

Recycling the groundnut crop waste as fertilizer and paper

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Abstract: India is the second largest producer of groundnut in the world. More than 85 lakhs of hectares of the land is approximately used in groundnut cultivation. In 2022 groundnut is produced in 9.86 million metric tons in which 50% of waste has been produced. Agricultural waste can be recycled into different forms of energy sources. Groundnut crop residues were collected from Lattur located at Chengalpattu district, Tamil Nadu, India. The collected residues were separated as groundnut shell and plant residues. The plant residues are subjected to both vermicompost and natural composting processes. Groundnut shell is used to prepare paper by using the Kraft process (Chemical pulping method). Both the compost is mixed with soil with the ratio of 1:10, 2:10 and Nutrients like N, P, K were analysed. The results show vermicompost having enriched nutrients. Comparing Natural compost, and the Groundnut shell were prepared as paper with a size of 210mm*297mm. Compost helps to improve the health and quality of the soil that is added to improve and maintain the environment. For the paper production trees were cut and used. This causes deforestation. To resolve this problem the better solution is preparation of paper using the non-wooden material. The groundnut shell is one of the non-wooden materials used for the production of the paper. These papers will be eco-friendly as well as it controls deforestation.

Key Word: Groundnut Crop residues, Composting, Non-woody plant materials, Paper

1.Introduction:

List of the countries by Groundnut production worldwide 44,041,913 tonnes of groundnut is produced per year. India comes second largest producer with 6,857,000 tonnes production per year. More than 8.5 million hectares of land is approximately used for groundnut cultivation. In 2022 groundnut production is 9.86 million metric tonnes, in which 50% of waste is generated. Tamil Nadu is the third largest producer of groundnut, over 338.3ha of area is used for groundnut cultivation. Groundnuts in India are available throughout the year due to a two-crop cycle harvested in March and October. The groundnut growing zones are Zone 1 (North Zone), Zone 2 (Western Zone) Zone 3 (Central Zone), Zone 4 (south-eastern zone) Zone 5 (Peninsular) Zone 6 (Southern zone).

Major Growing States are Tamil Nadu, Gujarat, Andhra Pradesh, Karnataka, Orissa, Maharashtra, Uttar Pradesh, Madhya Pradesh and Rajasthan. In Tamil Nadu (southern zone)

more the 16 varieties of groundnut were evolved, there are TMV2, TMV5, TMV7, POL1, TMV9, POL2, TMV12, CO1, CO2, TMV11, TMV6, TMV8, TMV10, TMV1, TMV3, TMV4. Groundnuts plants produce 50% of waste from its production. These groundnut wastes are classified into two majors: Groundnut plant residues, Groundnut shell. The groundnut crop waste is reused as cattle feed (for cow, goat, buffalo etc...,) and they directly fill into the land. Over 11 million metric tons of groundnut waste are generated per annul. But these wastes are not utilized properly. For solving this problem, we need a proper and fastest recycling method

1.1.Composting:

Composting is not a new concept in India. Compared with landfilling and incineration, composting is now one of the most popular technologies to recycle nutrients from organic wastes. The composting process is generally an environmentally acceptable method to waste treatment technology or in handling organic solid waste. This is the feasible way to decompose the solid waste in an economical way. Composting reduces the large fraction of organic waste in less time. This process works to accelerate biological decay.

1.2.Paper production:

Pulp and paper industry in the world have been growing fast. As a result, there has been a massive request for pulp and raw materials. The raw materials used in paper making can be classified into three groups: wood, non-wood, and recycled waste paper. The non-wood raw materials are an important fibre resource in the region where forest resources are limited. Recently a high-tech innovation in the field of paper making has made non-wood more reasonable with wood as a raw material for paper making. Consequently, the future of non-wood plant fibers as pulping and paper making raw materials looks bright. Raw material used in paper making is done by wood, non-wood, recycled paper.

2.Methodology

Agriculture is the backbone of the country. During the process of agriculture waste has been produced in abandonment. The disposal of this wastes creates several environmental problems, like land pollution, water pollution, contamination of groundwater, soil pollution etc. The treatment of this waste is the only solution for preventing pollution. The best treatment method is recycling.

