# Management of Crop Residue and Its Impact on Soil Quality

**S. N. Makwana[1*], V. B. Mor[2], M. H. Chavda[3], D. K. Patel[4] and C. S. Chaudhary[5]**

[1*]Research Associate, Agricultural Research Station, College of Agriculture, Anand Agricultural University, Jabugam-391 155, Gujarat, India

[2]Asssitant Professor and Head, Department of Agronomy, College of Agriculture, Anand Agricultural University, Jabugam-391 155, Gujarat, India

[3]Senior Research Fellow, Centre for Integrated Farming Systems, Sardar krushinagar Dantiwada Agricultural University, Sardarkrushinagar-385 506, Gujarat, India

[4]Assistant Professor, Van bandhu Polytechnic in Agriculture, Sardar krushinagar Dantiwada Agricultural University, Shree Amirgadh-385 130, Gujarat, India

[5]Ph. D. Scholar, Department of Agronomy, C. P. College of Agriculture, Sardar krushinagar Dantiwada Agricultural University, Sardarkrushinagar-385 506, Gujarat, India

*Corresponding Author: snmakwana96@gmail.com

Although crop wastes are regarded as raw materials for a variety of non-agricultural applications, they may be added to soil organic matter and employed as a surface soil cover with good results. Crop residues are the leftover stalks, straw, stems, and leaves that are left on the ground after harvesting different crops. Large volumes of leftovers are also produced by agro-based industries. The removal of residues can alter various soil qualities, reduce plant nutrients and soil organic matter, and have an impact on soil water conservation and storage. In order to increase agricultural yields, intensive farming techniques with brief fallow times and substantial fertilizer inputs have been employed. Regrettably, significant pollution and land deterioration have resulted from this agricultural practice. The result was a massive discrepancy between the demand and supply of nutrients. These leftovers may be utilized to improve crop yield, decrease pollution, improve soil health, and increase sustainability through the implementation of conservation agriculture-based technology.

The Indian economy's foundation and lifeblood is agriculture. In our country, a lot of agricultural waste is produced. This opens the door for the broad scope and idea of crop residue management, which originated with the burning issue of India's principal cropping system-wheat and rice. Because rice straw contains a lot of silica, it is thought to be a poor animal feed. According to National Policy for Management of Crop Residues (NPCMR), annually India generates about 500 Mt of crop residues. According to the National Policy for Management of Crop Residue, or NPMCR, the amount of rice crop residue created annually amounts to around 23 million tons, or 62.4% of all crop residue generated in the Indian subcontinent. In India, 80% of rice harvest waste is burned every year, according to IARI. Some of them are used to produce manure, industrial fuel, culinary fuel, and animal feed. The combustion of vital soil nutrients including nitrogen, phosphorus, potassium, and sulfur during crop burning reduces soil infertility. Crop residue management is predicted to provide 5.6 million tons of net primary kernel (NPK) each year (Bhattachariya *et al*., 2019). Crop leftovers are a valuable renewable resource that may be utilized to maintain crop output while protecting non-renewable soil and water resources. This article focuses on several solutions that are being implemented internationally to reduce the hazards to the environment, such as surface mulching, biochar production, and composting.

**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 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**

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).
- 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**

The physical, chemical, and biological qualities of soil are enhanced by crop residue management techniques such as crop residue inclusion. It leads to environmentally sustainable farming by increasing agricultural output. Crop residue recycling enhances the soil's nutritional balance. It assists in reducing the pace at which crops are fertilized. The recycling and assimilation of crop leftovers lowers the cost of farming. Crop leftovers should be used wisely to preserve soil health, increase production, and improve soil fertility. Burning crop debris releases more harmful and hazardous materials into the air. Remainders can be effectively and recycled in a variety of methods, such as composting, making cow feed, and growing mushrooms, as opposed to being burned.

**Reference**

Bhattachariya, S., Sahu, A., Manna, M. C. and 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. Current Science India, **116** (314).

* * * * * * * *