Journal of Agroecology and Natural Resource Management
p-ISSN: 2394-0786, e-ISSN: 2394-0794, Volume 5, Issue 3; July-September 2018, pp. 138-141

http://www.krishisanskriti.org

Efficient Measures of Paddy Straw Management

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Abstract—*A rise in the production of crops like paddy is leading to a rise in the generation of paddy straw, which, if not removed from the fields or otherwise managed interferes with wheat planting operations. Most common practice to deal with paddy straw by farmers is burning despite the ban by the government. This practice does not only emit huge quantities of suspended particulate matter but also harmful gases resulting in environmental and health issues. Thus, it is highly important to manage paddy straw effectively. Technical solutions are available, which can be majorly categorized into on-farm (in-situ) and off-farm (ex-situ) solutions of paddy straw management. Various machineries are available to manage the waste effectively on farm through methods like incorporation, surface mulching etc. but awareness among stakeholders especially farmers is very less. Paddy straw has a great potential as an energy resource and can also be used for the production of briquettes, compost, paper and board, mushroom cultivation etc. but in most cases a legal framework need to be implemented before a technical solution can be applied. The best solution to deal with the problem is by creating awareness amongst stakeholders regarding various issues of paddy straw burning and possible solutions to stop the same. Also, the implementation of various policies framed by government should be the responsibility of the stakeholders for effective management of paddy straw.*

Keywords*: paddy straw, stakeholders, management, in-situ, ex-situ.*

1. INTRODUCTION

Paddy is the chief crop of Kharif season in the country and its production has increased from 60.56 million tonnes in 1986-87 to 104.32 million tonnes in 2016-17 showingan increase of 72 percent over three decades[1] .This increased production has led to increased quantum of paddy straw. For every 4 tons of rice grain, about 6 tons of straw is produced. 685 million tons of rice straw is generated annually throughout the globe and about 60 percent of the mass produced by rice crop is rice straw [2].To manage this huge amount of waste is a serious challenge, thus enlightening the importance of agricultural waste management.

Paddy straw can be treated in number of ways but it is generally removed from the fields during harvesting and is subjected to open field burning in spite of the ban by the government. The main Causes of open field burning are: The Rice-wheat cropping pattern is the major cause of the practice as it provides agap of only 15-20 days in harvesting of paddy and sowing of next crop. According to a study, the delay of sowing of timely varieties of wheat after November, 15 results in yield losses of 1 % per day [3].Increased mechanization i.e. usage of combine harvesters is also one of the reason which leaves behind the stubble on the farm. Also there is shortfall of labor for collecting and storing straw and the process would require extralabor charges leading to additional cost for farmers. Paddy straw is very bulky, therefore its collection and storage incur huge cost and if collected properly, it cannot be fed as such to animals because of high silica content. Overall, farmers find burning as the easiest and quickest way to get rid of paddy straw economically.

2. PADDY STRAW MANAGEMENT: NEED OF THE HOUR

Paddy straw is an abundant crop residue, every one kg of milled rice produced results inapproximately0.7–1.4 kg of rice straw and the amount of straw produced depend on variety, cutting-height of the stubbles, and moisture content during harvest [4]. Paddy straw has huge energy potential and can also be used for production of electricity, briquettes, mushrooms, biogas, compost, packaging material etc. but there is lack of awareness among stakeholders especially farmers regarding its alternative uses. If not managed properly or burnt, the practice does not only affects soil fertility but also acts as an important source of air pollution. It does not only emithuge amounts of suspended particulate matter, but also gases like carbon monoxide, methane, nitrous oxide, sulfur dioxide and hydrocarbons are released in air. It has been estimated that burning of 1 ton of paddy straw accounts for loss of 5.5 kg Nitrogen, 2.3 kg Phosphorus and 1.2 kg Sulphur, apart from loss of organic carbon[5]. Moreover, heat generated due to burning of paddy straw penetrates into the soil, resulting in loss of moisture and useful microbes, which furthermore adversely affect properties of soil.

3. MEASURES OF PADDY STRAW MANAGEMENT-

1) In-situ management

Happy Seeder- Happy Seeder is a tractor ascending machine that trims the rice straw and lifts it and sows wheat at a depth of 12.5 cm into the bare soil, and spread the chopped straw over the sown area as mulch. It combines the seed drilling and

stubble mulching operations into one machine in a sole pass. Therefore, the wheat crop can be sown in standing stubbles of rice with happy seeder that avoids the need of preparatory tillage of the field and as compared to the traditional method of sowing; the crop can be sown 7-10 days earlier using happy seeder. The machine Cost ranges from 1 to 1.50 lakhs and the government is providing a Subsidy up to 50% on happy seeder, depending upon state to state.

