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Organic residues, organic manures

Organic residues/ crop residues:-

Crop residues are materials left on cultivated land after the crop has been harvested. Retention of crop residues after harvesting is considered to be an effective anti-erosion measure. Crop residues can improve soil structure, increase organic matter content in the soil, reduce evaporation, and help fix CO_2 in the soil. Good residue management practices on agricultural lands have many positive impacts on soil quality.

Besides, crop residues can be used in biofuel production. Information on residue cover guides policies for promoting beneficial management practices and helps to estimate soil carbon.

Traditional methods of residue cover measurement, such as line-point transects or photographic techniques, are inefficient in large-scale investigations, and their accuracy is impacted by operator bias and sampling representatives. A satellite-based approach is an efficient and less costly way to measure residue cover (Daughtry et al., 1996; Sullivan et al., 2004).

Currently, both optical and microwave remote sensing have been used to estimate crop residues; however, both of these techniques face some challenges. The biggest challenge to using optical remote sensing to detect crop residues is the ability to distinguish crop residues from bare soil. The spectra of crop residues and soils are often similar and differ only in amplitude for a certain wavelength.

So far, some indices have been developed for detecting crop residues, such as the Brightness Index (BI), Normalized Difference Index (NDI), Normalized Difference Tillage Index (NDTI), Normalized Difference Senescence Index (NDSVI), Normalized Difference Residue Index (NDRI), Soil Adjusted Corn Residue Index (SACRI), Modified Soil Adjusted Corn Residue Index (MSACRI), Crop Residue Index Multiband (CRIM), Cellulose Absorption Index (CAI), Lignin Cellulose Absorption Index (LCA), and Shortwave Infrared Normalized Difference Residue Index (SINDRI) (Bannari et al., 2006; Biard and Baret, 1997).

The contribution from crop residues is generally ignored. However, crop residues add considerable amount of nutrients and the amount depends on the crop. Finger millet crop residues add about 43 kg N/ha, while rice crop residues add 17 kg N/ha. The addition of phosphorus is 3.7 and 2.9 kg P2O5/ha by finger millet and rice residues respectively. By estimating the appropriate amount of nutrients added to the soil by crop residues, chemical fertilizer application can be reduced.

Application of organic matter in any form reduces the loss of nitrogen fertilizer and increases fertilizer useefficiency.
Large amounts of agricultural wastes are available and there is need to properly use them for some industrial purpose or recycle them to replenish soil fertility. Agricultural residues like paddy straw, rice husk, *jute/cotton/arhar* sticks, wheat straw, groundnut shells, maize straw, sugarcane trash, etc. are left in the fields which create many ecological problems. Perpetuation of diseases and other insect pests is helped by such wastes/residues. For example, cotton sticks left in the field harbour pests to affect the next season cotton crop seriously.

Agricultural residues offer a potential scope to meet our growing needs through their recycling. Crop residues are important energy source. About 2000 million tonnes (Mt) of straw is produced annually in India. Only rice, wheat, sorghum, maize and pearl millet leave 173 Mt of crop residues (Gaur, 1979). Though bulk of such crop straw is used as cattle feed in India, 51Mt of only paddy straw remains unutilized, particularly in wheat belt. Another 16 Mt of sugarcane trash is not utilized properly.

