

Original Research Article

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Cost and Returns of Paddy Crop under Different Residue Management Practices in Tunga Bhadra Command Area of Karnataka (India)

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ABSTRACT

Rice is the most important human food crop in the world, directly feeding more people than any other crop. India is one of the world's largest producers of rice and brown rice, accounting for 20% of all world rice production. Rice is India's pre-eminent crop, and is the staple food of the people of the eastern and southern parts of the country. The India's rice production reached to a record high of 104.32 million tonnes in 2011-2012 crop year. Thunga Bhadra Project (TBP) command area is called as 'Rice Bowl of Karnataka', since nearly 60-65 % of total (3.63 lakh ha) area of paddy in Karnataka is from the TBP command area (it includes the Ballari, Koppal and Raichur districts of Karnataka). The study identified there are four method of paddy residue management practices (a) Removal of straw and burning of stubbles (b) Burning of straw and stubbles (c) Removal of straw and incorporation of stubbles (d) Incorporation of straw and stubbles. It is observed that total variable cost per acre was higher in incorporation of straw and stubbles (₹ 30029.25) followed by removal of straw and burning stubbles (₹ 29345.33) and removal of straw and incorporation stubbles (₹ 29345.33), whereas lowest was recorded in burning of straw and stubbles (₹ 26616.61). In case of total cost per acre the incorporation of straw and stubbles (₹ 41845.65) was recorded highest whereas, burning of straw and stubbles (₹ 38411.33) recorded lowest. The highest yield per acre was recorded in the incorporation of straw and stubbles (29.75q/acre), followed by removal of straw and incorporation stubbles (29.15q/acre) and removal of straw and burning stubbles (28.58q/acre), whereas, burning of straw and stubbles recorded lowest yield of (28.11q/acre).

Keywords

Paddy, Different types of residue and cost of cultivation etc

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Introduction

Rice (*Oryza sativa* L.) is a vital cereal food crop for more than half of the World's population. Among the cereals rice is more nutritious of about 40 per cent of World population consumes as a major source of

calorie. More than 90 per cent of the World's rice is produced and consumed in Asia, where it is an integral part of culture and tradition. The world dedicated 162.3 m ha in 2014 for rice cultivation and the total production was about 738.1 mt. India is the second largest producer after China and has an area of over

43.95 m ha and production of 106.54 mt with productivity of 2424 kg/ha. The total area under rice in Karnataka is 1.29 m ha with an annual production of 3.6 mt and the productivity is 2630 kg /ha during 2014-15. ThungaBhadra Project (TBP) command area is called as 'Rice Bowl of Karnataka', since nearly 60-65 % of total (3.63 lakh ha) area of paddy in Karnataka is from the TBP command area (it includes the Ballari, Koppal and Raichur districts of Karnataka). Rice-rice-wheat, jute-rice-rice, rice-rice or rice-wheat are the most intensive cropping patterns. But the conventional agricultural production practices are comparatively lower-yielding and it seems difficult to change this yield with reachable resources under the prevailing situation. Due to growing repeated cereal crops, soil fertility and crop productivity are reducing over the time. This has occurred through in appropriate management of fertilizers, tillage and crop residues (Singh and Singh, 2001).

Crop residues are the materials left in an agricultural field after the crop harvested. These residues includes stalks, stems, leaves and seed pods. Normally, these are either harvested as fuel, animal bedding or are burnt in the field. As harvest remnants, crop residues play an essential role in nutrient recycling to improve soil quality and ensure higher level of crop productivity. It can be composted by various methods on the farm and used in the field for mulching. Incorporation of crop residues in the field alters the soil environment, which in turn influences the microbial population and activity in soil and subsequent nutrient transformations. The recycling of crop residues has great potential to return a considerable amount of plant nutrients to the soil. Left on the soil surface, crop residue serves as a mulch to decrease soil temperature and maintain higher soil moisture as well as reduce carbon emission in the atmosphere.

