Crop Residue Management in South Asia

Advancing Sub-Regional Cooperation for Sustainable, Climate-smart and Integrated Management of Crop Residues

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Hybrid mode
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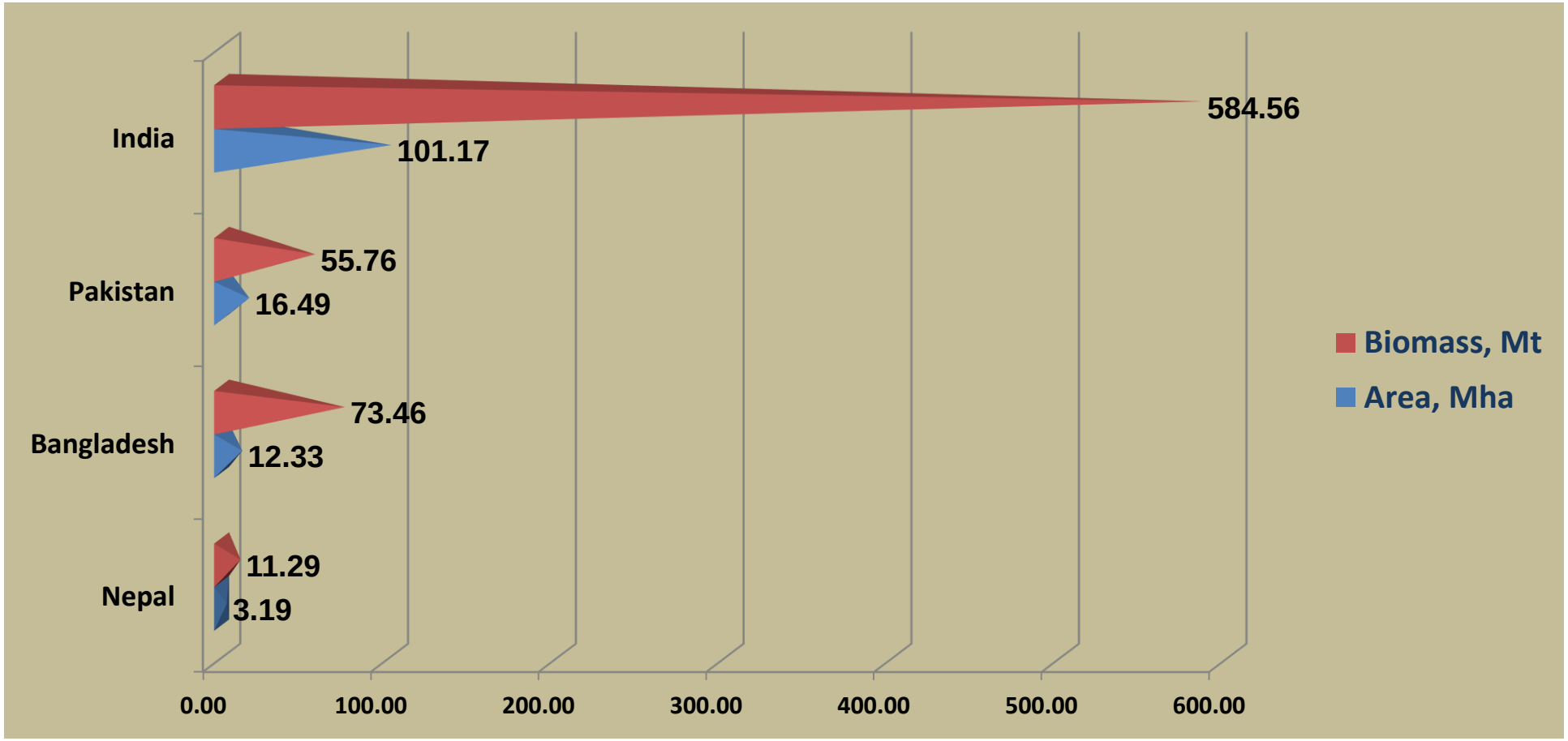
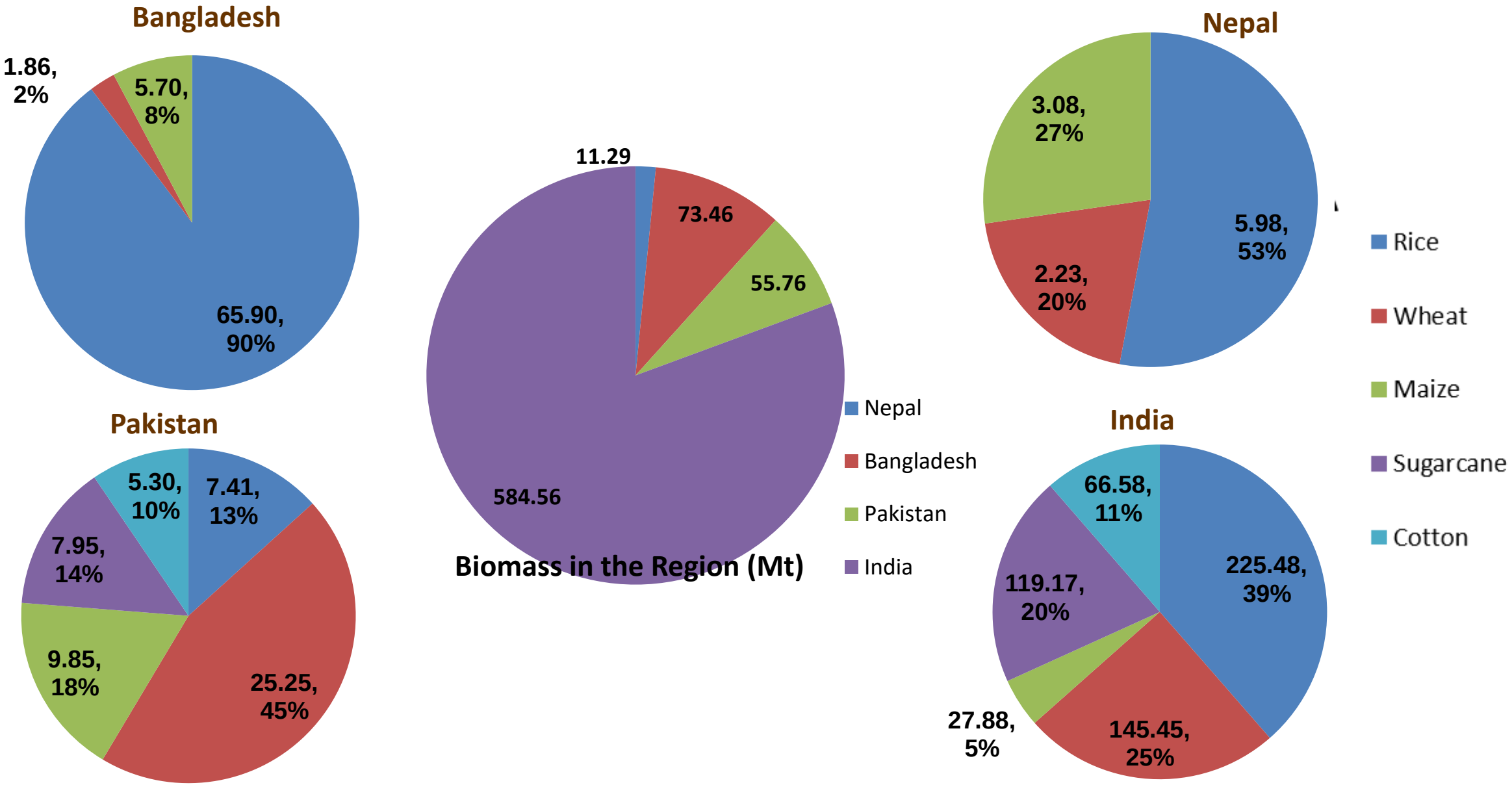
Biomass Production from Major Crops in the Region