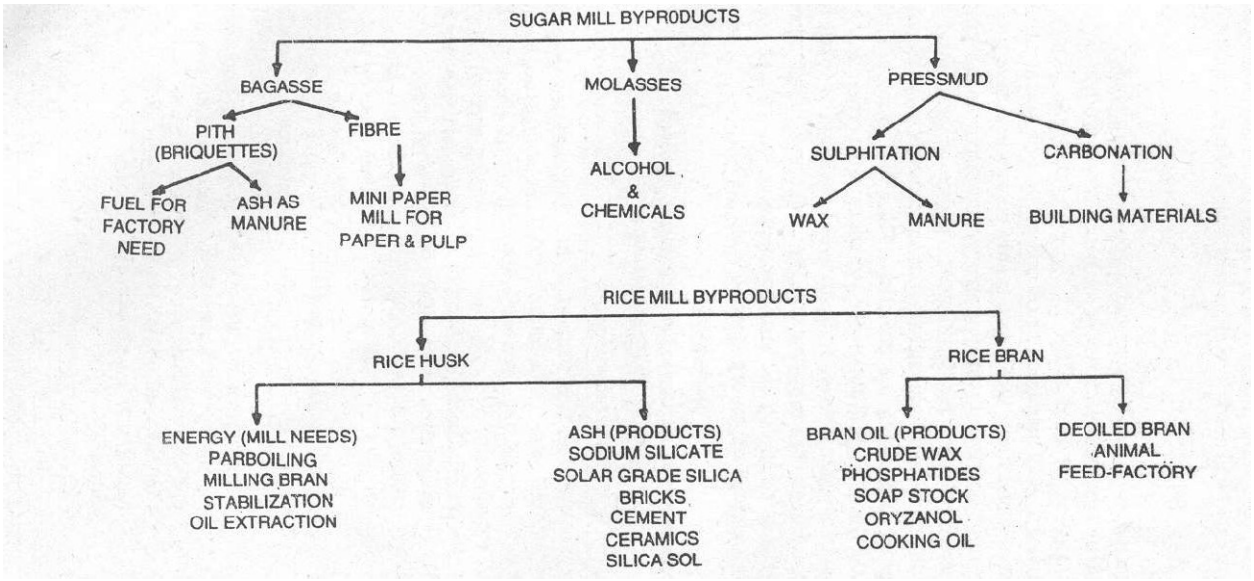
Industrial wastes like rice husk, rice bran, bagasse, press mud, cotton dust, oil cakes, slaughter house wastes, faecal matter, marine residues, city garbage, night soil, etc. could also provide NPK equivalent to about 4.72 Mt for increasing agricultural production and, thus, become a vast source of energy after developing a sound system of their use and recycling. A large quantity of about 247 Mt of agricultural byproducts like wood, dung and crop residues are burnt annually in India due to fire needs.

Agro-industries generate residues like husk, hull, shell, peel, testa, skin, fibre, bran, linter, stone, seed, cob,prawn, head, frog legs, low grade fish, leather waste, hair, bones, coir dust, saw dust, bamboo dust, etc. which could be recycled or used efficiently through agro-processing centres. In the last three decades, rice and sugarcane residues have increased by 162 and 172 %, respectively.
These can also be put to new uses for manufacture of various chemicals and specific products (like silica, alcohol, tannins, glue, gelatine, wax, etc), feed, pharmaceuticals (Iycogenin, antibiotics, vitamins, etc.), fertilizers, energy, construction materials, paper pulp, handicraft materials etc. Residues from fruit and

vegetable industries, fish and marine industries and slaughter houses leave a stinking smell. Similarly, presence of bitter components in non-edible oil seeds, wax in sulphitation press mud, tannins in cashew testa and potassium oxalate in rice straw decrease their efficiency without pretreatment.

Agro-industrial byproducts can be utilized only through the development of secondary and tertiary industries. The operation of this concept can be illustrated with respect to the utilization of the byproducts of sugar and rice factories

(Fig. 1) with minimized pollution hazards and sanitary conditions at the mill premises. Adoption of an integrated system utilizing cattle shed wastes, biogas slurry, crop residues, weeds, fallow leaves, etc. can provide gas for milk processing, feed for animals and manure for soil..



Summary of organic residues or crop residues:-

Plant residue is crop materials such as stems, leaves, and roots that are left on the field after the harvest. In the past, farmers considered crop residue to be trash that was usually destroyed by fire. However, today this practice is not recommended and highly is not used by farmers. There are two different ways to manage crop residues. The first method is tillage prior planting when plant residues are incorporated into the soil. Another modern farming practice is reduced tillage or no-till farming, where crop residues are left on the surface and planting is carried out without soil tillage.

Crop Residue Incorporation into the Soil

The main purpose of plowing crop residue is to improve soil organic matter. Plowing at a depth of 20-30 cm together with adding of nitrogen fertilizers (Urea, CAN) enriches the soil with humus and also prevents nitrogen depression. Farmers, who manage their fields with this practice, rely on the following crop residueadvantages:

- Recycled nutrients removed by a growing crop
- Maintained or increased soil organic matter that provides a substrate for soil microorganisms and increasesthe organic component of the soil.

- Better absorption of rain drops that decreases erosion potential.

In addition to the plowing of crop residue, a farmer can also include in his farm management, the plowing of cover crops i.e. green manure. It enriches the soil with organic matter, improves its biological activity, provides better accessibility of nutrients, and enables biological water drainage on heavier soils. It also has a favorable impact on both heavy and sandy soils and is strongly recommended on soils fertilized only withchemical mineral fertilizers.