The potential agro economic benefits of the happy seederto farmers are: reduction in air pollution and retention of nutrients and organic matter, by avoiding stubble burning. Increase in yield and reduction in fertilizer inputs through improved soil fertility. Other benefits are labor savings through fewer tillage operations; suppression of weeds and soil evaporation by mulching results in reduced weed control costsandirrigation water savings.[6,7,8]

There are also some technical and social constraints that may affect the adoption of happy seeder, these include: large capital investment which includes investment on happy seeder and a high power tractor (45 HP and above) required to operate happy seeder. Therefore machinery purchased by small farmers would be underutilized due to its limited use on-farmand most of the farmers have small land holdings. Lack of information and awareness regarding potential benefits of happy seeder among the farmers and also thefear of adopting the new technology without knowing its long term impact is another constraint. Moreover, very few people in this system have ground-level experience of working on the zero-till machines.

Bailing-Baler is a piece of farm machinery that is used to compress andcut gathered crop/residue in to compact bales that are easy to handle, store and transport. So for paddy straw, which is a very bulky crop residue, bailing is a good option for easy collection and convenient storage. Before baling, Firstly, a stubble shaver has to be operated to harvest the stubbles from base level. A baler is then operated over the farm which collects the straw and spins and compresses it in desired shape. A baler can form bales of various lengths that may vary from 40 to 110 cm size, whereas, the height and width of the bales is mainly fixed at 36 cm 46 cm respectively. The bales can be formed in round or rectangular shapes. The weight of bales varies from 20 to 30 kg depending on moisture content of straw and length of bales. The capacity of the baler varies from 0.30-0.35 ha/h. Cost of a baler ranges from 3.75 to 8 lacs depending upon type of baler. Subsidy provided by government is up to50%.

Baling has advantage that it results in convenient handling and storage of straw as compared to loose straw which can later be used by the farmer throughout the year or can be sold to manufacturing industries that require paddy straw for their production. But high cost of this piece of machinery is the largest disadvantage that restricts its adoption.

Paddy straw chopper followed by rotavator- this combination offers minimum tillage and helps to retain and mix residue in soil**.** Paddy Straw Reaper provides functioning as a threshing machine where it runs the function of cutting and threshing the straw in one operation. Its Cost range from 1.90 to 2.20 lacs and Subsidy up to 50 % is provided by government. The Capacity of a straw chopper is1 to 1.2 ha/hr. Later chopper can be followed by rotavator which is a tractor-mounted implement which is mainly used for seed bed preparation and is suitable in removing & mixing residual of paddy i.e. paddy straw within one or two passes. Its cost depends upon length which ranges from 5 to 9 feet: 0.65 to 0.95 lacs and the average capacity of a rotavator is .4 ha/hr.

This combination has benefit of incorporation of straw in to the soil which later improves soil organic matter hence yield is also improved later but the major drawback is rotavator cannot be used alone and using it with paddy straw chopper adds more to the cost. The machine need to be operated more than once on the farm if whole residue is to be incorporated, thus, increasing fuel consumption and time requirement.

Mulching- paddy straw mulching is a protective covering of straw on the ground/field to cover the soil bed to prevent excessive evaporation or erosion, suppress weed, retain moisture. A mulcher machine is used for this process which is a machine that cuts and spread the straw for use as mulch. Average cost of a mulcher is 1.5 lakh rupees. The mulch later is incorporated naturally into the soil by activities of worms and other organisms and enhances the fertility of soil in long term.

Mulching process offers a number of benefits which includes: improves soil by adding organic matter, Retains moisture thus reduces watering need, Moderate soil temperature and improve plant growth, Improve soil structure and the availability of nutrients for the plants, prevent the soil from erosion and seeds from birds and rodents. The reason for less adoption of mulching is that it involves huge cost and lack of awareness of its impact on yield of crop.

Reverse ploughing- The reversible plough (or "rollover plow") has two mould board ploughs mounted back-to-back, one turning to the right, the other to the left. While one is operating on the land, the other is carried upside-down in the air. Its basic functions are breaking and inverting the soil, therefore, the soil with chopped straw is incorporated inside the soil and the underground soil comes above with the inversion. It averagely Cost.90 lacs and Subsidy upto 40% is provided by government.

