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# EXPLORING THE IMPORTANCE OF CROP RESIDUE MANAGEMENT

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## ABSTRACT

*Scientists, academics, policy planners, social activists, and governments all have good reason to be concerned about the environmental impact of burning crop residues. The increasing surplus of agricultural waste due to increased crop biomass output presents a significant obstacle in the way of its efficient and effective management. Crop residue enhances the soil's physical, chemical, and biological qualities. Crop residue (CR) is a crucial part of sustainable agriculture's low external input without compromising yield. Crop residue improved crop yields. Crop Residue can somewhat replace the nutrients found in fertilizer, but not entirely. Crop residue may increase soil fertility. The results of agricultural residue burning and the advantages of crop residue management are discussed in this study.*

**Keywords:** Crop residue, Fertilizers, Agriculture, Soil, Benefits

## I. INTRODUCTION

The yearly production of agricultural residues in India is above 500 million tons. Animal feed, residential thatching, and industrial fuel are all made from these residues. Burning unwanted agricultural residues in the fields is a common practice, especially for getting rid of straw and stubbles that remain after harvest. Pollution, greenhouse gas emissions, and a loss of plant nutrients are all caused when agricultural residues are burned. Therefore, it is crucial that agricultural residues be managed properly. Crop residue is an excellent source of organic matter and a wonderful natural resource. After crops have been harvested and thrashed, this method is meant to leave 30 percent of the residue in the field to prevent further erosion from wind and water. Large amounts of agricultural residues are typically left in the field after mechanical harvesting, which can be reused as a source of nutrients.

Due to intense farming, the use of large dosages of chemical fertilizers, and a lack of usage of organics such farm yard manure, compost, crop waste, green manure, biofertilizers, etc., the natural fertility of the soil has worsened since the green revolution. There are a number of obstacles we must overcome right now on the way to achieving long-term food security and high-quality food sources. Agriculture has to play a significant role in mitigating climate change, non-point source pollution, hypoxia, and other environmental problems. Management of crop residues in combination with no-till farming and conservation agriculture (CA) is crucial in this respect. With a growing population, more food must be produced from a decreasing amount of farmland. Preserving soil health is crucial for a nation's long-term food supply. Organic matter in the soil has a significant impact on soil fertility. Soil organic matter affects a wide range of factors related to crop yields, making it a crucial component of soil. It is generally agreed that healthy, productive soil is rich in organic materials. Soil organic matter levels in India have dropped dramatically as a result of the country's intensive farming and tillage strategy. Soil

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fertility and yields have decreased alongside the loss of organic matter in the soil. Crop residues may be a viable option for preserving soil organic matter. Soil health and crop yield are greatly aided by effective crop residues management (CRM). agricultural residues are the unusable portions of plants that remain in the field after harvest, as well as the waste products of seed packaging and agricultural processing. Agriculture that can "maintain [its] productivity and usefulness to society indefinitely" is considered sustainable. These systems need to be ecologically friendly, efficient in terms of resources, helpful to society, competitive in the marketplace, and profitable.

Crop residues decompose at a very high pace. The warm and humid tropics cause roughly 80% of crop residual carbon to be lost in the first year. The rate at which agricultural residues are mineralized for N depends on the same factors that regulate carbon breakdown. In Indian Punjab, where a lot of land is planted with rice and wheat, combines are now often used for harvesting. Farmers commonly burn the rice and wheat straws that remain in the field after a combine harvests the crop to make it easier to prepare the soil for sowing. The nutrients collected by rice and wheat crops are concentrated in crop residues. When things are burned, they lose their organic substance and nutrients, and they pollute the environment. When low-quality residues with high C: N ratios, high lignin and polyphenol concentrations are decomposed, soil and fertilizer N are typically immobilized by microorganisms. Sustainable agricultural endeavor relies on nutrient cycling in the soil-plant environment. Although fertilization methods have played a more prominent role in the last three decades, crop residues, or the leftovers from the previous harvest, continue to play an important part in the cycling of nutrients in rice-based cropping systems. The soil environment is changed as crop residues are worked into the soil, which affects the soil microbe population and activity and the following nutrient conversions. However, it has been observed that incorporating cereal straws with a high C:N ratio might immobilize soil N, reducing the yield of the subsequent crop. Soil scientists and the agricultural community alike have taken an interest in the practice of recycling crop residues without reducing crop yields.

