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IMPORTANCE OF CROP RESIDUE MANAGEMENT IN AGRICULTURE

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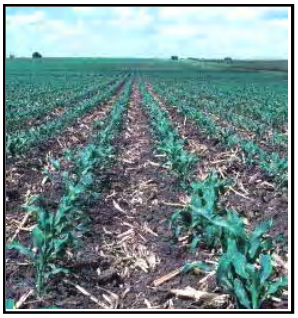
The term "residue", with its connotations of something left over that nobody wants, gives a false impression of the value of the straws, stubbles and other vegetative parts of crops that remain after harvest, especially since many farmers burn them or otherwise dispose of them.



Why crop residue?:

– To maintain an acceptable environment free from excessive pollution on ground and the air

– To conserves ever scare and more costly raw material and energy cycle (*in situ*).

Importance of residue:

Plant, animal including human residues, green plant materials and municipal wastes are serve as effective source of plant nutrients and humus in soil. SOM plays an important role in maintaining proper rhizosphere for better growth of the plants. In intensive agriculture, soil often gets sickness due to continuous use of chemical fertilizers. Organic manures are used to increase efficiency of fertilizers.

Crop residues potential: A large amount of rice residue is annually produced in the rice growing countries. Moreover, the adoption of mechanized farming has resulted in leaving a sizeable amount of rice straw in the field after harvesting the grain. There is enormous potential of recycling these residues in the crop production systems. Total amount of crop residue produced in India is estimated at 350 x 10^6 kg yr^{-1}, of which wheat residue constitutes about 27% and that of rice about 51%[3]. Another estimate shows that 120 x 10^6 kg yr^{-1} rice residue, out of 180 x 10^6 kg yr^{-1} (assuming that 1/3rd of the residue is used as feed for animals and other purposes) can be returned to the soil to enhance soil quality; it will contribute to soil 2.604 million tonnes of $N+P_2O_5+K_2O$, considering the nutrient contents in rice straw as 0.61% N, 0.18% P_2O_5 and 1.38% K_2O_4.

Factors affecting crop residues decomposition:

- Quantity added
- Size of the residue
- Method of application
  - Incorporation
  - Surface application

Advantages of residue management on physical properties of soil :

Soil structure: Favour the formation of aggregates due to addition of Organic matter to the soil structural stability increase due to straw addition and better aggregate size distribution occurs due to a reduction in soil disturbance crop residues.

Bulk density and porosity : Low bulk density so incorporation of straw with FYM reduces the bulk density of soil and increase the probity of the soils.

Hydraulic conductivity : Crop residues increase hydraulic conductivity by modifying soil structure microspores and aggregate stability.

Soil temperature : Mulching with plant residues raised the minimum soil temp. in winter due to reduction in upward heat flux from soil and decrease soil temp. during summer due to shading effect.

Soil moisture : Reduces evaporation rate due to increase in amount of residues on the soil surface.

Advantages of residue management on chemical properties of soil:

– Organic carbon: Increases with continuous O.M. addition.

– Soil pH: Increases soil pH significantly. By decarboxy lotion of morganic anions, ligand exchange

Table 1 : Availability of some crop residues in India and their plant nutrient potential

Crop	Residue yield	Nutrients (%)			Nutrient potential (000)t		
	(000)t	N	P_2O_5	K_2O	Total	Utilizable	Fertilizer equivalent
Rice	1,10,495	0.61	0.18	1.38	2398	799	399
Wheat	82631	0.48	0.16	1.18	1504	501	250
Sorghum	12535	0.52	0.23	1.34	262	87	43
Maize	11974	0.52	0.18	1.35	252	84	42
Pearl millet	6967	0.45	0.16	1.14	121	40	20
Barly	2475	0.52	0.18	1.30	51	17	08
Finger millet	5351	1.00	0.20	1.00	118	39	19
Sugarcane	22736	0.40	0.40	1.28	423	23	211
Potato	7867	0.52	0.21	1.06	141	141	70
G.nut pods	10598	1.60	0.23	1.37	339	339	169
Total	273629	-	-	-	5609	2470	1231

and addition of basic cations.

– C.E.C.: Soil O.M. as reservoir for plant nutrients essential prevents leaching of lements, required for growth. Additions of residues increase C.E.C.