Recycling is defined as the process of collecting and processing material that would otherwise be thrown away as trash and turning them into new products. The most conventional recycling method is composting, the groundnut crop residues will be composted. Groundnut shell is recycled to paper.

2.1.Groundnut Waste collection

The groundnut plant residues are collected from the harvested places. In the study area the groundnut plants are harvested in manually methods and the pods also removed manually. The separated plant residues are collected and transported to the college campus. 3 kg of groundnut shells were collected and 10kg of Groundnut crop residues were collected

2.2.Waste Separation

The groundnut waste can be separated into two types, groundnut crop residue, and groundnut shells. The groundnut crop residues were subjected to the composting process. The composting is done both natural and vermi compost. The groundnut shell was used for paper making. The paper is made by chemical pulping method and soda pulping method.

2.3.Pit preparation

There are two pits constructed for the composting process. Pit 1 is used for natural composting and Pit 2 for vermi composting (Fig.1). The pit is 4-meter length, 3-meter breadth and 2-meter depth. During the digging process the soil samples were collected and separated into three parts for nutrient analysis. The brick line was constructed around the pit. The pit is

covered by a green shade net for controlling the temperature in the pits (Fig.2). This shade net will provide only 30% of sunlight inside the pits.



Fig. 1 PIT PREPARATION



Fig.2 PIT COVERED WITH GREEN SHADE NET COVER

2.4.Filling the waste

Groundnut crop residues collected from the study area(Lattur). Cow dung is collected and used to feed Earthworms. Garden soil is collected from the nearby area. The collected material were Groundnut crop residue, Cow dung, Cocopeats, Soil and Water and they were fill in the pit1 layer by layer. (Fig.3)



Fig.3. PIT FILL

After 20 days the compost in Pit1 is split in two parts, and a partial amount of compost is transferred into Pit 2. After two days *Eisenia fetida* earthworms were added. *Eisenia fetida* worm works efficiently in breaking down and decaying natural remains and turning these scraps into high quality organic compost. It is capable of eating as much as half of its weight daily. Add the worm in the composting after two days in Pit 2. Allow the worm to adapt to that temperature.

2.5.Watering for the pile

Composting materials should be between 40 and 60% water. When conditions are

too wet, water will fill the ore space needed for air movement, and anaerobic conditions can result. Pits watering should be done in 2 days at regular intervals. If the compost is too dried at that time watering should be done daily.

2.6. Turning and Monitoring

Turning the compost allows you to transfer underplated organic material back into the mix so the fast-acting microorganisms can carry on their work. In the Pit 1 turning is done 15 days once. On the 15th day the first turn is done. The turning is done for aeration and speed up the process. Turning in vermicomposting should be done in a manual method using hands. The major four things that should be monitored in compost are Temperature monitoring, Moisture monitoring and Odour.

2.7. Decomposition

Composting stabilizes nutrient content of manures and organic material and releases nutrients slowly, minimizing nutrient loss and potential environmental contamination.

2.8. Nutrient analysis

After the decomposition the samples were collected from the Pit 1 and Pit 2. And the soil samples were mixed with the collected compost sample. The nutrients were analyzed for the soil, soil mixed natural compost, soil mixed vermicompost, and compared the nutrient value of these three samples.

2.9. Pulp Extraction Kraft pulping

Groundnut shells are taken and washed several times with water to remove dust and soil particles present on it. Later it is crushed into short and tiny pieces. They are crushed to remove the water content and dried at 80 to 90°C for about 40 to 50 minutes to further reduce the water content. For cooking liquor to be prepared, chemicals must be taken in the right proportion so that effective cooking happens. Kraft pulping consists of the following chemicals: Sodium hydroxide (NaOH), Sodium carbonate (Na_2CO_3), Sodium sulphate (Na_2SO_3). Firstly, cooking liquor prepares chemicals must be taken in appropriate properties so it generally pulps effectively. For the Kraft's process NaOH, Na_2SO_4 & Na_2CO_4 these three chemicals combine gives 12.5% of total weight of solution. According to Kraft's analysis in that 50% of NaOH 25% of Na_2SO_3 12.5% of Na_2CO_3

