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Agricultural Burning: Sectoral to Regional Impacts and Solutions

Challenges and solutions on crop residue management to reduce agriculture burning in South Asia

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Background

- Crop residue burning is an **environmental hazard** in many South Asian countries
  - Increases concentration of particulate matter and black carbon **affecting health**
  - **Damages soil** fertility by depleting soil of organic matters, nutrients and microorganisms
  - **Emits greenhouse gases** which contributes to global warming and climate change
- **National studies** undertaken in Bangladesh, India, Nepal and Pakistan to understand the situation of crop residue management, collect good straw management practices/technologies and propose actions
- **Subregional report** developed to explore key actions and areas of subregional cooperation to promote the sustainable and integrated management of crop residues

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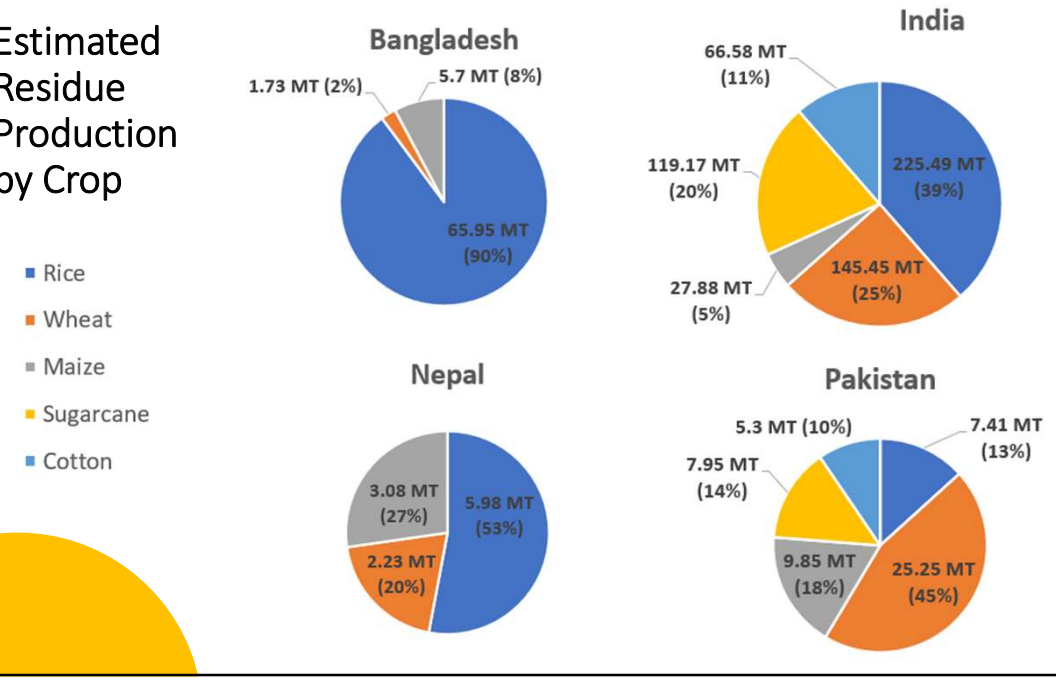
Estimated Residue Production by Crop



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Utilization of crop residues in study countries

Straw management practices		Nepal	Bangladesh	Pakistan	India
In-situ	Residue incorporation	√	√	√	√
	Residue mulching	√	√	√	√
Ex-situ	Animal feed	√	√	√	√
	Bedding material for cattle	√	√	√	√
	Compost making	√	√	√	√
	Domestic fuel	√	√	√	√
	Value added items	√	√	√	√
	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	-	-	-	√

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Factors influencing burning of crop residues

Issues	Reasons for burning
Crop cycle, crop type and harvesting season	• Very short time interval (10–20 days) and resources for sowing of next crop (Rice-wheat cropping system) – India, Pakistan and Nepal • Easiest and cheapest way for quick disposal of crop residues
Potential use of residues	• Lack of awareness about downside of crop residue burning • Limited of awareness of conservation agriculture practices • Paddy straw is less preferred as ruminant feed – India and Pakistan
Agricultural mechanization	• Use of combine harvesters and lack of straw management machinery • Low level of skills and knowledge about CRM machinery
Feasibility of on-farm residue collection and transportation	• Labour scarcity and high cost of collection and storage of straw • Lack of storage facilities and market opportunities
Profitability of alternative options	• High cost to plough back stubbles mechanically • Limited incentives/subsidies provided to manage crop residues in alternative ways

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In-situ crop residue management equipment/machinery

INDIA

PAKISTAN

Provided subsidy on straw chopper and Pak seeder (2021)

NEPAL

Used some implements on limited scale

BANGLADESH

Used some implements under CIMMYT

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Best practices of in-situ crop residues management

Residue mulching

Zero till drill and Happy seeder machine, preferably after operation of combine with SMS system (India, Nepal & Pakistan)

