International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(6): 2652-2655

Received: 03-09-2019
Accepted: 06-10-2019

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An economic analysis of production and its utilization of biomass of wheat crop in Rajnandgaon District of Chhattisgarh State

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Abstract
The present study is based on economic analysis of production and its utilization of crop residues of wheat with the objective to work out the production and its utilization of crop residues of wheat in the study area. The present study was conducted in Rajnandgaon district of Chhattisgarh, India. Out of 10 blocks in the district, three blocks namely, Rajnandgaon, Khairagarh and Chhuikhadan, was selected purposively for the study. Each selected blocks, 2-3 per cent of villages was selected purposively and the total 300 respondents were selected purposively for the study. The primary data were collected for year 2017-18. The major findings of this study revealed that on an average the per hectare cost of cultivation of wheat was calculated as Rs. 26919.85, on an average yield of paddy was observed 24.77 quintals and average cost of production per quintal of paddy is (Rs. 1086.81). The input-output ratio of paddy was (1:1.60). The total overall yield of mechanically and manually harvested wheat straw was estimated to be 5.11 (17.13%) and 24.75 (82.87) quintal per hectare respectively. The overall average wheat straw was used in various forms observed that fodder (72.49%), littering material (3.27%), collected by others (7.64%), sold (5.86%), burned (8.77%) and other purpose (1.96%) respectively.

Keywords: Wheat, economic analysis, cost of cultivation, gross return, biomass production, utilization

Introduction
Wheat (*Triticum aestivum* L.) is one of the principal cereal crops grown worldwide and one of the important staples of nearly 2.5 billion of world population. Wheat is the important crop of Chhattisgarh region and crop grown in nearly 44million ha of land in the country with the productivity of 2.2 t/ha which is less than the productivity of many countries. Annual population growth rate of the country is nearly 1.8%and if per capita consumption of wheat is expected to be 400-410 gm of wheat per day then the demand for wheat in 2025 will be 130 m. tonnes. In Chhattisgarh, wheat occupies average of 3.6 million ha. With the productivity of the state ranging between 1.2 to 1.6 t/ha depending upon the rainfall. The present study is, therefore, an attempt in the analysis of production behavior of wheat crops of Chhattisgarh on the aspects of various components which is responsible for change in instability in crop production indifferent district of Chhattisgarh over the past several years. Wheat straw, a by-product obtained after harvesting of wheat grains, has an annual global production of 529 million tons (Govumoni *et al*., 2013) [5].Wheat straw is the second most abundant lingo cellulosic raw material in the world (Pensupa *et al*. 2013) [6]. The international grain council forecasted the annual world wheat production of 754 million tons in 2016 (ICG 2017) with a straw to grain ratio of 1.3 (for most wheat varieties). Surplus amount of straw has resulted in environmental and public health concerns attributing to the inefficiency of the conventional straw disposal or utilization methods. Currently, wheat straw is used as animal feed, as supporting materials (Panthapulakkal *et al*. 2006) [7].Traditionally farmers have harvested grain and burnt or otherwise disposed of straw and other residues. The marketability of crop residues will boost local economies by providing jobs and services. An increase in farm earnings will diminish the need for farm subsidies, which will eventually reduce farmer's reliance on the government for support. For industry, 4 kg of crop residues could replace the one liter of furnace oil.

Materials and Methods
Selection of area
Ten blocks from Rajnandgaon district *viz*., namely; Rajnandgaon, Khairagarh and

Chhuikhadan blocks were selected purposively and each selected blocks, 2-3 per cent of villages were selected purposively and the total 300 respondents was selected purposively for the study.

Collection of data
The study was based on primary data collected from Rajnandgaon district.

Primary data
The primary data on inputs used and yield obtained from wheat were collected from selected farmers by survey method. In all 300 farmers were selected for the study. The data pertain to the year 2017-18. The selected farmers were stratified into three groups on the basis of size of holdings *viz*., marginal farmers (i.e. 83) with the size of holding (less than 0.01 ha), small farmers (i.e. 116) with (0.01 ha to 2.00 ha), medium farmers (i.e. 77) with (2.01 to 4.00 ha) and large farmers (i.e. 24) (4.01 ha and above).