– Advantages of residue management on Biological properties of soil.

– It provides energy for growth and activities of microbes and substrates for microbial biomass.

– Provide suitable environment for Biological N – fixation.

– Enzymes *Microbial biomass, dehydrogenase and alkaline phosphates activities increase in sandy loam soil.

– Microbial population: Increase microbial biomass and it can enhance nutrients availability in soil as well as the microbial biomass act as sink and source of plant.

Other advantages:

Root development: Crops need good soil filth to develop their roots. This requirement can only be met if the topsoil is properly managed, including erosion control where necessary, and if root penetration in the subsoil is enhanced.

Water availability of the various means of increasing the availability of water to plants, the most efficient are those that promote its infiltration and storage in the soil profile and slow down its evaporation. Here, porosity and water absorption are the keys. Crop residues can help to improve these two parameters.

Nutrients store: The main reason for advocating the return of crop residues to the soil is that this provides the soil with the nutrients needed to grow future crops.

Interactive effects of organic matter: It is difficult to separate the various effects of returning crop residues to the soil. A good soil filth combined with the proper provision of water and nutrients promotes good yields. If only one of these components is missing, the whole system may be disrupted. For this reason it is better, at least at first, to try to improve the whole system than to focus too narrowly on individual components.

The socio-economic context: Returning crop residues to the soil is not common practice for most farmers, who prefer to use them for other purposes - livestock feed, fuel and building materials - or to burn them or remove them from their fields. The rationale for this behavior lies in the fact that residues are an obstacle to tillage operations and that, in certain cases, they can sustain pests, whose populations build up to levels that threaten the next season's harvest.

Soil resilience: Soil degradation occurs slowly, due to the resilience of the soil. It is reassuring because a well-managed soil may not suffer too greatly from short-term stresses such as flooding or severe drought. It is worrying because prolonged stress takes time to show its effects, such that crop yields may remain relatively high as stress levels build. As a result, farmers may realize too late the problems they are facing.

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Detrimental effect:

- It may help in proliferation of pathogens
- Excessive organic residues may hinder tillage and planting operations
- It may influence through phytotoxins
- It may be detrimental due to allelochemicals.

Residue management options: Rice residue management is important in rice-wheat cropping system as machines are increasingly used for harvest. Several management options available to farmers for the management of rice residues are burning, incorporation, surface retention and mulching, and baling and removing the straw.

Residue burning: Traditionally, rice and wheat straw are removed from the fields for use as cattle feed and for other purposes in South Asia. Recently, with the advent of mechanized harvesting, farmers have been burning *in-situ* large quantities of crop residues left in the field as crop residues interfere with tillage and seeding operations for the subsequent crop, causing loss of nutrients and soil organic matter (SOM). Many farmers chop-off the rice stubbles with a stubble shaver, dry them and burn completely to facilitate timely planting of wheat leading to all kinds of environmental pollution. Thus, one option is burning despite the large losses (up to 80%) of N7, 25% of P and 21% of K8 and 4-60% of S. This practice also causes significant air pollution and killing of beneficial soil insects and microorganisms. Burning, however, also kills soil borne deleterious pests and pathogens.

Residue incorporation: Crop residues may be incorporated partially or completely into the soil depending upon methods of cultivation. Ploughing is the most efficient residue incorporation method. Incorporation of rice residues before wheat planting compared to incorporation of wheat straw before rice planting is difficult due to low temperatures and the short interval between rice harvest and wheat planting.

Surface retention and 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. The large volume of residues remaining on the surface often leads to machinery failures, thus affecting sowing of seeds of the following crop. Farmers usually follow this method where no- till or conservation tillage practices are prevalent.

Baling and removing the straw: Surplus straw from agriculture may be used for a number of useful purposes such as livestock feed, fuel, building materials, livestock bedding, composting for mushroom cultivation, bedding for vegetables such as cucumber, melons etc. and mulching for orchards and other crops.

No tillage: Addition of rice straw at 10 t ha^{-1} at 4-5 weeks before transplanting of rice is equivalent to the basal application of N 40 kg ha^{-1} through urea. To use this residue it would necessitate the adoption of conservation tillage system in soils and eco- regions wherever the technique can be adopted. In this approach soil quality is enhanced.