2.10. Soda pulping

In this process 50% by weight solution of NaOH is required as cooking liquor. If we take 1000ml as the basis 50%. These 500 grams NaOH is dissolved in water and made up of 1000 ml to give required concentration of cooking liquor. Once the cooking liquor is prepared 250 grams of raw material is taken in 800 ml cooking liquor in a 1000 ml beaker and the level is marked. and water must be added continuously to maintain the initial concentration of the cooking liquor and this process must be repeated the entire boiling time.

2.11. Digesting

After preparation of liquor of around 400 ml. Take out 100 ml in a beaker & add 20 grams of raw material & level is marked. It needs continuous heating for evaporating water present in liquor. Heat is supplied by means of around 1.30hrs, at high temperature. After breaking bonds, the colour of liquor turns black.

2.12. Washing

After digesting, brown stock and black liquor are formed. Brown stock contains pulp and a small amount of lignin. This lignin gives brown colour to it. The mixture is filtered using cloth to obtain black liquor as waste that can be removed. Only one filtration is not enough, so we need filtration again and again. The chemicals have been removed by washing completely. Finally, the product obtained had less lignin content in it.

2.13. Blending

Deal with the cooked materials into a jar and upload 75% of bleaching agent, after

which the pulp turned into the box, then the pulp changed into beaten with the assist of a blender. Beating is the essential hyperlink within the pulp and paper making process which has a crucial effect on the operations of paper making and power residences of paper. Beating can make fibre transformative, swelling, and fibrotic, and so forth. So, the binding forces among the pulp enhance the paper power.

2.14. Bleaching:

Bleaching of non- wood pulp has been practised on account of early times. Bleaching is the remedy of pulps with chemical sellers to book their brightness by means of either lignin removal or lignin decolonization. The principle parameters influencing the bleaching end result are the sort of chemicals, its dosage, pH price, temperature, and retention.

After filtration & washing is done effectively pulp is further washed with 200 ml water + Bleaching agent. It is required to remove brown colour for white paper. It is attractive as a bleaching agent for secondary fibres. Hydrogen peroxide is the most frequently used chemical for high yield pulp bleaching when high levels of brightness are required.

2.15. Pressing

As the paper enters the press section, it undergoes compression between two hydraulic presses to squeeze out more water. Then it continues its way through the sun drying to losing the moisture.

2.16. Drying

To find the yield, we removed entire water in the bleached pulp. To remove entire water content in the bleached pulp, it is dried at a temperature of 100°C for one hour in sun drying.

3. Result and Discussion

3.1. Nutrient analysis of compost

The following are the nutrient values for soil, natural compost and vermicompost. The NPK values are compared.

Table 1 Nutrient value of Samples ratio (1:10)

Sl.No	Sample	Soil pH	Organic matter	Nitrogen	Phosphorus	Potassium
1.	Sample 1	7.7	3.4%	0.73%	1.26%	0.91%
2.	Sample 2	7.1	4.6%	1.20%	2.14%	2.03%
3.	Sample 3	6.8	5.2%	1.37%	2.20%	2.16%

Sample 1- Soil, Sample 2- Soil+ Natural compost, Sample 3- Soil + Vermicompost The analyses data were tabulated above for the three soil samples

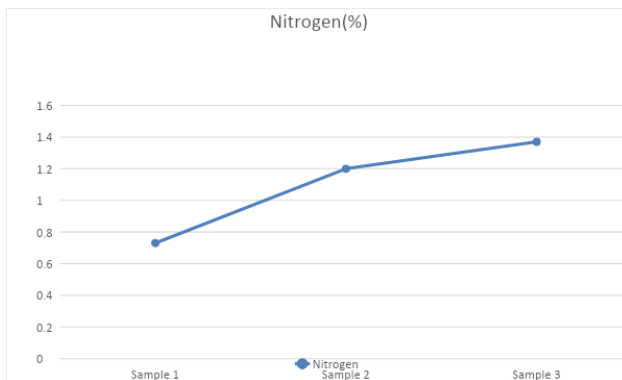


Fig 4 Graphical representation of soil sample for Nitrogen

The nutrient value of nitrogen in sample 1 and sample 2 and sample 3 were compared using the graph.

