

India

Good Straw Management Practices using agricultural machinery

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**CSAM-Workshop and Virtual Demonstration on Good
Practices in Integrated and Sustainable Straw
Management**

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Paddy straw burning problem

- **Nearly 30 million tonne of paddy straw are generated in mainly Punjab, Haryana and western Uttar Pradesh states of India.**
 - about 7 million tonne (from 0.8 million ha) is removed from the field for alternate uses like power generation, biofuel, feeding animals and for heat generation etc.
 - about 23 million tonnes of paddy straw (from 2.8 million ha) is burnt in the field as an easy and quick method of disposal.



Straw burning contd...

- **Burning of 23 million tonnes of rice residues in NW India leads to a loss of about 9.2 million tonnes of C equivalent (CO₂-equivalent of about 34 million tonnes) per year and a loss of about 1.4×10^5 t of N (equivalent to Rs 200 crores) annually.**
- **It is estimated that one tonne rice residue on burning releases 13 kg particulate matter, 60 kg CO, 1460 kg CO₂, 3.5 kg NO_x, 0.2 kg SO₂.**
- **Thus, burning of straw causes phenomenal pollution problems in the atmosphere and huge nutritional loss and physical health deterioration to the soil.**

Conventional Practices

- Time available between the rice harvesting and wheat sowing is very narrow and in the range of 20-30 days.
- After harvesting rice by combine, the farmers sun-dry the straw for a few days (4-5 days) and then burn them in the field before preparing the field for next cropping by using disc harrow, cultivator and planker and sow the wheat/potato by seed drill/planter.
- This mental set up- if field is not cleared, we are going to loose next crop or we get low production of wheat/ vegetable etc.

Management of paddy stubble/straw

- Two alternate and safe methods for straw management.
 - In-situ option
 - Ex-situ option

In-situ straw management

- Financially most viable and workable option for immediate use.
- Mulching and incorporation are the two suggested methods of in-situ straw management.
- Mulching: The straw is remain as mulch on the surface and crop is sown by making narrow furrow temporarily shifting the straw. This method is adopted for crop such as wheat sowing.
- Incorporation: The straw is chopped and incorporated in the soil with help of Mould board plough. After decomposition and pulverization, crop is sown. This method is mostly adopted for vegetable or other crop.

In-situ straw management contd..

- **From residue incorporation, farmers' may save about 1600 kg C, 20-30 kg N, 4-7 kg P, 60-100 kg K, 4-6 kg S in addition to micronutrients, which is equivalent to USD 20-25/ha (Rs. 1500-2000/ha) for plant nutrients (after 3-4 years).**

Straw mulching and Sowing

Viabale and scalable solution for
Rice-Wheat cropping

- Attachment of **super Straw Management System** in Existing Combines
- Direct wheat sowing with **Happy Seeder/ Super seeder/Smart seeder**



Super straw management system (fitting with existing combine)

- It chop and spread uniformly the loose straw coming out of combine for smooth operation of happy seeder



Happy Seeder

- It use to directly drilling/sowing wheat in the combine harvested field with standing stubble.
- Operate with 40-45 HP tractor



Super Seeder

- It cut, mix the standing stubble and sow/drill the wheat crop in combine harvested field.
- Operate with 50-55 HP tractor



Smart Seeder

- It cut, partly mix the standing stubble and sow/drill the wheat crop in combine harvested field.
- Operate with 45-50 HP tractor



Straw Chopper

- It chop and spread the straw in combine harvested field.
- Operate with 30-35 HP tractor



Straw incorporation

(For Rice-Potato/vegetable cropping system)

- **Paddy straw Chopper-cum-spreader + Reversible Mould Board Plough + Rotavator + Sowing of potato / vegetable and other crops**



Ex-situ option

- In Ex-situ option, the straw collected with help of rake and baler and transported to different plants for industrial applications.
- Straw is mainly used for:
 - **Power generation** in biomass based power plant
 - **Biomass pelleting** in biomass pelleting plant
 - **Compressed biogas/Bio-CNG** in biogas generation plant
 - **Alcohol production** in Biomass based alcohol production plant (2nd Generation)

Rake & Baler

(for ex-situ option)

- Rake collect the straw in a row.
- Baler bales the collected straw



Biomass based power generation plant (18 MW direct fired)

M/s Sukhbir Agro Energy Ltd, Punjab, India

Power generation cost: Rs 8/kWh as compared to Rs 6/kWh in coal based Thermal power plant and Rs 4/kWh in solar PV power plant.