Cr p Residue - No-till Management

No-till is a modern farm practice, mostly used by farmers in the US. Nearly 40% of c opland acres are no- tilled and more than 10 million acres of cover crops have been seeded across the co ntry. The practice is based on leaving the crop residue on the field and the sowing of new crops directly into the untilled soil. No-till farming requires different practices to preserve higher yields, such as cover crops and fertilization and pesticide use, to achieve better soil properties. No-till farming has also many advantages on the soil:

- Crop residue on the soil surface are responsible for cooling the soil, increasing the soil moisture and limiting evaporation; crop residue prot cts the soil from erosion and serves as a source of carbon
- Heavy machinery passes are reduced; no-till farming uses only a sowing machine, thus preventing soil compaction and surface crusting. This makes it easier for plants to sprout and grow deep roots. It, therefore, results in reduced disturbance to the soil

- Farming costs such as labor, machinery costs, and fuel are reduced.

the seeds into the ground and cover them with soil. The goal is to move as little soil as possible in order not to bring weed seeds to the surface and to not stimulate them to germinate. No other soil tillage operation is
done. The residues from the previous crops will remain largely undisturbed at the soil urface as mulch.

Organic manures

Manures are plant and animal wastes that are used as sources of plant nutrients. They release nutrients aftertheir decomposition.
Manures can be grouped into bulky organic manures and concentrated organic manures based onconcentration of the nutrients.

Type1. The Concentrated Organic Manures:

The concentrated organic manures, consisting of concentrated materials, are

1. Oil-cakes,
2. Bone-meal,
3. Urine and
4. Dried blood from slaughter-houses and
5. Fish manures.
6. Bird guano

First of all these manures are converted into readily utilizable form of nitrogen like ammonia and nitratethrough the bacterial decomposition.

Therefore, these manures are slow acting and supply available nitrogen for a longer period. The oil-cakescontain not only nitrogen but also some phosphoric acid and potash, as well as a good quantity of organicmatter.

The chemical compositions of principal oil-cakes are given in the following table:

Table 4.1 : Chemical composition of principal oil-cakes

Types of oil-cakes	Percentage composition		
	N	P_2O_5	K_2O
Castor cake	4.0-4.4	1.9	1.4
Groundnut cake	6.5-7.5	1.3	1.5
Cotton seed cake	6.9	3.1	1.6
Rape cake	4.8	2.0	1.3
Linseed cake	4.8	2.0	1.3
Coconut cake	3.4	1.5	2.0
Palmnut cake	2.6	1.1	0.5
Neem cake	5.2-5.6	1.1	1.5
Sunflower cake	7.9	2.2	1.9
Mahua cake	2.5	0.8	1.9
Karanj cake	4.0	0.9	1.3

Bone-meal is the ground bone widely used as phosphate fertilizer.

It is available in two forms:

(i) Raw bone-meal,

(ii) Steamed bone-meal.

Steaming of bones under pressure removes fats, nitrogen and glue-making substances. Availability of phosphoric acid in bones depends largely on their degree of grinding. Steamed bones are more brittle andcan be readily crushed.

The raw bone- meal contains about 4% slow acting organic nitrogen and about 20% phosphoric acid, whereas the steamed bone-meal contain only 1 -2% nitrogen but nearly 30% available phosphoric acid. As it is slow acting, it must be applied into the acid soil instead of top dressing a few days before sowing.

Due to lack of steaming and grinding facilities in remote villages it can be used as charred powder, which loses most of the nitrogen and retain a large quantity of P_2O_5 in an easily available form.

The cattle urine is a very good source of nitrogen along with potassium and sulphur. But if it is notproperly conserved the nitrogen is lost in the form of ammonia.

Conservation of urine from quick bacterial decomposition is done through bedding made by different absorbent materials like wheat straw, peat straw, dry leaves, etc. Nitrogen in the urine remains mainly inthe form of urea, which is readily converted to highly volatile

ammonium carbonate through decomposition.

To minimize this loss to a great extent the urine soaked absorbents for bedding are kept compact in a pitthrough sectional manner. Each section is plastered with 2.5 cm layer of a mixture of mud and dung in equal proportions after addition of 4-5 buckets of water to conserve moisture and nitrogen. The manure gets ready for use in about 4-5 months after plastering.

If urine is not conserved in the bedding used for cattle it must be collected in a covered pucca cistern and then added to the dung in the manure pit. The nitrogen and mineral element content in the urine can be increased by the administration of concentrated feeds to cattle.

