

Paddyware as Solution for Consumptive Use of Crop Residue (Parali)

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Abstract— After the Green Revolution Northern Indian states engaged themselves with wheat and rice production as a result India became the largest agriculturally based economy. However due to lack of a proper way to dispose the Residue material left after harvesting (paddy/Wheat straw etc.) farmers started burning the stubble which ended up contributing to at least 10% of yearly pollution in Delhi and Northern Indian thus making it one of the most polluted cities in the world. To counter this issue, we came up with a solution of Paddyware which not only offers an effective solution for disposal but also an eco-friendly substitute of plastic ware. Paddywares are the product made of pulp extracted from plant fiber of paddy straw which is made of 80% cellulose and 20% of lignin (plant starch). The methodologies used in manufacturing of the product are simple as washing, chopping, grinding, bleaching, steaming, beating and moulding. This technique, if adopted on industrial level, has caliber to counter the above said problem by at least 5-6%.

Index Terms— Crop Residue, Paddyware, Parali, Stubble Use.

I. INTRODUCTION

Recently Supreme Court on Delhi Pollution said " Stubble Burning Cause for 10% of Air Pollution, 75% due to Industries, Dust and Transport". Since the burning of stubble causes smoke in large amounts, Due to the topography of Northern India majorly the Aravalli mountains and the Himalayas offer a barrier to the brooming effect of wind to the smoke and pollution, thus causing the accumulation of polluted contaminants in the Northern Indian.

Since Delhi and several neighboring cities are the hot spot of the world, pollution causes severe pulmonary and Cardiac diseases to the natives and destroys the very ecology. According to the [1] experts one of the major reasons for this pollution is stubble burning in Northern states. Thus, we came up with the idea of building something out of nothing that is manufacturing of Eco-Friendly products out of straw fiber pulp that includes a few steps of processing. We have taken rice straw in our pilot experiment.

For the last four years the government had spent over 2000 crore Rupees to resolve the problems of burning Parali in which they launched [2] various schemes to help the farmers but as seen so far that the farmers didn't show their interest to switch with any other alternative provided by the government. This problem still persists in Northern Indian states which in future might lead to drastic decline in air quality.

Since idea is based on Parali consumption and manufacturing of a plastic replaceable product can help to reduce Parali burning practices therefore, can reduce funds used in resolving problems due to burning of Parali by the government and can also be presented as a startup idea for various entrepreneurs.

Some of the previous and relevant researches have following findings, these contribute in laying down the methodology guidelines and steps to be followed. Niveta Jain et al (2014) analyzed the amount of air contaminants according to different states in India which is caused from burning of crop residues.

S. Bhuvaneshwari et al (2019) stated that crop residues left after harvesting covers almost one part of the field that creates particular [3] strenuousness because of the excess amount and lack of propensity to supervise them. Changes around pollution can be seen by creation of CO₂, CO, N₂O and NO_x in the soil which is an additional problem from high yielding.

Pratika Chawla, H.A.S. Sandhu (2020) explained that during 2014-18, 32% and 40% of crop residue area which is burnt decreased in Patiala and Ludhiana, in spite of this pollutant level [4] slightly increased. The amount of SO₂ released was found to be more in comparison with RSPM and NO_x.

Camilia El-Dewany, et al, (2018) showed interest to highlight the problems that occurred from burning of rice straw like on individual's, particularly for those who have respiratory issues and some other problems like irritation in eyes, nose etc.

Niti Gupta (2019) studied and set up sensors which took least effort and placed them across 4 regions in Punjab to screen PM_{2.5} emissions; through ranchers explain their difficulties and as the arrangement what they want to see; all data collected and through satellite data tried to explain the pattern of paddy [5] build up copying in Punjab.

Rob Bakker, et al, (2013) examined features, limitations, possibilities and a few unstable findings in special elements

of parali and wheat stubble, whilst applied as an uncooked cloth for the bio-primarily based total economy.

