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Crop residue management and its effect on soil quality

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Introduction

Crop residues are considered as raw materials for various non-agricultural uses, but can be effectively used as surface soil cover and to add soil organic matter in soil. After harvesting various crops, the remaining stalks and the remaining straw, stems and leaves lying on the ground, etc., are called crop residues. Agro based industries also produce large amount of residues. Residue removal can affect soil water conservation and storage, deplete plant nutrients and soil organic matter and change other soil properties. Intensive farming systems with short fallow periods and high fertilizer inputs have been used to achieve higher crop yields. Unfortunately, this farming pattern has led to marked pollution and soil degradation. It led to a huge gap between nutrients demand and their availability. With the adoption of conservation agriculture-based technologies these residues can be used for improving soil health, increasing crop productivity, reducing pollution and enhancing sustainability. Agriculture is the backbone and soul of Indian economy. Large quantities of agricultural wastes are generated in our country. This paves way for the copious scope and concept of crop residue management arrived from the major cropping system of India i.e., rice – wheat which is the burning problem. Rice straw considered to be a poor feed for the animals owing to high silica content. According to National Policy for Management of Crop Residues (NPCMR), annually India generates about 500 Mt of crop residues. The rice crop residue generated is around 23 million tons i.e., 62.4% of the total crop residue generated annually in Indian sub-continent (National Policy for Management of Crop Residue, NPMCR). According to IARI 80% of rice crop residue is burnt in India annually. Some of

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them are used as animal feed, fuel for cooking, industrial fuel and manure production. Soil infertility is depleted due to burning of essential soil nutrients like nitrogen, phosphorous, potassium, and sulphur during the crop burning. It is estimated that crop residue management can supplies about 5.6 million tonnes of nutrients (NPK) annually (Bhattachariya *et al.*, 2019). Crop residues are an important renewable resource that can be used to conserve non-renewable soil and water resources and sustain crop production. This article focuses on various alternatives like bio-composting, surface mulching, biochar production *etc*. which are introduced globally to mitigate the risks induced to the environment.

- **There are two types of agricultural crop residues**

A) Field residues:

In these materials left in an agricultural field or orchard after the crop has been harvested includes stalks, stubble, stems, leaves, seed pods. The residue can be ploughed directly into the ground before sowing of succeeding crop.

B) Process residues:

In this, materials left after the processing of the crop into usable resources. These residues include husks, seeds, bagasse and roots. They can be used as animal fodder, in preparation of organic manures *viz.*, Vermicompost and as soil amendment.

- **Adverse effect of open field burning:**
  - Reduction in organic matter
  - Environmental pollution
  - Loss of plant nutrients
  - Non-availability of straw to livestock
  - Death of beneficial micro-organisms
- **Methods of Crop Residues Recycling**

In situ incorporation

As an alternative to burning, residue incorporation which is defined as the use of tillage implements to bury remnant plant residues into soil. Ploughing is the most efficient residue incorporation method. Incorporation of the remaining stubble and straw into the soil returns most of the nutrients and helps to conserve soil nutrient reserves in the long term. Crop residues are incorporated in soil before sowing of succeeding crop. Crop residues having wide C:N ratio decomposes slowly in the soil. Indian Agricultural Research Institute (IARI), recently managed

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to find a promising eco-friendly alternative called 'PUSA DECOMPOSER' which includes the use of cocktail of microorganisms for fermentation of the rice residue and then converting it to manure.

Surface mulching

Direct drilling in surface mulched residues is a practice that leaves straw residues from a previous crop on the soil surface without any form of incorporation. Surface retention of residues helps in protecting the fertile surface soil against wind and water erosion. Mulch influences reflectivity of heat and water transmission characteristics of mulched soil. The mulch keeps the soil cool and doesn't allow the soil moisture to evaporate so rapidly. Beneficial effect of crop residue mulch on soil is moisture conservation and moderate soil temperature.

Composting from crop residues

Crop residues (Straw, stalk, leaves, stubbles *etc*.) are collected from field after harvest and kept into compost pit up to well decomposition and applied in the field before sowing of next crop.