Large variability exists in the estimates of production, utilization and on-farm burning of crop residues in the region

Crop-wise Residue Production in the Region



Utilization of Crop Residue in the Region

Straw uses	Nepal	Bangladesh	Pakistan	India
Animal feed	√	√	√	√
Bedding material for cattle	√	√	√	√
Residue incorporation	√	√	√	√
Residue mulching	√	√	√	√
Domestic fuel	√	√	√	√
Value added items	√	√	√	√
Compost making	√	√	√	√
Paper production	√	√	√	√
Building material	√	-	-	√
Mushroom production	√	√	-	√
Bio-gas production	-	√	-	√
Briquetting of crop residues	-	-	-	√
Bio-CNG/Compressed bio-gas (CBG)	-	-	-	√
Power generation from biomass	-	-	√	√
Bio-ethanol production	-	-	-	√
Bio-char	-	-	-	√

Crop Residue Burning in the Region

Crop residue burning is influenced by the agricultural practices that include

- **Crop cycle and type,**
- **Harvesting season,**
- **Potential use of residues,**
- **Agricultural mechanization,**
- **Feasibility of on-farm residue collection and transportation and**
- **Profitability of alternate options**

Country	Crop residue burning (Mt/year) (Total)	Major crops residue burning
India	140 (683)	Rice, wheat, cotton, sugarcane
Pakistan	- (56)	Rice, sugarcane
Bangladesh	0.22 (73)	Wheat, *Aman* rice
Nepal	- (11)	Rice (Tarai)

Crop Residue Burning in the Region – Main Reasons

- Very **short time interval** (10–20 days) and resources for sowing of next crop (Rice-wheat cropping system) – India, Pakistan and Nepal
- Use of **combine harvesters** and lack of **straw management machinery**
- **Easiest and cheapest way** for quick disposal of crop residues
- **Labour scarcity** and high cost of collection and storage
- **Lack of storage** facilities and **market opportunities**
- **High cost to plough back stubbles** mechanically
- **Paddy straw is less preferred** as ruminant feed – India and Pakistan
- **Lack of awareness** about the downside of crop residue burning
- **Disproportionate incentives/subsidies** to manage crop residues
- **Low level of skills and knowledge** about CRM machinery

Consequences of Crop Residue Burning - Highlights

- Burning of 23 million tonnes of rice residues in **north-west India** - loss of about **9.2 Mt of C equivalent (34 Mt CO_2 equivalent) and a loss of about 1.4×10^5 t of N** per year.
- Over **60,000 people died in Pakistan from high level of fine particles in the air**, one of the world's highest death tolls from air pollution (WHO, 2015)
- Total agricultural emissions from **Bangladesh** are expected to reach **87 Mt CO_2e by 2030 and 100 Mt CO_2e by 2050** (CIMMYT, 2021)
- Burning of wheat straw in **Bangladesh** results in loss of **100% nitrogen, 70-90% sulphur, and 20-40% phosphorous and potassium**.
- In **Nepal**, emission from crop residue burning increased from **85 ktCO_2e in 1961 to 160 ktCO_2e in 2018**.

➢ **Air pollution from straw burning is a cross border/trans-boundary issue – need sub-regional cooperation**

Examples of Best Practices in the Region

In-situ Management of Crop Residues

- **Residue mulching -** Zero till drill and Happy seeder machine, preferably after operation of combine with SMS system (India, Pakistan & Nepal)
- **Residue incorporation -** Paddy chopper cum spreader and MB plough/Disc plough/Rotary tiller - require lot of energy (India, Pakistan & Nepal)

In-situ method of straw management

- **Saving of 30 - 35% nitrogen, 20 - 25% potassium and 25% of irrigation water**
- **Increase in organic carbon, and**
- **Help in restoring microbial activities in the soil.**

Examples of Best CRM Practices in the Region

In-situ Management of Crop Residues – Equipment/Machinery being used

INDIA


Mulcher


Combine with SMS


Sugarcane trash chopper-spreader


Zero till drill


Happy seeder


Super seeder

PAKISTAN


PTO powered disc plough


Stubble chopper


Combine straw spreading kit


Rocket seeder

Pak seeder

Provided subsidy on straw chopper and Pak seeder (2021)