Residue incorporation

Paddy chopper cum spreader and mould board plough/disc plough/Rotary tiller - require lot of energy (India, Nepal & Pakistan)

Benefits of in-situ method of straw management

- Saves 30 - 35% nitrogen, 20 - 25% potassium and 25% of irrigation water
- Increases soil organic carbon
- Restores microbial activities in the soil

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Equipment used for Ex-situ Management of Crop Residues


Straw Reaper


Combine with Straw Reaper Attachment


Straw Rake


Straw Baler-Round


Straw Baler - Rectangular

- **Help in collection of straw for different uses**

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Examples of ex-situ crop residues management practices

- **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

Bio-gas plant

Composting

pellets

briquettes

Power plant

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Common Challenges & Gaps in Management of Crop Residues

In-Situ Management

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

Ex-Situ Management

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

Other common issues

- **Lack of statistical info on availability, utilization and surplus crop residues resources**
- Lack of **crop residue management policy**
- Subsidy & financial support to farmers and entrepreneurs
- Need for **incentives to farmers for not burning crop residues**

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Way forward

- **Strategy** - assign a real economic and commercial value to the crop residue and making burning an economic loss to the farmer
- Need for a combination of technologies and incentives
- Solutions involving long-haul transportation, expensive technology, or high capital investment are less likely to succeed
- In-situ management practices should be preferred as it feed nutrients in crop residues back into the soil
- In-situ should be supplemented with ex-situ management techniques

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Recommendations

Mechanization interventions

- Promote CRM machinery through promotion of CA practices
- Develop small tractors/power tillers operated CRM machinery for small farmers
- Improve access to CA machinery through subsidies, custom hiring systems and soft loans to purchase implements
- Conduct large-scale demonstrations, trainings, workshops

Institutional interventions

- Collect data on availability, utilization and surplus residues using uniform protocol
- Develop crop residues management policy for rationalizing various issues
- Develop mechanism for crop residue biomass aggregation for ex-situ uses
- Carbon credit schemes for farmers using CA and not burning residue
- Enforce legislation on prevention of burning through incentives and deterrence

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Recommendations

Socio-economic interventions

- Media campaigns and community programmes on negative impacts of crop residue burning on health and the environment
- Capacity building on conservation agricultural practices
- Establishing self-help groups and encouraging unemployed youths to take up custom hiring of CRM machineries as a profession

Other interventions

- Bio-gas production from crop residues at domestic/community level
- Incentivize power generation from bio-mass
- Pellets from crop residues as a fuel substitution in thermal power plants
- Industrial level production of Bio-CNG/Compressed Biogas from paddy straw
- Promote 2G biomass-based ethanol plants in PPP mode

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Subregional framework for cooperation

A. Joint research and analytical studies		
Conduct study on availability, utilization, surplus and burning of crop residues following a uniform protocol	Bangladesh India, Nepal & Pakistan	Leverage existing networks of agriculture research institutions (e.g. **APAARI, CIMMYT, IRRI**) to support joint research and engage departments of agriculture/agriculture engineering for studies
Fire mapping studies to understand extent of burning	Bangladesh Nepal & Pakistan	A **subregional coordination group** of line ministries/agencies from interested countries could lead fire mapping studies. Agriculture Research Councils, such as **ICAR** could facilitate coordination of this work
B. Supply chains for aggregation of crop residue biomass		
Development of mechanism for aggregation of crop residue biomass to make ex-situ practices economically viable	Bangladesh India & Nepal	**ESCAP** could facilitate the sharing of experiences from India and other Asia-Pacific countries on domestic and cross-border agriculture supply chains and their application for aggregation of crop residue biomass

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Subregional framework for cooperation (cont.)

C. Sharing of technologies, equipment and practices for management of crop residues		
Formation of a common pool for funding collaborative R&D of machines/solutions	Bangladesh India, Nepal & Pakistan	**ESCAP** may work with SAARC to establish funds for R&D efforts
Knowledge sharing and training programmes to exchange technologies and experiences		**ESCAP-CSAM** should strengthen technical exchanges of knowledge and pilots on crop residue management in the subregion. **SAARC Agriculture Centre** may help in organizing skill development programme in the sub-region.
D. Harmonization of testing standards and promoting more integrated trade of agriculture machinery		
Harmonization of machinery testing codes and certificates to facilitate trade of quality and efficient machinery	Bangladesh India, Nepal & Pakistan	The **Asian and Pacific Network for Testing of Agricultural Machinery (ANTAM)** should continue its efforts to harmonize testing codes
Establish networks and business linkages among agriculture machinery enterprises to further develop machinery markets and tech dissemination		**Regional Council of Agricultural Machinery Associations in Asia and the Pacific (ReCAMA)** aims to strengthen ties between manufacturers and distributer associations and should continue work in the sub-region.

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MOVING FORWARD TOGETHER

SANS
South Asia Network on the SDGs

Thank you

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