## II. UTILIZATION AND DECOMPOSITION OF CROP RESIDUES

### Utilization

Traditionally, animal feed has been made from crop residues. After harvest, corn fields are sometimes left for beef cows to graze on the stalks and any residual grain. During the winter, cattle are fed harvested agricultural residues. Animal bedding is made from crop residues, particularly straw from tiny grains. Many potential commercial applications for agricultural residues are in the works. Crop residues can be used as a raw material to make composite goods including paper, fiberboard, and liquid fuels. In recent years, a number of companies have developed to transform straw into fiberboard, with varying degrees of success. There has also been research on the viability of using agricultural residues as a source of pulp for the paper industry.

Even by the most conservative of calculations, the amount of agricultural residues available might increase the supply of papermaking fiber by as much as 40 percent. For the production of syngas (synthetic gas), which includes carbon monoxide (CO) and hydrogen, crop residues can be utilized as a feedstock in the gasification (thermo-chemical) process. Producing power, creating particular chemicals, and creating ethanol, gasoline, and diesel are just few of the many uses for syngas.

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Methane (CH4) and carbon dioxide (CO2) are the primary components of biogas, which may be produced from biomass. In many places of the world, biogas may be utilized to provide inexpensive home heating and cooking. Additionally, it can be converted into a source of mechanical or electrical energy. Vehicles may be powered by biogas that has been compressed in the same way that natural gas is. To generate heat and steam, crop residues can also be burnt directly. As traditional feedstocks become scarce and the demand for renewable sources of feedstock grows, so too will the research into alternate applications for crop residues to generate commercial products. The lack of focus on agricultural residues may be partially explained by the fact that we have no good way to measure how big this harvest really is or where it went. Growing interest in using agricultural residues as a feedstock for cellulosic ethanol production has coincided with the rise of the ethanol sector.

**Decomposition**

The degradation of agricultural residues is a step-by-step process managed by microbes, with carbon and nutrients being released into the biocirculation at the end. In addition to the weather (temperature and precipitation), the soil (available nutrients, pH, and aeration), the residue (C/N ratio, chemical composition, size, age, lignin content, polyphenol content, and species or cultivar type), and the management factors (loading rate, tillage, and irrigation), microbial degradation is primarily responsible for residue decomposition. Crop residue decomposition, which might be caused by physical breakdown, wind or water removal, or utilization by soil fauna, can have a big impact on residue loss and carbon loss. The nitrogen concentration of cereal, oilseed, and pulse crop residues was the most important factor in determining their breakdown rates. Three factors—the organisms and processes in the soil, the quality of the agricultural residues, and the physical and chemical environment—interact to determine the rate and kind of decomposition. Plant residues harbor distinct microbial communities that vary in both abundance and structure from those found in the soil below. A very active microbial ecology characterizes the residues' colonization by microorganisms.

## III. IMPACTS OF CROP RESIDUE BURNING

Indian farmers typically burn their agricultural residues, which presents a problem for crop residue management. About 18% of the 730 Mt of yearly biomass combustion in Asia comes from India. The following issues are caused by burning agricultural leftovers.

**Loss of nutrients**

Nitrogen (N), Phosphorus (P), Sulfur (S), and Potassium (K) make up an estimated 80%, 25%, 50%, and 20%, respectively, of general crop residues of various types, respectively. It is estimated that when one ton of agricultural waste is burned, 5.5 kilograms of nitrogen, 2.3 kilograms of phosphorus, 25 kilograms of potassium, and 1.2 kilograms of sulphur are lost. Furthermore, the atmosphere is polluted, and greenhouse gas emissions rise, all of which contribute to global warming. When crop residues are worked into the ground or left in place, they provide food for soil microorganisms and plant nutrients while also enriching the soil with the aforementioned nutrients.