Chandra, R et al (2012) [6] tested that plant biomass has many ingredients like cellulose, hemicellulose, protein extractives, ugars, and nitrogenous material, chlorophyll and inorganic waste.

Lohan et al (2018) [7] stated that several countries make use of the crop residues produced from different agricultural activities in different ways. They are utilized in refined or unrefined form, which depend on their end use. They gave various options to use these residues as animal feed, compost, and production of bio-energy.

Kumar, P et al represented a number of the laws that issues an excessive amount of on crop residue burning are: The Section one hundred forty-four of Civil Procedure Code to ban parali burning, The Air interference and management of Pollution Act, passed on 1981, The surroundings Protection Act, enforced on 1986, [8] The National court Act in 1995 and therefore the National surroundings legal proceeding Authority Act in 1997. To limit the crop residue burning National inexperienced court (NGT) is simply too strict notably within the northern states owing to massive production like Rajasthan, Uttar Pradesh, Haryana and Punjab.

II. CHALLENGES DUE TO PARALI

A. Pollution

The smoke produced after combustion produces a haze of contaminants that create a toxic atmosphere. An expert’s estimation reports that 149 [9] million tonnes of CO₂, 9 million tonnes of CO, 0.25 million tonnes of Sox and 1.28 million tonnes of particulate matter were emitted from the combustion of crop residues.

Table I : Percentage of suffered people by various issues

Issues Facing	Suffered People %
Irritation in eyes	76.8
Irritation in nose	44.8
Irritation in throat	45.5
Cough or increase in cough	41.6
Wheezing	18

According to study of Vitull k Gupta, professor of medicine, Bathinda in 2016,[10] revealed following health issues related to increment of smog due to burning of Parali.

B. Declination in Soil Nutrients

Burning plant material not solely decreases the soil quality however also affects the index and engineering properties of soil and causes organic process deficiency, as an instance N,

P, K, S. The warmth made by the combustion of stubble penetrates the soil up to one centimeter, raising the temperature from 33.8 to 42.2 degrees Celsius. [11] As a result of this temperature rise, microorganism and flora populations necessary for fertile soil are killed.

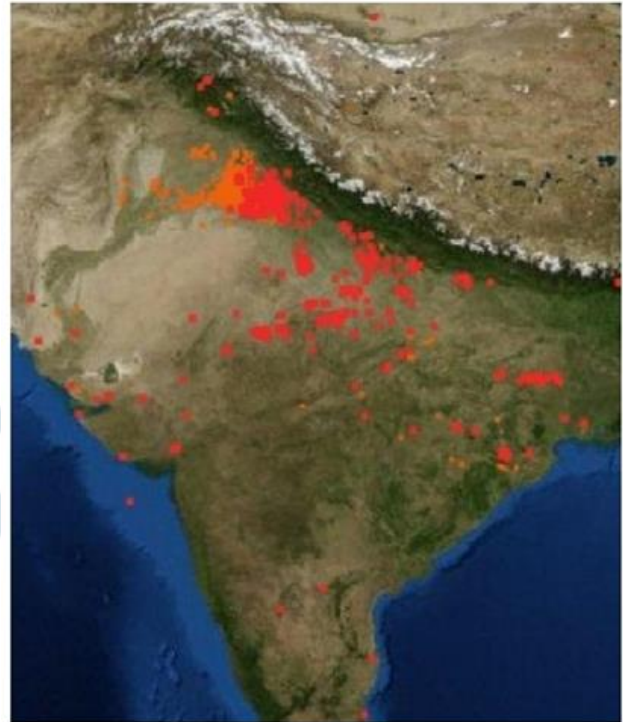


Fig. 1 : Satellite Made India’s Pollution due to burning

The burning of crop residues causes harm to alternative microorganisms within the higher layer of the soil further on its organic quality. [12] Thanks to the disappearance of "friendly" pests, the anger of "enemy" pests has inflated and, as a result, crops are a lot more vulnerable to disease. The solubility capability of the highest soil layers was additionally reduced.