Reverse ploughing helps to incorporate straw in to the soil effectively and seeds for next crop can be sown easily over this soil bed. Straw incorporation enhances soil characteristics and fertility. This equipment also has various other functions at the farm level like it tills the hard soil, with deep roots and unwanted plants, shrubs and weeds, so can be utilized in

multiple ways. Major constraint is lack of awareness regarding the same and its potential benefits.

Super straw management system- The super SMS system is an extension to be attached with harvester. It will cut down straw into small pieces before releasing it in fields. In this way, the sowing of next crop will be possible without burning of paddy straw by combining the practice with happy seeder, reverse plough, rotavator etc. In order to provide financial assistance to farmers it has been decided by the government to provide subsidy up to 50 per cent (maximum Rs 50,000) and Its Cost ranges from 1 to 1.25 lacs.

Super straw management (SMS) has a benefit as it cut and chop the straw along with harvesting the crop and it makes the operation of machines like happy seeder easier as straw is uniformly cut and spread. However its cost and lack of information and usage demonstration is the potential constraint of its adoption.

2) Ex-situ management:

Briquetting-The briquetting process converts lose agro waste biomass into high density compacted green fuel. Straw briquette pellet fuel belong to renewable energy, which refer to the dense and uniform briquetting fuel made of straw through collection, dehydration and crushing under certain conditions. Briquetting of paddy straw can also be done with mixing of other crop residues such as soybean straw, pigeon pea stalk etc. Rice straw is densified under a die pressure range of 20-140 MPa. After briquetting, the combustion performance of fuel is greatly improved, the combustion efficiency is increased from 10%～15% of direct combustion of straw to 30%～40% and the bulk density of material is increased by 4-10 times Paddy straw has a fuel value in the range of 3400 to 3600 K Cal/ kg and after briquetting changes to nearly 4400 k cal/ kg[9].Cost of briquetting machine ranges from 5 to 15 lacs depending upon size and capacity.

Briquetting results in easy storage and transportation of the straw in a concentrated and dense form and enhance its burning efficiency. Biomass briquettes are cheaper to other biofuels and has huge potential to be used as a fuel in boiler, furnace, brick kiln and also in household cooking. The major drawback is that the process include large investment, also there is problem with transportation and storage of the raw material which is very bulky and available once in a year.

Composting-Composting is a process that converts crop residues into a better organic fertilizer. Organic fertilizers, like rice straw compost are highly beneficial as they contain micronutrients, micro-organisms and enzymes that are often not found in inorganic fertilizers while they are low in major nutrients such as phosphorus (P) and nitrogen (N). Rice straw is also rich in carbon and potassium (K).The key to good compost is adequate supply of nitrogen, moisture content and required microorganisms.

Rice straw compost contains various microorganisms and micronutrients that are beneficial to soil health and crop growth and nutrients in compost are released slowly, thus are less likely to be lost by leaching. The major constraints in the process of composting are requirement of a lot of labor to collect and pile residue, turning compost heaps and for spreading compost in the fields. As this compost lack in efficient nitrogen content, therefore, there would be need of inorganic fertilizers.

Power generation-Rice straw can either be used alone or mixed with other crop residues/biomass materials in direct combustion, whereby combustion boilers are used in combination with steam turbines to produce electricity and heat. The energy content of rice straw is around 14 MJ per kg at 10 percent moisture content. The by-products are fly ash and bottom ash, which have an economic value and could be used in cement and/or brick manufacturing, construction of roads and embankments, etc[10].

The benefit of using paddy straw for production of electricity is that paddy straw is an abundant crop thus, available at low cost and has fair calorific value but there also a number of drawbacks in using the same, which includes: high cost due to increased transportation and storage cost, high ash content which leads to generation of huge amount of paddy straw ash, technology need to be developed to recycle this ash.

Biogas generation- Paddy straw can be digested by anaerobic means for the production of biogas to be used as a fuel for the kitchen as well as for power generation. The latest method of anaerobic digestion is “Dry Fermentation of organic wastes” (recommended by PAU). The digested material so produced from such anaerobic digestion is a good quality manure and ready for use in the fields. The disposal of digested material is also not difficult as it can be lifted from the plant with the help of semi-automatic system.

The benefits of producing gas from paddy straw using this technology are that it requires little labor and produces large amount of biogas for a period of 3 to 4 months. The digested material from the plant is rich organic humus which can be carried in the baskets and can be spread in the field as organic manure. Lack of awareness is the major constraint in the adoption of the process and storage of bulky material like paddy straw is also not convenient.