Crop residue practice is suggested for the purpose of preserving and enhancing productivity (Wilhelm *et al.*, 2004). It results in substantial saving in irrigation water and fertilizer and thereby improves soil fertility and enhances crop productivity. Maung (2008) performed a case study on economics of biomass fuels for electricity production with crop residue and found that crop residue currently costs much more than coal for electricity generation. Sidhu and Beri (2008) revealed that, incorporation of residue have shown that it improves the physical, chemical and biological properties of the soil, but in long term experiment it has been seen that the increase in the wheat yield ranges from 0 to 0.5 t/ha over the burning year. The study estimated the benefits of rice residue burning in the field. The open burning of crop residue in the field is a human initiated activity for the purpose of preparing the fields for the next crop rapidly and inexpensively. By burning residue in the field, farmers derive specific benefits such as cost- and time-savings. It is also a means to control weeds, diseases and pests. Farmers in the burning group enjoy a yearly net benefit of Tk. 3,240-3,353/acre (or USD 43- 45/acre) on average from residue burning in the field relative to farmers in the non-burning group. Their willingness to accept compensation for giving up the practice of rice residue burning is Tk. 3,355/acre (or USD 45/acre) which is far less than the average market price of residue (at Tk. 6,746/acre or USD 90/acre) (Mohammed, 2013).

The above literature review indicates that most of the studies attempted impact assessment of crop residues on soil health, crop yield and benefits under different residue management practices. Therefore, much work is required to enhance the empirical knowledge regarding present status of rice crop residue practices, cost and returns under different management practices and in order to formulate policy

options. With that view, the specific objectives set for the study are as follows: (i) To estimate the Cost and returns of paddy crop under different residue management practices (ii) To identify the determine in adoption of environment friendly management practices.

Materials and Methods

The study was carried out purposively in Tungabhadra Project (TBP) Command area of Karnataka, since the problem of paddy residue management is severe in this region. The stratified multistage random sampling technique was used for selection of sample farmers from TBP command areas. In the first stage, three districts of TBP area namely Koppal, Ballari, and Raichur were selected. In the second stage, the five taluks namely Gangavati, Siruguppa, Hospet, Sindhanur and Manvi from selected districts were selected based on the location on command area. In the third stage four villages from each taluka were selected based on density of livestock population *i.e.*, two villages having high livestock density and two from low livestock density. The livestock density was estimated from the data and information obtained from veterinary offices of the respective taluks. In the fourth stage five sample farmers from each village were selected. Thus, the total sample size comprised 100 farmers. The data were analyzed by using descriptive statistics and Garrett ranking technique.

Garrett ranking technique

To capture comprehensively the constraints in paddy crop residue management practices, Garrett ranking technique was used. Garrett's ranking technique gives the change in orders of constraints into numerical scores. The major advantage of this technique when compared to simple frequency distribution is that here constraints are arranged based on their importance from the point of view of respondents. Accordingly these ranks

were converted into scores by referring to Garretts table. Garretts formula for converting ranks into per cent was given by $\text{Per cent position} = 100 * (\text{Rij} - 0.50) / \text{Nj}$

Where, Rij= Rank given for ith item jth farming system

Nj= Number of items ranked in jth farming system

The per cent position of each rank was converted to scores by referring to tables given by Garret and Woodworth (1969). Then for each factor the scores of individual respondents were summed up and divided by the total number of respondents for whom scores were gathered. The mean scores for all the factors were ranked.

Results and Discussion

Paddy residue management practices in TBP command area was presented in table 1. In data 48 per cent of the sample farmers were practicing removal of straw and burning stubbles method of residue management with area of 42.25 per cent followed by removal of straw and incorporation stubbles (22.00 % farmers with 23.31 % area), burning of straw and stubbles (19.00 % farmers with 24.53 % area) and incorporation of straw and stubbles (11.00 % of farmers with 9.71% of area).