C. Spreading of Fire

Due to the burning of stubble in the field, there are greater chances of expansion of fire to the nearby fields and jungles which might affect the [13] homes and shelter of animals and humans. Spreading of fire kills favorable microorganism and bacteria which are beneficial for crops of same or in nearby fields.

D. Hardly used as fodder for Animals

Rice straw cannot be used as fodder by animals as it contains a huge amount of cellulose and hemicellulose which is not easy for animals to digest. Nutritional value in straw is less as there is in hay that’s why it is not used as a fodder.

E. On field Decomposing Difficulties

For storage of this stubble, the area required is large and thus decreases the land remaining for cultivation and cannot

be left in the field to decompose, which causes the release of methane gas. Rice straw is a notable source of anthropogenic greenhouse gas emissions (GHGEs) and the prime source of agricultural emissions.

III. METHODOLOGY

The methodology used in making the wares out of paddy straw is similar to conventional manufacturing processes of paper pulp wares industries. The way paper pulp is used to make the decomposable wares similarly the rice straw pulp is used to make biodegradable wares.

A. Properties of Rice Straw

Narendra Reddy et. al. (2006), examined the properties of high-quality long fibers from rice straw. These were having natural cellulose as main biomass.

Table II : Chemical properties of Long Rice Straw

Long fiber from Rice straw	
Properties	Values
Cellulose	64%
Crystalline cellulose	63%
Strength	450 Mpa
Elongation	2.20%
Modulus	26 Pa

B. Solution: Paddyware

Paddywares are the products made by the processing of rice husk. Since the rice husk has its components as cellulose and lignin. Paddyware consists of words Paddy and Ware, paddy implies rice plant and ware implies product, which in combination means product made of rice straw.

These Paddywares possess the properties of water retention, light weighted, Eco Friendly, Anti-slip and anti-moss, Low cost. As we know by making Paddyware, we are going to shrink the use [14] of plastic wares which is going to diminish following sources of pollution:

It Counters the problem of Pollution caused due to burning of plastic. Plastics are non-biodegradable in nature. Most plastics are recycled but remaining are burnt for the purpose of disposing of them, which account for 3.8% of global greenhouse gas emission that almost double the emission of the aviation sector.

This can replace the use of plastic ware which further decrease the production. As The production and destruction of plastic will add 850 million metric tonnes plus of

greenhouse gases to the atmosphere which is equal to the exudation from 189500 MW coal power plants.

Pollution due to burning of parali is also a factor which is being tackled by use of Paddyware, agricultural residue burning emits fine particles and air pollutants. These are concerns for people's health when present in air in huge quantities. These particles can get captivated in the lungs and amplify risk of lung cancer by 36%. By making Paddyware we would be able to reduce problems and challenges that we mentioned above like health issues, loss of soil nutrients, etc.

C. Machinery

Some of the machines used in Paddyware making are as follow, although, selection of machine is totally depending on scale of production and process to be adopted. Even on domestic level, with bare use of kitchen tools only, one can prepare the paddyware for local use.



Fig. 1 : Some of the machines used in Paddyware making

Table III : Use and Estimated cost of involved Machinery

Machinery	Use	Cost
Chaff Cutter	Chaff cutter is used to chop the rice straw into small pieces.	15,931
Washing machine	Washing machine is used to wash the dirt in the straw picked from the field.	10,000
Steamer	Steamer is used to extract the fiber from the straw.	76,700
Hollander beater	Beater is used to extract the pulp from the paddy straw.	1,50,000
Double die paper plate making machine	This is a mould machine used for making plates and other wares using the pulp.	55,460

D. PROCESSING OF PADDYWARE

To make a Paddyware product, two methods can be followed, in this paper wet process adopted on domestic level only.