Mushroom cultivation- most of the higher fungi can utilize agricultural wastes for the production of protein rich biomass as edible mushrooms. Most production is of Agaricus bispor us, the white button type mushroom which requires composted substrate based on wheat and paddy straw. Use of the two residues can be together or paddy straw can also be mixed with maize stalk.

Paddy straw being an abundant material can be economical in mushroom production as cost of procurement is low, thus, reducing the cost of production. Moreover, paddy straw is available in September to November, the composting season,

therefore needs no storage. The drawback in using paddy straw alone is compromise in yield, thus should be used in a mixture with wheat straw, maize stalk etc.

There are various other uses of paddy straw off the farm, i.e., can be used in furnace, paper and pulp board industry, animal feed (by the use of urea treatment technology), animal bedding, packaging material and filler etc.

4. CONCLUSION

For the rapid adoption of paddy straw management practices awareness generation and a strong knowledge base and a combination of institutional and technological innovations, is required. Therefore, it is a challenge for all stakeholders, farmers, scientific community, industry and extension agencies to understand the opportunities, and come up with strategies that are more acceptable by stakeholders and act as a motivation for them to manage paddy straw effectively. There is a big challenge to change the past mindset of farmers. The best solution to deal with the problem is to manage the straw on the farm itself which makes it more economical and convenient. Presently, the most beneficial and cost-effective way to manage paddy straw is to use happy Seeder which is a zero-till sowing machine. Government plays a major role in this issue and should offer various subsidies and incentives to farmers and other stakeholders to motivate them to manage paddy straw effectively.

REFERENCES

[1] Anonymous (2017) Agriculture- Statistical year book India 2017. Retrieved on 28th August from http://mospi.nic.in/statistical-year-book-india/2017/177.

[2] Lim, J. S., Manon, Z. A., Aluri, S. R. W. and Hashim, J.,"A review on utilization of biomass from rice industry as a source of renewable energy". *Renew Sust Energy Rev*, 2012 pp. 3084-94.

[3] Brar, N.K., Jason C., Jeffrey, E. and Singh, Y.,"Nitrogen management in wheat sown in rice straw as mulch in North-West India" In Proc: 19th World Congress of Soil Science, Soil Solutions for a Changing world Brisbane., Australia. August1-6, 2010, Published on DVD.

[4] Nguyen, H. V., Nguyen, C. D., Tran, T. V., Han, H. D., Nguyen, N. T. and Gummert, M.,"Energy efficiency, greenhouse gas emissions, and cost of rice straw collection in the Mekong river delta of Vietnam". *Fields crop research*(2016), pp. 16-22.

[5] Jerath, N., Ladhar, S. S. and Singh, G. (2014) "*State of Environment, Punjab"*. Punjab State Council for Science and Technology, Chandigarh, (2014) pp 103-07.

[6] Sidhu, H.S., Singh, M., Blackwell, J., Humphreys, E., Bector, V., Singh, Y., Singh, M. and Singh, S,. "Development of the Happy Seeder for direct drilling into combine harvested rice". In 'Permanent beds for rice-wheat cropping systems and direct drilling into rice residues', ed. by E. Humphreys and C. Roth. ACIAR Proceedings No. 127 (in press),2008.

[7] Sidhu, H.S., Singh, M., Humphreys, E., Singh, Y., Singh, B., Dhillon, S.S., Blackwell J., Bector V., Malkeet-Singh and Sarbjeet-Singh. 2007. The Happy Seeder enables direct drilling of wheat into rice stubble. Australian Journal of Experimental Agriculture 47.

[8] Singh, Y., Sidhu, H.S., Singh, M., Humphreys, E. and Kukal, S.S., 2008. "Straw mulch, irrigation water and fertiliser N management effects on yield, water use and N use efficiency of irrigated wheat sown after rice". In 'Permanent beds for ricewheat cropping systems and direct drilling into rice residues, ed. by E. Humphreys and C. Roth. ACIAR Proceedings No. 127 (in press).

[9] Ndiema, C. K. W., Manga, P. N. and Ruttor, C. R."Densification characteristics of rice straw briquettes". *J of the Energy Inst*. 2002,pp. 11-13.

[10] Zafar, S. (2018) "Rice straw as bioenergy resource". Retrieved on 25th august A018 from https://www.bioenergyconsult.com/rice-straw-as-bioenergy-resource/.