NEPAL


Rotary mulcher


PT roto till drill


Zero till drill


Happy seeder

Used some implements on limited scale

BANGLADESH


Strip till planter


Zero till planter

Used some implements under CIMMYT

Examples of Best CRM Practices in the Region

Equipment used for Ex-situ Management of Crop Residues

Straw Reaper


Straw Rake


Combine with Straw Reaper Attachment


Straw Baler-Round


Straw Baler - Rectangular

- Help in collection of straw for different uses

Examples of Best CRM Practices in the Region

Ex-situ Management Practices of Crop Residues

- Composting of paddy straw
- Biogas plants for paddy straw at domestic/community level
- Biomass pellets from crop residues for use as fuel in power plants
- Briquetting of crop residues as an industrial fuel supplement
- Power generation from biomass
- Bio-CNG production from paddy straw
- Ethanol production from crop residues

Common Challenges & Gaps in Management of Crop Residues

In-Situ Management

- **Lack of adoption of CA**
- Non-availability of high hp (≥ 50) tractors
- Expensive and seasonal use of CRM machinery
- **Use of combine harvesters**
- Demand-supply gap - local manufacturers unable to meet needs of farmers
- Additional management skills
- Apprehension of yield loss/returns
- **Negative attitudes or perceptions**

Ex-Situ Management

- **High cost of collection and transportation of residues**
- Lack of assured supply of residue
- **Lack of assured markets for processed by-products**
- Lack of network of collection centres and supply chain management (SCM) facilities
- **Lack of technical and economic feasibility studies**

Other common issues

- **Lack of relevant statistical information on availability, utilization and surplus straw resources**
- Lack of **crop residue management policy**
- Subsidy & financial support to farmers and entrepreneurs
- **Incentives to farmers for not burning crop residues**

Action Plan and Way Forward

- Any solutions involving **long-haul transportation, expensive technology, or high capital investment** are less likely to succeed.
- Sustainable solutions - methods to feed the **nutrients in crop residues back into the soil**

In-situ management is to be preferred over ex-situ management

Mechanization Intervention	• **Promotion of CRM machinery through promotion of CA practice** • **Dev. of small tractors/power tiller operated CRM machinery for small farmers** • **Dev. of multi-functional CRM farm machinery – increase use** • **Improve access to CA machinery at subsidized rates, promoting custom hiring system and providing soft loans to purchase implements** • **Large scale demonstrations, trainings and workshops**
Institutional Interventions	• **Conduct survey to collect information on availability, utilization and surplus straw resources** • **Need of crop residues management policy for rationalizing various issues** • **Develop mechanism for crop residue biomass aggregation** • **Carbon credit schemes for farmers using CA and not burning residue** • **Enforcing appropriate legislation on prevention of burning through incentives and deterrence**

Action Plan and Way Forward

Socio-economic Interventions	• **Bio-gas production from crop residues at domestic/community level (Bringing back fertilizer to field)** • **Awareness creation about negative impacts of crop residue burning on human health and the environment through media campaigns and community programmes** • **Capacity building on adaption of conservation agricultural practices** • **Establishing self-help groups and encouraging unemployed youths to take up custom hiring of CRM machineries as a profession**
Other Technical Interventions	**In-situ management is to be supplemented with ex-situ management techniques** • **Biomass pellets from crop residues as a fuel substitution in thermal power plants** • **Industrial level production of Bio-CNG/Compressed Biogas (CBG) from paddy straw** • **Incentivise power generation from bio-mass** • **Promote 2G biomass based ethanol plants in PPP mode.**

Common Framework for Sub-regional Cooperation

- Conduct study on availability, utilization, surplus and burning of crop residues in South Asia
- Share equipment/technologies for in-situ management of crop residues
- Share knowledge of best practices of CRM in different countries through workshops/seminars/visits organised by CSAM
- Harmonization of testing standards for CRM machinery
- Explore policy harmonization for adaptation of CRM machinery.

Combine harvester with Super SMS and Happy Seeder

- Need for a combination of technologies and incentives.
- Strategy - assign a real economic and commercial value to the crop residue and making burning an economic loss to the farmer.

Thank you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South Asia Network on the SDGs