Biochar production

An important role of biochar is long term Sequestering of carbon in the soil and plays pivotal role mitigation of greenhouse gases. Biochar is produced from crop residue biomass by heating in the absence of oxygen. Biochar application influences various soil properties including pH, bulk density *etc*. These changes in soil properties are likely to impact nutrient reactions on soil particles and microbial transformation of nutrients, maintains soil aggregate structure.

As livestock feed

The rice straw is considered poor feed for animals due to its high silica content. The nutritional value of rice straw can be upgraded by different methods. Physical, chemical and biological treatments have been used to weaken and break down ligno-cellulose bonds in crop residues, thereby increasing their nutritional value. Rice straw stems are more digestible than leaves because their silica content is lower, therefore the rice crop should be cut as close to the ground as possible, if the straw is to be fed to livestock. To complete the nutritional requirements of animals, the residues need processing and enriching with urea and molasses, and supplementing with green fodders.

As mushroom cultivation

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Wheat and rice straws are excellent substrates for the cultivation of white button mushroom and straw mushroom. Straw for white button mushroom cultivation is usually mixed with horse manure and hay and a very high conversion efficiency of the substrate into fungal bodies is possible.

Crop Residue as animal bedding material

It has been found that the use of paddy straw bedding during winter helped in improving the quality and quantity of milk as it contributed to animal's comfort and health. Paddy straw bedding helped the animals keep themselves warm and maintain reasonable rates of heat loss from the body. In the animal shed each kilogram of straw absorbs about 2-3 kg of urine, which enriches it with N.

Mechanization in crop residue management

Happy seeder is a tractor mounted machine that cuts and lifts straw and sows succeeding crop into bare soil. The lifted straws are sown over the area as mulch. Crop residue management is possible by sowing a zero-tillage machine or happy seeder with a moong or daincha in the standing crop after harvesting of wheat.

Role of crop residues management on physical properties of soil

- **Soil Structure**: Favour the formation of aggregates due to addition of organic matter to the soil and structural stability increase by better aggregate size distribution.
- **Bulk Density & Porosity**: Low bulk density of soil and increases the porosity of the soil with addition of crop residues.
- **Hydraulic Conductivity**: Crop residues increase hydraulic conductivity by modifying soil structure (micro pores & aggregate stability).

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- **Soil temperature**: Mulching with plant residues raised the minimum soil temperature in winter & decrease soil temperature during summer due to shading effect.
- **Soil moisture**: Reduces evaporation rate due to increase in number of residues on the soil surface.

Effect of crop residue management on chemical properties of soil

- **Organic carbon**: Increases with continuous organic matter addition.
- **Soil pH**: Decrease in the soil pH due to production of organic acids during decomposition.
- **Cations Exchange Capacity**: Soil organic matter as reservoir for plant nutrients essential prevents leaching of elements, required for growth. Addition of residues increase cations exchange capacity.

Influence of crop residue recycling on biological properties of soil

- It provides energy for growth & activities of microbes which helps in build-up of microbial biomass into soil.
- Provide suitable environment for biological N-fixation.
- Enzymes, microbial biomass, dehydrogenase & alkaline phosphatase activities increase with addition of crop residues.

❑ Conclusion

Crop residues management practices like incorporation of crop residue improves physical, chemical and biological properties of soil. It increases the crop yield resulted in eco-friendly farming. Recycling of crop residues improve the nutrient status of soil. It helps in minimizing the rate of fertilizer application to the crops. Crop residues recycling (incorporation) reduce cost of cultivation. Judicious use of crop residues could bring considerable improvement in soil fertility, productivity and maintain soil health. Crop residue burning releases higher amount of toxic and poisonous substances. Instead of burning residues, they can be used in reusable and effective manner in many diversified ways such as compost, cattle feed, and mushroom cultivation.

References

✓ Bhattachariya, S., Sahu, A., Manna, M. C., & Patra, A. K. (2019). Potential of surplus crop residues, horticultural waste and animal excreta as a nutrient source in the central and western regions of India. *Curr. Sci. India*, 116 (314).