**Impact on soil properties**

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Beneficial soil organisms are killed off by the increased soil temperature caused by the burning of residues. There is no buildup of nutrients in the soil profile, although the bicarbonate extractable P concentration is increased immediately after burning agricultural residues. The full loss of microbial population caused by frequent residue burning is transitory, however, since the microorganisms rebuild after a few days. Field fire decreases the amount of N, C, and mineralizable N in the top 15 centimeters of soil.

**Emission of greenhouse gases (GHG)**

GHGs (green house gases) are released in large quantities when residues are burned. When burned, rice straw releases around 70% as carbon dioxide (CO2), 7% as carbon monoxide (CO), and 0.7% as methane (CH4), while 2% as nitrous oxide (N2O). Greenhouse gas emissions rose as a result of this.

## IV. BENEFITS OF CROP RESIDUE MANAGEMENT

**Enriching the soil health and quality**

Soil bulk density is decreased and soil porosity is increased when crop residues are worked into the soil, especially the big pores of the soil. It is evident that residue retention improves soil quality over time, but its impacts on crop yield may not be optimal in various agro-ecosystems. The impact of agricultural residue management on crop yield is extremely sensitive to factors such as soil type, crop rotation, and weather. In addition to supplying organic matter to the soil residue mineralization changes the soil structure and, in turn the growth of a plant's root system.

**Role in water conservation**

Crop residue serves as mulch, reducing water loss through evaporation and runoff and increasing soil permeability to help retain moisture. Crop residues are a valuable mulch resource, especially in arid regions, where they may reduce soil temperature, improve water penetration and retention, and ultimately increase crop yields.

**Crop residue as a potential source of energy as well as amendments**

Crop residues have the potential to be utilized as an alternative fuel and energy source. As an alternative to chemical fertilizers and a source of soil amendment, biomass fuel for animals, and energy, it has many potential applications. Field burning of agricultural residues may have nullified these potential benefits.

**Enriching the environmental health and quality**

Crop residue retention has several positive effects on the soil, water, and plant system, including an increase in the structural integrity of the soil. Crop residues management, which has the potential to reduce carbon dioxide emissions and offset the need for fossil fuels, would have had a negative impact on the environment if field crop residue burning had been used instead.

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**Benefits to the farming community**

When utilized in conjunction with other agricultural methods like crop rotation and zero tillage, crop residues have a substantial impact on crop output. By reducing the need for costly fertilizers and other amendments, farmers may pocket the savings from using the residue to boost fertility. When used as a power source, it can lessen the financial burden of buying gasoline for farm machinery. Farmers may supplement their revenue with biomass production without sacrificing their ability to grow staple or even non-food crops.

**Benefits to the rural areas**

Energy security, lower carbon dioxide (CO2) emissions from burning fossil fuels, and a boost to rural economies may all be achieved via promoting the use of biomass, or agricultural residues, as raw materials for bio energy generation.

**Benefits to the society as a whole**

Human and animal health, as well as the health of the ecosystem, may all benefit from effective agricultural residue management. By implementing effective strategies for residue management, we can lessen the negative effects on the environment that improper agricultural practices, such as burning crop residue on the field, have on human health and the economy.

## V. CONCLUSION

It may be argued that, with correct management, agricultural residues are very advantageous and cost-effective. Therefore, alternatives to burning should be explored as a management strategy, since they may be more beneficial to both the farmer and the environment. Because depleting the soil of its nutrients by burning agricultural leftovers is counterproductive. A better ecological health and environment for crop production may be ensured by the careful management of agricultural residues, which mitigates the negative impacts of burning residues. Therefore, for the benefit of society, agricultural production, and environmental health, the need of the hour is optimal usage and effective management of crop residues.

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