■ The Wet Process

- Step 1: The rice straw is collected from the field. These straws are then chopped into small pieces using a chaff cutter.
- Step 2: Now the chopped straw is washed thoroughly to remove all the dust and dirt from the straws using a washing machine and make it clean for further processing.
- Step 3: The straws are bleached using biodegradable chemicals. This step is optional.
- Step 4: To extract the fiber from the straws, they are further steamed in an autoclave reactor (a giant pressure cooker) for 1 to 2 hours.
- Step 5: To extract the pulp from the steamed straws using mechanical shear, a beater machine is used. Up till these steps the pulp from the rice straw is being generated which can be used as a raw material in different industries.
- Step 6: Finally, the pulp extracted is used in the double die paper plate making machine to produce ware of rice straw. These wares made are light weighted, water resistant, and biodegradable.
- Step 7: Using 1Kg of pulp approximately 200 pieces of plates (size equal to paper plate) can be made.

■ The Dry Process

- Step 1: The rice straw is collected from the field. These straws are then washed to remove dust and dirt.
- Step 2: Then these straws are left to dry using an oven or in sunlight.
- Step 3: Further these rice straws are grinded into fine powder using a grinding machine.
- Step 4: Now the dough is prepared using plant starch.
- Step 5: Finally, this dough is used as a raw material for making the Paddyware products.

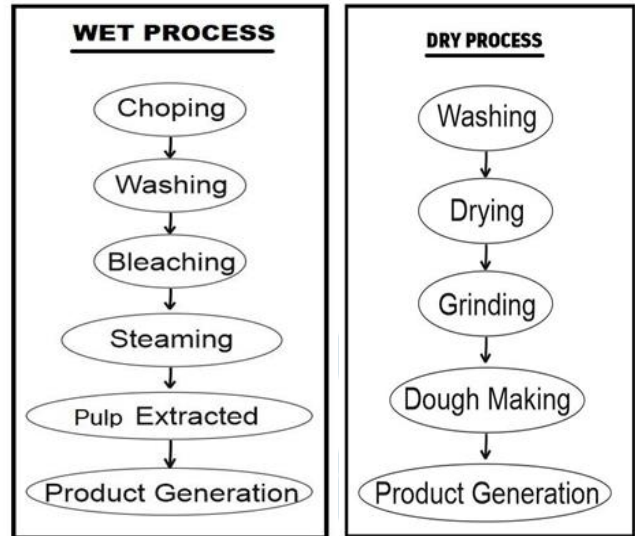


Fig. 2 : Flow Chart for Wet & Dry Making Process

IV. CONCLUSION

The products made using rice straw creates a demand pull for paddy straw for consumption which stops the burning activity of Parali. Furthermore, conclusions can be drawn.



Fig. 3 : Finished Industry ready products

- [1] Different natural fibers from different crops within the agricultural waste such as rice straw, wheat straw, sugarcane baggers etc., are present in huge amounts in our country.
- [2] This Plant biomass consists basically of cellulose, hemicellulose and lignin with supplementary quantities of pectin, macromolecule extracts, carbohydrates, phosphorus, chlorophyll and inorganic waste.
- [3] These plant straws can be employed in production of plant fiber pulp that further can be used in production of several fiber pulp-based products.
- [4] As above research suggests a solution to the matter by manufacturing a product using rice straw fiber pulp to contribute to pollution free India by using straws in bulk.
- [5] This idea can also be used as a startup by varied entrepreneurs and can also scale back the consumption of plastic wares and can embrace the economy.
- [6] This reduces the pollution rate caused because of

production of plastic and burning of Parali and plastic which causes multiple issues to flora and fauna.

- [7] The idea of Paddyware is useful in several perspectives and this product is 100% eco-friendly and biodegradable and can be decomposed by bio-organisms and returned to the soil as a fertilizer forming a natural biological cycle.
- [8] This can be a sound and sensible resolution and also the substitute of plastic ware that's the necessity of the hour.

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