Biomass Pellets from crop residues for use as fuel in thermal power plants

- Recommended Pellet substitution in thermal power plants: 10% with coal
- Increase in power generation cost by addition of 10% pellet with coal: 7%



Industrial level Plant for production of Compressed bio-gas/ Bio-CNG from Paddy Straw

- Capital investment for Bio-CNG plant (40 tonne straw/day): USD 4.4-5.0 million (Rs 35-40 Crore)
- Bio-CNG produced from 1 tonne paddy straw : 140 kg
- Manure produced from 1 tonne straw : 1.25 tonne



Industrial level Plant for contd....

- **Total bio-CNG production: 16,80,000 kg (5600 kg/day x 300 day)**
- **Sale price of Bio-CNG : @ Rs 70/kg**
(Procurement price announced by oil PSUs)
- **Estimated net profit from plant: USD 0.6 Million/year (Rs 533 lakh/year) (1176 - 643)**
- **Estimate profit in converting paddy straw into bio CNG: USD 0.38/kg (Rs 31/kg) of bio CNG or USD 13.5/tonne (Rs 4440/tonne) of paddy straw**
- **Manure and spent slurry are extra, may be given to farmers in lieu of paddy straw**

Alcohol production from paddy straw (lignocellulosic biomass)

- Capital investment for establishing bio refinery (100 Kilo litre per day capacity): USD 100-125 million (Rs. 800 -1000 crore)
- Amount of alcohol produced from 1 tonne paddy straw: about 200 litre
- 100 KL per day will consume around 1.50 lakh tonnes of biomass/annum and will produce around 3 Crore litres of ethanol/annum.



Alcohol production from paddy straw contd....

- This option is **NOT recommended** for further consideration
- Technical and commercial data on the plant performances is not available at this point of time. The experience of India is also limited.

Remark on Ex-situ Options

- Baling and transporting straw from field, though appear to be an option for safe disposal, it may **not be feasible currently for large amount of straw generated** and till alternate sufficient plants are installed.
- The ex-situ straw management options are **more capital intensive** and would require significant subsidy amounts for farmers and user industry to be sustainable.

Central Sector Scheme on “Promotion of Mechanization for In-Situ Management of Crop Residue in the states of Punjab, Haryana, Uttar Pradesh and NCT of Delhi”

- Funds released to different states and ICAR during three years (2018-19, 2019-20, 2020-21 & 2021-22) are US \$ 303 million (Rs 2426 Crores)

Central sector scheme on In-situ mechanization contd.....

- During past three years, totally 213,000 equipments/machines were supplied in these states under the central sector scheme.
- 30,960 Custom hiring centres were established in Punjab, Haryana and Uttar for making easy availability of equipments/machines to the small and marginal farmers on hire basis.
- Mobile app-based aggregator platform to facilitate hiring of machines from Custom Hiring Centres was developed.

Information Education Communication (IEC) Activities

- 2558 awareness programmes
- 33,508 demonstrations of machines for crop residue management
- 856 training programs to the farmers,
- 517 exposure visits to farmers
- 147 Kisan Melas organised
- 117,700 students were mobilized from 1125 schools
- 1.36 million leaflets/pamphlets distributed
- 425 TV programmes/panel discussions
- 3649 hoardings fixed
- 39071 posters/banners placed
- 1274 advertisements in print media, and 10,690 wall writings.

Benefit of residue incorporation

Survey conducted by the ICAR-KVKs in Punjab and Haryana revealed that the Happy seeder/ super seeder sown (in-situ crop residue managed) wheat farmers got the following advantages as compared to the conventional system:

- on average 2.7% higher wheat yield;
- saving of 25% water for irrigation (usually one irrigation);
- saving of about 20 kg urea/ha.

Burning Events

- Burning events was monitored by multiple satellites with thermal sensors during the harvest period from 1-Oct to 30-Nov in the states of Punjab, Haryana and Uttar Pradesh.
- The burning events recorded during 2019 in the three states (Punjab, Haryana and UP) were
 - 18.8% less as compared during 2018,
 - 31% less as compared to 2017,
 - and 52% less as compared to 2016.

Thanks