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Importance of Crop Residue Management and Different Machinery Used

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Introduction

Crop residues are parts of the plants and left in the field after crops have harvested and threshed. The recycling of crop residues has the advantage for converting the surplus residues into useful product for meeting nutrient for soil microorganism as well as succeeding crops.

Why farmer go for crop burning?

1. Due to the shortage of the human labor.
2. The reason behind this is, limited time between two consecutive crop cultivations.
3. From the farmers' point of view, burning may be seen as the best management practices for disposing of crops residues. It is not only a cost-effective method but it acts as an effective practices insect pest control (Dobermann and Fairhurst, 2002).

Problems associated with crop residue burning

1. **Loss of nutrients**

   It is estimating that burning of one tonne of crop residue account for loss of the nutrient 5.5 Kg Nitrogen, 2.3 Kg phosphorus, 25 Kg potassium and 1.2 kg sulphur besides and complete loss of organic carbon.

2. **Impact on soil properties-**
   - **a)** It elevates soil temperature causing death of beneficial soil organisms.
   - **b)** It immediately increases the bicarbonate extractable P content, but there is not build up nutrients in the soil profile.
   - **c)** It results in temporary loss of microbial population, as the microbes regenerate after a few days.

3. **Emission of greenhouse gases (GHG)**

Burning of residues emits a significant amount of Green House Gasses (GHGs). About 70%, 7% and 0.7% of C present in rice straw is emitted as carbon dioxide (CO_2), carbon monoxide (CO) and methane (CH_4), respectively.

Impact of Crop residue management-

1. It usually refers to maintaining the soil surface cover and protecting the soil from nutrient losses as well as erosion.
2. Proper crop residue management helps in adding soil organic matter and provides food for soil micro-organisms.
3. It plays decisive roles in improving soil quality as well as addressing several environmental issues. These crop residues generally act as a primary contributor to elemental carbon in soil.

Challenges for management of crop residue:-

A. Huge volume of crop residue.
B. Collection & Storage.
C. Time window between harvesting and sowing of two (next) crops.
D. Utilization of crop residue.
E. Cost-effective mechanization, awareness and availability of appropriate machinery.

Management of crop residues-

In-situ straw management-

Mulching and incorporation are the two suggested methods of in-situ straw management. Mulching is practiced where rice is followed by wheat and incorporation is adopted when rice is followed by potato or other crops.

Machinery for retention of paddy straw as mulch on soil-

Combine with super SMS- For uniform spreading of loose paddy straw left in the field after combine harvesting, the super straw management system (super SMS) attachment has been developed. There are more than 35 manufacturers of the super SMS, cost $ 1500.

Happy seeder-It cuts and chops the straw in front of furrow openers and throws it over the sown crop which acts as mulch. Operated by 40 kW tractor, cost about $ 2100 and covers 0.3-0.4 ha per hour. 35-40 manufacturers and more than 250 suppliers.

Happy Seeder

Super SMS

Machinery for incorporation of paddy straw into the soil

Paddy straw chopper/ mulcher- Harvests the stubbles, chops it into pieces and spreads in the field in a single operation. Operated by a 35 kW tractor, costs $ 1700 and covers about 4 ha per day.

Reversible mould board plough- For mixing chopped paddy residue left after combine harvesting into the soil for seedbed preparation before sowing wheat, potato or other vegetables. It consists of 2 bottoms, costs $ 2800 and covers 0.3 ha area per hour.

Rotavator- for filed preparation, operated with 35kW tractor. Rotating blades pulverise soil by breaking clods. After field preparation, sowing of the next crop by seed drill/planter. It costs $ 1500 and covers 0.3-0.35 ha area per hour.

Reverse Mould Board Plough

Paddy Straw Chopper

Rotavator

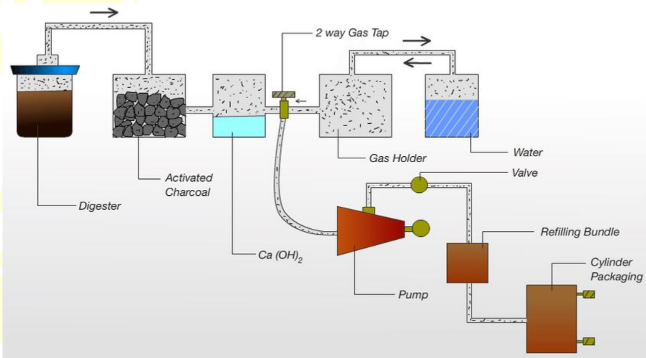
Ex- situ crop residue management-

Baling and transporting straw from the field, though appear to be an option for safe disposal, will be feasible only when alternate, effective and economically viable usage methods are identified and facilities and infrastructure for ex-situ management methods are created.