Where in case of manual harvesting, removal of straw and burning stubbles method of residue management was the leading practice with 57.89 % of farmers and 54.12 % of area followed by burning of straw and stubbles (15.79 % farmers with 18.82 % area), removal of straw and incorporation stubbles (15.79 % farmers with 17.65 % area) and incorporation of straw and stubbles (10.53 % farmers with 9.41% area). Similarly, by mechanical/combine harvesting, removal of straw and burning stubbles method of residue management was the leading practices with 45.68 per cent of farmers and 41.29 per cent

of area followed by removal of straw and incorporation stubbles (23.46 % farmers with 23.87 % area), burning of straw and stubbles (19.75 % farmers with 25.10 % area) and incorporation of straw and stubbles (11.11 % farmers with 9.74 % area).

With regards to the total cost and returns under different residue management, it is observed that total variable cost per acre was higher in incorporation of straw and stubbles (₹ 30029.25) followed by removal of straw and burning stubbles (₹ 29345.33) and removal of straw and incorporation stubbles (₹ 29345.33) in table 2, whereas lowest was recorded in burning of straw and stubbles (₹ 26616.61). For total fixed cost per acre incorporation of straw and stubbles, removal of straw and incorporation stubbles and removal of straw and burning stubbles recorded the cost of ₹ 11816.00, ₹ 11810.40 and ₹ 11799.20 respectively. The lowest of ₹ 11794.72 was observed in burning of straw and stubbles.

In case of total cost per acre the incorporation of straw and stubbles (₹ 41845.65) was recorded highest whereas, burning of straw and stubbles (₹ 38411.33) recorded lowest. The removal of straw and burning stubbles and removal of straw and incorporation stubbles recorded cost of ₹ 41405.46 and ₹ 41155.73, respectively. The highest yield per acre was recorded in the incorporation of straw and stubbles (29.75q/acre), followed by removal of straw and incorporation stubbles (29.15q/acre) and removal of straw and burning stubbles (28.58q/acre), whereas, burning of straw and stubbles recorded lowest yield of (28.11q/acre). Return per rupee of spent was slightly higher in farmers practicing removal of straw and burning stubbles (1.30) followed by removal of straw and incorporation stubbles (1.27) method of paddy residue management practices, compared to burning of straw and stubbles (1.23) and incorporation of straw and stubbles (1.20) were presented in Figure 1.

Table.1 Identification of paddy residue management practices in Tungta Bhadra Project (TBP) command area (2015-16)

Sl. No.	Practices	Manual		Combine harvester		Total	
		No. of farmers	Area (acre)	No. of farmers	Area (acre)	No. of farmers	Area (acre)
1	RS & BS	11.00 (57.89)	92.00 (54.12)	37.00 (45.68)	704.00 (41.29)	48.00 (48.00)	796.00 (42.45)
2	BS & S	3.00 (15.79)	32.00 (18.82)	16.00 (19.75)	428.00 (25.10)	19.00 (19.00)	460.00 (24.53)
3	RS & IS	3.00 (15.79)	30.00 (17.65)	19.00 (23.46)	407.00 (23.87)	22.00 (22.00)	437.00 (23.31)
4	IS & S	2.00 (10.53)	16.00 (9.41)	9.00 (11.11)	166.00 (9.74)	11.00 (11.00)	182.00 (9.71)
	Overall	19.00 (100.00)	170.00 (100.00)	81.00 (100.00)	1705.00 (100.00)	100.00 (100.00)	1875.00 (100.00)

Note: Figures in the parentheses indicate percentages to the column sample total

- i) **RS & BS:** Removal of straw and burning of stubble
- ii) **BS & S:** Burning of straw and stubble
- iii) **RS & IS:** Removal of straw and incorporation of stubble
- iv) **IS & S:** Incorporation of straw and stubble

Table.2 Cost and returns structure of paddy under different residue management practice in TBP command area

Sl. No.	Particulars	(₹/acre)			
		RS & BS	BS & S	RS & IS	IS & S
I	Total Variable Cost (₹)	29606	26617	29345	30030
Ii	Total Fixed Cost (₹)	11799	11795	11810	11816
Iii	Total Cost (₹)	41405	38411	41156	41846
Iv	Main product (q)	28.58	28.11	29.15	29.75
V	By- product value (₹)	5250	-	3200	-
Vi	Gross Return (₹)	53761	46743	52111	50201
Vii	Net Return (₹)	12356	8332	10955	8355
viii	Returns per rupee of investment	1.30	1.23	1.27	1.20