The concentrated feeds are cotton seeds, cotton-seed cake, linseed-meal, wheat bran, gram husk, groundnut cake, gram, horse-gram, etc., which are rich in nitrogen, phosphorus, potassium, magnesium and sulphur.

Dried blood or blood-meal is a very rich source of nitrogen and phosphoric acid. It contains 10-12% readilyavailable nitrogen and 1 to 2% phosphoric acid. Dried blood is a very rapid acting manure and effective on all types of soils. It is collected from slaughter-houses and then subjected to bacterial conversion into readily utilized amino nitrogen and nitrate nitrogen.

Fish manure is a very good source of organic nitrogen and phosphoric acid. It is available either as driedfish or as fish meal or powder. After extraction of fish oil the residue can be used as a manure. It is also rapid acting and suitable for all crops and soils. It is generally used as powder.

Type2. Bulky Organic Manures:

Bulky organic manures are the humus obtained from different sources.

It can be grouped as

(a) Farmyard manure,
(b) Composted manure,
(c) Town compost,
(d) Sewage and sludge,

(e) Night soil or poudrette and
(f) Green manures.

(a) Farmyard Manure:

It is most commonly used organic manure in India. It is a mixture of cattle dung, the bedding materials used for cattle and any remnant of straw and plant stalks fed to cattle. The cattle dung together with stable-waste and house sweeping is first collected in the open backyard and then it is transferred to an uncoveredpit in a common plot outside the village.

The pits may be made of stone or brick-lined. Rotting of raw organic matters is necessary for the formation of good manure. The loose heaps lie exposed to the sun results in drying up of organic matters without decomposition. So, for proper decomposition the heap should be kept compact and moist.

If properly conserved, the bacterial decomposition of raw organic matter is enhanced, seepage of solublemineral elements is prevented, the nutrients are made soluble, and loss of nitrogen is minimized.

If partially decomposed, the farmyard manure should generally be applied to the moist soil about 3-4 weeks before sowing of a crop to complete the decomposition. If the manure is already well decomposed, itis advisable to apply it evenly on the soil just before sowing of a crop to avoid the loss of nitrogen.

In vegetable and fruit cultivation, well decomposed manure together with fertilizers, applied individually toyoung plants gives the best results.

Adequate moisture in the soil is necessary for the proper decomposition of organic matter. For that reason farmyard manure is applied to the crops grown in the rainy season or grown under irrigation. In irrigated field crops 5 to 10 tonnes of farmyard manure per hectare is applied.

For sugarcane, maize, potatoes, turmeric, ginger, vegetables and fruits, 8 to 12 tonnes of farmyard manureper hectare is generally applied.

The farmyard manure is applied to the soil as:

(i) It improves the soil tilth and aeration

(ii) It increases the water-holding capacity of the soil

(iii) It stimulates-the activity of microorganisms that digest the complex organic matters to make it available to the crop plants.

One tonne of cow dung contain 2.95 kg of nitrogen, 1.5 kg of phosphoric acid, and 2.95 kg of potash. So, the phosphoric acid content is low. It is advisable to use bulk farmyard manure along with superphosphate.

(b) Composted Manure:

Composting is the process of reducing vegetable and animal refuse to a quickly utilizable form for improving and restoring soil fertility. Composted manure as good as cattle manure can be produced from different wastes like cereal straws, crop stubble, cotton stalks, groundnut husks, farm weeds and grasses, leaves, house refuse, wood ashes, litter, urine-soaked earth from cattle-sheds and other similar substances.

The raw vegetable wastes are rich in cellulose and other digestible carbohydrates with a carbon-nitrogen ratio of 40:1. It is necessary to decompose them before application, to reduce the carbon-nitrogen ratio to about 10:1, otherwise the application of un-decomposed materials can bring about a temporary deficiency of nitrates and ammonium compounds due to rapid growth of microorganisms.

The composting methods are of two types:

(i) Aerobic decomposition

(ii) Anaerobic decomposition.

In aerobic process, the cattle used beading; the cattle-shed sweepings and urine soaked earth from the stable floor are removed every day. These are then mixed with little amounts of cattle dung and wood ashes and deposited on well-drained site to build up a pile of about 45 cm in height, 5 m in width and any convenient length.

After a heavy rain, 1.2 m strip wide of the wetted material on each side is turned on to a 2.4 m wide strip in the middle with the help of a rake. Thus the height of the heap becomes nearly to one metre. This starts a quick decomposition and prevents moisture loss.