Economics of wheat production
Economics of wheat production was worked out by using standard cost concepts as per CACP will be adopted which includes cost A, cost B and cost C.

Cost A1
i. Value if hired human labour.
ii. Value of hired bullock labour.
iii. Value of owned bullock labour.
iv. Value of owned machinery labour.
v. Hired Machinery Charges.
vi. Value of seed (both farm produced and purchase).
vii. Value of insecticides and pesticides.
viii. Value of manure (owned and purchase)
ix. Value of fertilizer.
x. Depreciation on implements and farm buildings.
xi. Irrigation charges.
xii. Land revenue, cesses and other taxes.
xiii. Interest on working capital.
xiv. Miscellaneous expenses (Artisans etc.).

Cost A2: Cost A1 +rent paid for leased in land

Cost B1: Cost A1 +interest on value of owned fixed capital assets (excluding land).

Cost B2: Cost B1 +rental value of owned land (net of land revenue) and rent paid for leased-in land.

Cost C1: Cost B1 +imputed value of family labour

Cost C2: Cost B2 +imputed value of family labour

Cost C2*: Cost C2 adjusted to take into account valuation of human labour at market rate or statutory minimum wage rate whichever is higher.

Cost C3: Cost C2* +value of management input at 10 percent of total cost (C2*).

- **Interest on working capital:** It was calculated @4% per annum for half of the crop period.
- **Interest on fixed capital:** It was calculated @10% per annum for the crop period.
- **Rental value of owned land:** It was calculated based on the prevailing rates in the sampling villages.
- **Depreciation:** It presents the value by which a farm resource decreased in value as a result of cause other than a change in general price of the item. Straight line method was used for calculating the depreciation:

$$\text{Depreciation} = \frac{\text{Purchase value of asset-junk value}}{\text{No. of useful years of life (expected life)}}$$

Gross and net return
Gross return: Return obtained from the sale of crop output i.e. main products and by product.

Net return
Net return was computed at different cost concepts i.e. Cost A, cost B and Cost C by deducting respective costs from the gross returns.

Input output ratio
The input-output relationship was work out on the basis of standard cost concepts.
Input-Output ratio at Cost 'A', Cost 'B', Cost 'C':

$$\text{Input-Output Ratio: } \frac{\text{Gross Return}}{\text{Respective costs}}$$

Estimation of biomass production
For the estimation of biomass, yield is taken in quintal per hectare and area in hectare. The following formula will be used to compute the yield of biomass per hectare and then extrapolated at the state level using secondary data on area under particular crop.

$$\text{Biomass Yield } (qha^{-1}) = \frac{MEH \times Ae + MH \times Ah}{\text{Total Area (ha)}}$$

MEH = Yield of mechanically harvested crop (qha^{-1})
MH = Yield of manually harvested crop (qha^{-1})
Ae = Area harvested mechanically (ha)
Ah = Area harvested manually (ha)

Result and data analysis
The results obtained from the present investigation as well as relevant discussion have been summarized under following heads

Cost of cultivation of wheat
The economics of cultivation of wheat grown in the study area. Per hectare item wise cost for wheat production worked out and presented in Table 1. It could be seen from Table 1 that the per hectare total cost of cultivation of wheat for the sample as a whole was Rs. 26919.85. Among the different items of expenditure human labour accounted highest share of the total Cost i.e. (17.82%). The proportion of other item of expenditure were bullock and machinery labour (15.78%), seeds (2.55%), manure and fertilizer (11.67%) and interest on working capital (0.97%) and fixed capital (1.99%), respectively. The proportion of expenditure on irrigation was (5.46%). The proportion of expenditure on rental value of land (39.00%) which was highest share of total cost of cultivation. The per hectare total cost of cultivation i.e. Cost 'C' ranges from Rs. 23627.15 in marginal farms to Rs. 27738.85 in small farms to Rs. 28398.95 in medium farms to Rs. 29603.16 in large farms. Higher total cost on large size

farm was obviously due to higher use of inputs. Cost of cultivation showed increasing trend from marginal to large farmers.

