 to 5 m³ per day
- * Period ~3 months
- * LPG cylinder equivalence is 3 to 4 per month

PADDY STRAW BALE GEYSER- for water heating



100 litres of water heated to 45-50°C in 3-4 hours

MUSHROOM PRODUCTION

WHITE BUTTON MUSHROOM



➤ **Wheat straw : paddy straw**

1 : 2



Thank You All

E-mail: kksingh03@yahoo.co.uk

<http://www.icar.org.in>