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Commercial Comparison on Use of Paddy Straw: Electricity Generation versus Mulching

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Abstract: Agro-waste has two major utilities; in generation of electricity in agro-waste based thermal plants, and for mulching in the soil at the site of its production. The present paper details the study carried out to compare the electricity produced by burning agro-waste, with electricity/water saved on account of reduced irrigation. This reduction in irrigation is a result of increased moisture retention because of mulching the fields with paddy straw, which happens to be the major agro-waste. Mulching has several other advantages too, namely, zero pollution, easy management, retention of nutrients like nitrogen, phosphorus, sulphur etc., which ultimately increase the fertility and hence the yield of the crop, with much savings on the cost of the fertilizers as well. Even if we do not quantify these benefits in monetary terms, the farmer stands to save a substantial amount of money on account of reduced irrigation alone. The present study concludes this saving to be as high as 45% of what he gets by selling his waste to thermal plants, not considering the other benefits. Mulching, thus emerges as a better alternative of agro-waste utilisation, as compared to electricity generation.

Keywords: Paddy straw, mulching, agro-waste, power generation, water saving.

1. INTRODUCTION

Agro-waste has two major utilities; in generation of electricity in agro-waste based thermal plants, and for mulching in the soil at the site of its production [1]. Mulching means covering of soil. It reduces the irrigation demand as a result of increased moisture retention. Apart from this, mulching has several other advantages too, namely, zero pollution, easy management, retention of nutrients like nitrogen, phosphorus, sulphur etc, which ultimately increase the fertility and hence the yield of the crop, with much savings on the cost of the fertilizers as well [2]. To maximise the benefit from the available agro-waste, the amount of this waste used for mulching needs to be optimised [3]. Even if we do not quantify the benefit of mulching in monetary terms, the farmer stands to save a substantial amount of money on account of reduced irrigation alone.

2. PROBLEM DEFINITION

A study has to be carried out to compare the commercial benefit of selling the paddy straw for electricity production, with that of the electricity saved by mulching same amount of agro-waste in farms.

3. METHOD

For determining the electricity saved by mulching, one of the essential parameters to be determined is the optimised value mulching to be done in the field. This happens to be 9 kg of paddy straw waste in the plot size of 10' by 12' . For this amount of mulching, it is already established that amount water saved for one irrigation is 15.83 litre/kg[3]. The next parameter required is the cost of pumping water. To determine this pumping cost, we took tube well tank measurements and noted the time taken by the pump to fill it. The power consumed by the motor is taken as 9.185 kW.

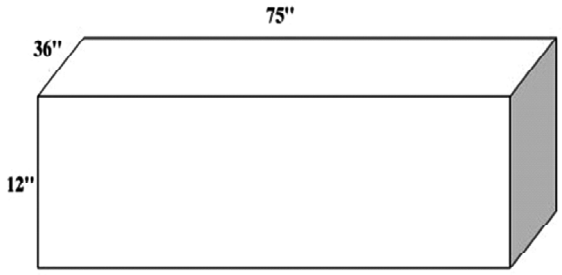

Figure 1: Tube Well Tank Measurements

4. RESULTS AND DISCUSSIONS

From the dimensions of the tube well tank, we get

Volume of tube well = 12'' x 75'' x 36" x 2.5^3 ≈ 5,00,000 cc

≈ **500 Litres**

= **0.5 kilolitre**

1 Kilolitre is equal to Two Tanks

With the help of stop watch we noted the exact time that the submersible motor took to fill the tube-well completely. Time was observed by three watches, to get the accurate time.

Time taken by Submersible motor to pump 500 litres = **36 seconds**

Submersible motor was of 12.5 Hp or we can say 9.185 kW

Electricity consumed in pumping 500 litre of water =

$$\frac{9.185 \times 36}{3600} = \mathbf{0.0919\ kWhr}$$

Electricity consumed to pump 1 kilolitre = 2 x 0.0919 = **0.1838 kWhr**

Electricity is free to agriculture sector, but it costs to government. So base our calculations on domestic electricity per unit cost. i.e. **1 kWhr = Rs. 5.5/-**

Cost to pump 1 kilo litre water = 0.1838 x 5.5 = **Rs. 1.0109/- say Rs. 1/-.**

1 kilolitre costs Rs. 1/- or 1 litre cost 0.1 paise

4.1. Saving of Electricity

One kg of mulching saves 15.83 litre of water per irrigation. The annual saving of water can be determined by assuming one irrigation per month.

Annual saving per kg of mulching = 15.83 x12 = 190 litres

cost of 190 litre of water = 190 x 0.1 =19 paise per kg or say 20 paise

One kg of mulch reduces irrigation cost by 20 paise per annum

Commercial value of paddy straw is Rs. 450 per tonne i.e. 45 paise per kg.

Saving in terms of commercial cost =

$$\frac{\text{cost of saved electricity per kg}}{\text{commercial cost per kg}} = \frac{20}{45} \times 100 = \mathbf{45\%}$$

4.2. Recommendations

This pilot study done for the optimisation of mulching to conserve irrigation water evaporation loss and hence the electricity used for pumping water has the following recommendations for the farmers:

1. Do not burn agricultural residue in open field
2. Do not sell this residue for power generation
3. Use this agro-waste in the same field, in the same amount as produced at the same time and avail the benefits of
   (a) Saving 45% of the commercial cost by way of water irrigation
   (b) Avoiding pollution caused by burning, either in the field or in the power plants
   (c) Avoiding loss of nutrients in the waste
   (d) Decreasing the fertiliser consumption
   (e) Increased yield
   (f) Retention of ever lowering ground water level.

5. CONCLUSION

The present study concludes that the farmer by mulching his fields with paddy straw can save in irrigation cost as high as 45% of what he gets by selling his agro-waste to thermal plants, not considering the other benefits of mulching. Mulching thus emerges as a better alternative of agro-waste utilisation, as compared to electricity generation. The options for the farmers to utilise the agro-waste are concluded in Table 1.

Table 1
Farmer's Options for Paddy Straw Waste

	BURN	*SELL*	*MULCH*
Earning/kg	0	45 paise	20 paise
Labour	nil	high	moderate
Soil fertility	decreases	remains	increases
Pollution	high	moderate	nil
Yield	decreases	remains	increases
Fertiliser	increases	remains	decreases
Recommend	avoid	may	must

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