In the soil nitrogen content is very low but, in the soil, mixed with compost it gradually increases and in vermicomposting it reaches the top. Vermicomposting gives a high nutrient value compared to natural compost. The vermicompost (sample 3) mixed with soil is the high nourishment for the plant.

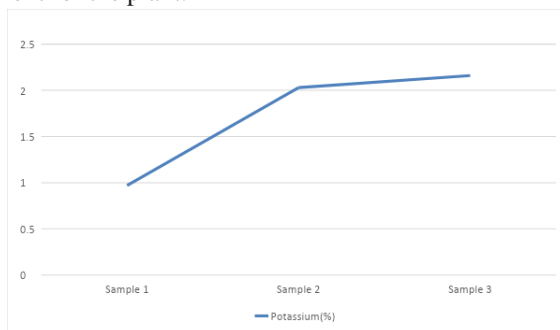


Fig. 5 Graphical representation of soil sample for Phosphorus

The nutrient value of phosphorus in sample 1 and sample 2 and sample 3 were compared using the graph. In the soil phosphorus content is very low but, in the soil, mixed with compost it gradually increases and in vermicomposting it reaches the top. Vermicomposting gives a high nutrient value compared to natural compost. The vermicompost (sample 3) mixed with soil is the high nourishment for the plant

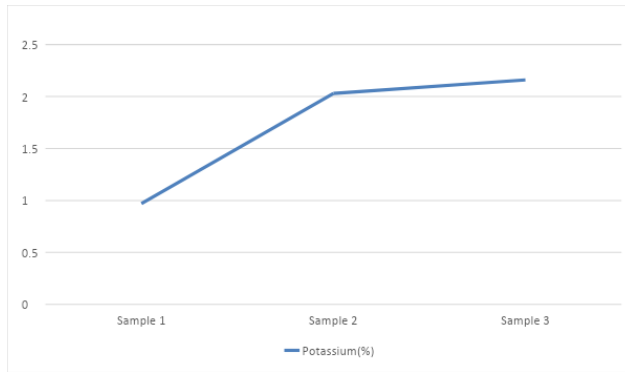


Fig. 6 Graphical representation of soil sample for Potassium

The nutrient value of potassium in sample 1 and sample 2 and sample 3 were compared using the graph. In the soil potassium content is very low but, in the soil, mixed with compost it gradually increases and in vermicomposting it reaches the top. Vermicomposting gives a high nutrient value compared to natural compost. The vermicompost (sample 3) mixed with soil is the high nourishment for the plant.

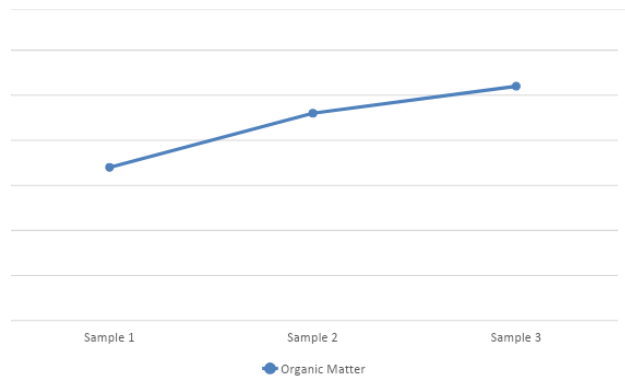


Fig. 7 Graphical representation of Organic matter in soil sample

Compare these values of the organic matter. The soil mixed with vermicompost has a high organic matter. Other two samples have a smaller amount of organic matter.