Note: i) **RS & BS:** Removal of straw and burning of stubble
 ii) **BS & S:** Burning of straw and stubble
 iii) **RS & IS:** Removal of straw and incorporation of stubble
 iv) **IS & S:** Incorporation of straw and stubble

Table.3 Constraints for non-adoption of environment friendly paddy residue management practices in TBP command area

Sl. no.	Reasons	n=100	
		Garret Score	Rank
1	Lack of technical knowledge about residue management	42.81	V
2	Unwilling to put extra effort for a composting straw	37.98	VIII
3	Non availability of custom hire service especially reaping binder	34.89	VII
4	High cost of residue management compare to burning	55.39	IV
5	Inadequate size of landholdings for adoption EFMP	39.62	VI
6	Land leveling problem after residue incorporation	57.06	III
7	Available short time between <i>kharif</i> paddy harvesting (late October and early November) and sowing of <i>Rabi</i> paddy	71.66	I
8	Scarcity of labour for residue collection after use of combine harvesters	57.59	II

In overall the total variable cost per acre was (₹ 26895.34), total fixed cost per acre (₹ 11805.08), total cost per acre (₹ 38700.42), yield (28.86q/acre), returns per rupee of investment (1.25)

Some of limitation associated with adaption of environment friendly paddy crop residue management practices system expressed by the farmers was presented in the Table 3. The results of observed that major constraints faced by the respondent farmers, among this availability short time between *kharif* paddy harvesting (late October and early November) and sowing of *rabi* paddy was identified as major constraints and it stands Rank- I (71.66 mean Garret score) followed by scarcity of labour for residue collection after use of combined harvesters Rank - II (57.59), land leveling problem after residue incorporation Rank - III (57.06), high cost of residue management compared to burning Rank - IV (55.39), lack of technical knowledge about residue management Rank -V (42.81), inadequate size of landholdings for adoption environment friendly management practices (EFMP) Rank - VI (39.62) and unwilling to put extra effort for a composting straw Rank - VII (37.89) non availability of custom hire service especially reaping binder Rank - VIII (34.89).

Similar results were reported by Rosmiza *et al.*, (2014) that farmers had a low level of knowledge towards the range of possible rice straw-uses. Results show that several factors are influencing the stagnation of better straw-utilisation. It includes weather (humidity and rain); incentives that are not commensurate to farmers; inefficient straw collection technology; lack of logistic facilities such as baler machines, storage and transportation; low level of skills and knowledge of farmers; inefficient management from agricultural agencies; and lack of capital to manage straw in their fields. They often had a lack of

information on how straw development could offer more benefits to their further socio-economic development. This seems to be due to a weakness of agricultural extension delivery systems and information technology.

It is concluded that, in TBP command area 81 per cent of farmers harvest paddy crop using the machine (*i.e.* combine harvesters). Majority of farmers are practicing removal of straw and burning of stubble (42.45 %) in TBP command area. The major factors which influence the decision to burn paddy crop residue are the use of combined harvesters and scarcity of labour for collection of residue. Total cost of cultivation of paddy per acre was found to be marginally lower in farmers practicing residue management by burning of straw and stubbles method as compared (₹ 38411) to incorporating straw and stubbles (₹ 41846). Returns per rupee of investment was moderately higher in case of farmers practicing residue management by removal of straw and burning of stubbles (1.30), compared to incorporating straw and stubbles (1.20) in the TBP command area.

It was found that, higher cost for collection of residues compared to burning, to overcome this Govt. should provide subsidize equipment/machines required for the making the paddy residue into bales using reaper binder and transport it to fodder scarcity areas. In this connection, the Government could promote the reaper binder by at subsidized price. It helps reduce the cost of collection of residue left over after the harvest and also reduce air pollution.

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