After about a month when the heap almost sinks by rain the wetted materials turned into a

fresh heap with proper mixing of outer and inner portions. A final turning is given after about a month or more on a cloudy or moderately rainy day. Nearly after two months from final turning the compost becomes ready for use.

The best suited proportions of raw materials generally used for making compost are as follows:

In anaerobic procedure the raw materials are collected in pits of convenient size. Every-days collection is spread in a thin layer and then a mixture of fresh cow dung, ashes and water is sprinkled over it and compacted.

The filled pit is then plastered 25 cm with a mixture of mud and cow dung. Decomposition in this case is anaerobic and it takes about five months. This process is generally practiced by gardeners in or near cities and towns.

(c) Town Compost:

A large amount of organic refuse is collected per day in every town or city. This town refuse and night soil can be converted into good manure.

They can be composted in large scale by constructing trenches of convenient size away from the human habitation. The trenches are filled with successive layers of night soil, town refuse and earth. It takes about 3 months for decomposition. The compost is then used for cultivation.

(d) Sewage and Sludge:

Sludge and sewage are the liquid wastes manure of the towns and cities, which contain large amounts of plant nutrients. These are especially useful for growing sugarcane, vegetable and fodder crops. Sewage-farms are prepared near many towns.

In the sewage-farms septic tanks are constructed in which sewage is collected temporarily to settle and remove the heavier solid and also allowed to preliminary fermentation. To remove the offensive substances from it thorough aeration of the sewage by blowing air in the septic tank is done.

The process also brings about rapid oxidation of the organic matters present in the sludge, which contain 3- 6% nitrogen, 2% P_2O_5 and 1% K_2O in the very utilizable form. The effluent coming out after aeration is an odorless, clear liquid containing nitrates in solution.

Both the effluent and the activated sludge is used safely for manuring and irrigation.

(e) Night Soil or Poudrette:

The sanitary disposal of night soil mainly in towns and cities is potential source of soil improvement. It can be conserved and converted into manure that can be used safely for cultivation. The night soil is dried as such, or dehydrated using some absorbing materials like soil, ash, charcoal and sawdust to make a poudrette that can be used as manure.

When mixed with equal volume of ash and 10% charcoal powder, it produces an odourless material, containing 1.32% nitrogen, 2.8% phosphoric acid, 4.1 % potash, 24.2% lime. If equal amount of sawdust is mixed the night soil and acidic poudrette is formed, which contains 2-3% of nitrogen.

(f) Green Manures:

Very cheap and easiest method to restore the soil fertility is green manuring. By this means organic matterscan be very easily added to soil.

The green- manure crop supplies organic matter as well as additional nitrogen, particularly if it is a legumecrop, which has the ability to fix atmospheric nitrogen with the help of its root- nodule bacteria. A leguminous crop producing 8 to 25 tonnes of green matter per hectare will add about 60 to 90 kg of nitrogen when ploughed. The green crops also exercise a protective action against erosion and leaching.

The crops most commonly used for green manuring in India are the following:

Crotalaria juncea, Sesbenia aculeate, Cyamopsis tetragonoloba, Melilotus parviflora, Vigna catjang, Dolicos biflorus, Trifolium alexandrine.

Dhaincha is widely used in Assam, Bengal, Bihar, and Tamil Nadu. It is suitable for alkaline, water-logged soils. Cluster bean is used in Punjab, U.P., Rajasthan, Delhi and some parts of Madhya Pradesh. Cowpea isused as green manure in Karnataka for American cotton.

In case of senji, berseem beans, lucerne and sunnhemp one or more cuttings are taken for use as green fodder. The roots and stumps residues are incorporated into the soil as they contain considerable amounts of nitrogen, phosphorus, potassium and other mineral nutrients, besides organic matters.

In localities near forests in Tamil Nadu, Karnataka and Andhra Pradesh, the paddy crop is often manured with green forest leaves. These are incorporated into the soil at time of puddling. Glyricidia maculata and Sesbania speciosa are grown on the borders of paddy fields growing areas, Pongamia speciosa, Tephrosia, Terminalia and other trees yielding large quantities of leaves are planted for the use as a green manure.

For the proper rotting of the green manure, It is necessary that the green material should be succulent andthere should be adequate moisture in the soil. The increase of yield after green manuring is usually of theorder of 30 to 50 percent.

The fertilizing value of the legume crop can be increased by manuring it with superphosphate. This practice increases the phosphorus content of the green manure plants. Thus inorganic fertilizer is converted into organic manure.