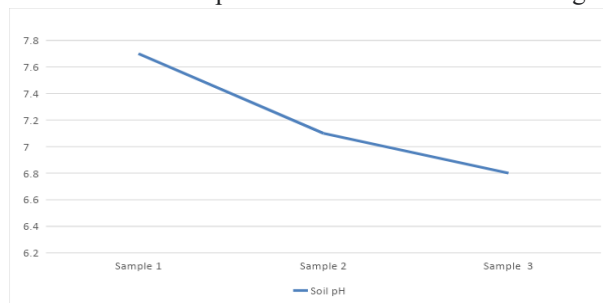


Fig. 8 Graphical representation of soil pH

The above graph explains soil pH for the soil sample, soil sample with compost, soil sample with vermicompost. Most plants prefer a slight acidic soil with a pH between 6.0 and

7.0. In these three samples the sample 3 (soil sample with vermicompost).is only having the pH value of 6.8. The other two samples had the pH of above 7.

Table 2 Paper production Process

S.No	Process	Groundnut shell (grams)	Pulp production (grams)
1.	Kraft process	250	80.75
2.	Soda process	250	61.73

In the paper production processes, the two methods are followed, one is the kraft process and another process is the soda process. The same amount of the groundnut is taken and pulp extracted. The kraft process the amount of pulp is extracted is 80.75 g in 250 g of raw material. In the soda process the amount of pulp is extracted is 61.73g in 250 g of raw material. In this table 5.3 says that pulp is extracted more in the kraft process. In the kraft process the three chemicals like NaOH, NaSO₃, NaCO₄ were used for the pulp extraction. These chemicals speed up the process and extract the pulp. But in the soda process the chemical NaOH is only used. This process takes a long time for pulp to be extracted. The quality of the paper is less in soda process from the table. The pulp is also less in the soda process. This extraction process is differentiated in the Chart

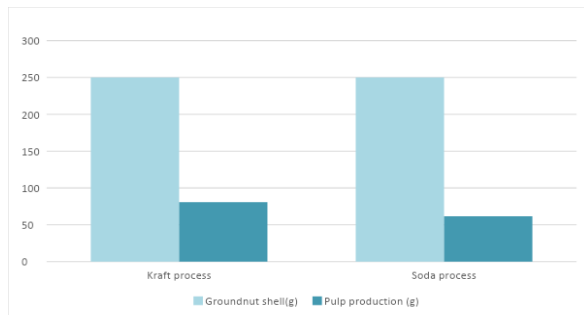


Fig. 9 Variation of Grams in shell and Pulp

Table 3 Difference between soda pulp and kraft pulping processes

Sl.No	Parameters	Kraft Process	Soda Process
1	Paper Color	Light yellowish	Light yellowish
2	Size of the Paper	210 x 297mm	210 x 297mm
3	Weight of the Paper	12 grams	11 grams
4	Thickness of the Paper	0.50mm	1mm

From the above table 3 explain about the difference between soda pulp and kraft pulping processes. The paper from the kraft is high grade paper. Paper from the soda processes paper is ingrade. The colour of the paper is light yellow in both the process. The paper from the kraft process is less weight, but the paperthe soda process is more weight compared to the kraft process. thickness of the paper was compared and the paper from the process is less thick. So high grade paper is from the kraft process

4. Conclusion

This compost is cost efficient and doesn't cause any pollution to the environment. It is fully made up of organic matter. This organic matter enriches the soil and gives higher yield. Vermicompost contains high nutrient value compared to natural compost which gives higher yield. Nowadays farmers are using more fertilizer. We can suggest natural compost and vermicompost to the farmers for soil enrichment and better yield. Groundnut shell has been used for paper production in two methods one is Kraft process another one is soda process. Three types of chemicals were used for the Kraft process (NaOH, NaSO₃, NaCO₄). In soda pulping only NaOH is used. The properties of the paper like colour, size, thickness was measured and compared. From the comparison of the two processes the best quality of paper comes from the Kraft process. Generally, the paper was made from wood for the paper production wood were cut and used. For cutting these woods it causes deforestation. Prevent from the deforestation the best solution is afforestation and the tree should cut as raw material.

Standard, recycling agricultural crop waste into fertilizer and paper can be a win-win answer for both the environment and the agricultural industry. Through embracing those practices, we will reduce waste, promote sustainable agriculture, and guard our herbal sources for destiny generations.

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