1. Biomass pellets from Crop Residues as a fuel substitution in thermal power plants
2. Industrial level production of Biogas / Bio-CNG / Compressed Bio-gas (CBG) from Paddy Straw
3. Power Generation from Biomass
4. Alcohol production from paddy straw (lignocellulosic biomass)
5. Ex-situ Composting of Paddy Straw

Biomass pellets from Crop Residues as a fuel substitution in thermal power plants-

The biomass pellets are preferred in the thermal power plant because of the small diameter and sizes and the good binding strength they possess. They burn also very easily along with coal, the common fuel in power plants.



Biomass Pellets

Biogas Production

Industrial level production of Biogas / Bio-CNG / Compressed Bio-gas (CBG) from Paddy Straw-

Paddy straw can be digested by anaerobic means for the production of biogas as a fuel for the kitchen as well as for power generation. Utilization of surplus crop residue especially the paddy straw to generate biogas / Bio-CNG / CBG creates better opportunities for reducing environmental pollution and employment generation.

Power Generation from Biomass-

Operation of plant- The plant comprises of i) Feed preparation unit, ii) Substrate feeding unit, iii) Biogas reactors, iv) Hydrogen sulphide scrubbing unit (Biological Scrubber), v) Power generation and grid feeding unit, vi) Bio-fertilizer preparation unit.

Biomass power based power generation process includes installations from biomass combustion, biomass gasification and bagasse cogeneration. India has an installed capacity of over 5,940 MW biomass based power plants comprising 4,946 MW grid connected and 994 MW off-grid power plants.

Biomass Power projects have been the following inherent advantages over thermal power generations:

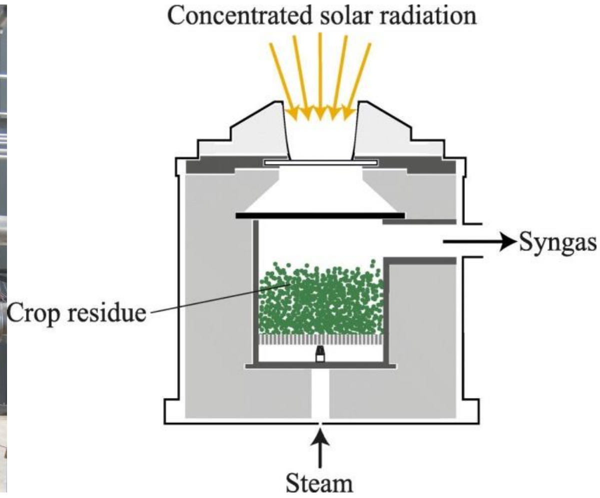
1. They are environmentally friendly because of relatively lower CO2 and particulate emissions.
2. They displace fossil non-renewable fuels such as coal.
3. They are decentralized, load based means of generation, because electricity is produced and consumed locally. Therefore, the losses associated with transmission and distributions are reduced.
4. They offer employment opportunities to locals and help in local revenue generation and up-liftment of the rural population.
5. They have a low gestation period and low capital investment.
6. It is an established and commercially viable technology option.

Alcohol production from paddy straw (lignocellulosic biomass)-

Govt. of India has allowed procurement of ethanol produced from other non-food feedstock besides molasses, like cellulosic and lignocelluloses materials including petrochemicals route, subject to meeting the relevant BIS standards. The next generation of technologies which can produce ethanol from non-food feedstock are being termed as second generation (2G) technologies. The ethanol being produced from these technologies is being termed as “2G Ethanol”.

The production of ethanol from any lignocellulosic biomass generally involves four steps – feedstock pre-treatment, enzymatic saccharification, fermentation and ethanol recovery. One kg of rice straw contains roughly 400 g of cellulose which is theoretically enough for producing 250 to 300 ml ethanol.

Alcohol production from paddy



Power Generation From Biomass

Conclusion:

Crop residues of common agricultural crops are significant resources, not only as sources of nutrients for following crops and hence agricultural productivity, but also for improved soil, water and air quality. The development of effective CRM systems depends on a thorough understanding of factors that control residue decay and their careful application within a specific crop production system. Preserving and managing crop residues in agriculture can be economically beneficial to many producers and more importantly to society. Improved residue management and reduced tillage practices should be encouraged because of their beneficial role in reducing soil degradation and increasing soil productivity.