Economic production of wheat

The yield, value of output per hectare and cost of production per quintal of wheat on the sample farms have been worked out in Table 2 and Figure 1. It indicates that the average yield per hectare of wheat came to 24.77 qtl./ha. and where higher yield was found at large farms (27.87 qtl./ha.) and the lowest was observed at marginal farms (22.75 qtl./ha.). The average gross return estimated was Rs. 42975.08/ha. Which varies from Rs. 39471.25/ha. at marginal farms and Rs. 48354.45/ha. at large farms. The average net return was calculated as Rs. 16055.23/ha. Which was higher at large farms (Rs. 18751.29/ha.), followed by medium farms (Rs. 16988.65/ha.). The average input-output ration of paddy was worked out to 1:1.60.

Table 1: Input wise cost of cultivation of wheat on the sampled farm (Rs. /ha.)

S. No.	Particulars	Marginal	Small	Medium	Large	Overall
A	**Input Cost**					
1	**Human labour**					
	a) Family	3508.41 (14.85)	2735.42 (9.86)	1735.65 (6.11)	1101.32 (3.72)	2561.94 (9.52)
	b) Hired	1242.12 (5.26)	2134.25 (7.69)	3012.31 (10.61)	3675.39 (12.42)	2236.09 (8.31)
	Total human labour	4750.53 (20.11)	4869.67 (17.56)	4747.96 (16.72)	4776.71 (16.14)	4798.03 (17.82)
2	**Bullock and Machinery**					
	a) Family	432.12 (1.83)	463.24 (1.67))	454.85 (1.60)	461.25 (1.56)	452.32 (1.68)
	b) Hired	2914.35 (12.33)	4232.52 (15.26)	3965.78 (13.96)	4182.32 (14.13)	3795.35 (14.10)
	Total Machine and Bullock Labour	3346.47 (14.16)	4695.76 (16.93)	4420.63 (15.57)	4643.57 (15.69)	4247.66 (15.78)
3	Total labour Cost	8097.00 (34.27)	9565.43 (34.48)	9168.59 (32.28)	9420.28 (31.82)	9045.70 (33.60)
4	Seed cost	601.21 (2.54)	671.42 (2.42)	743.74 (2.62)	874.35 (2.95)	686.79 (2.55)
5	Manure & Fertilizers	1534.21 (6.49)	3524.32 (12.71)	3865.35 (13.61)	4515.74 (15.25)	3140.57 (11.67)
6	Plant protection	1215.41 (5.14)	1282.34 (4.62)	1278.46 (4.50)	1281.87 (4.33)	1262.79 (4.69)
	Total material cost	3170.83 (13.42)	5308.08 (19.14)	5687.55 (20.03)	6471.96 (21.86)	4907.28 (18.23)
7	Irrigation charges	984.12 (4.17)	1351.25 (4.87)	1976.35 (6.96)	2104.12 (7.11)	1470.35 (5.46)
8	Interest on working capital @4%	178.16 (0.75)	273.90 (0.99)	306.42 (1.08)	342.47 (1.16)	261.24 (0.97)
	Sub total	12430.11 (52.61)	16498.66 (59.48)	17138.91 (60.35)	18338.83 (61.95)	15684.57 (58.26)
B	**Fixed Cost**					
9	Land Revenue	10 (0.04)	10 (0.04)	10 (0.04)	10 (0.04)	10 (0.04)
10	Interest on Fixed Capital @10% per annum	532.72 (2.25)	534.77 (1.93)	535.72 (1.89)	535.92 (1.81)	534.54 (1.99)
11	Depreciation on implements	154.32 (0.65)	195.42 (0.70)	214.32 (0.75)	218.41 (0.74)	190.74 (0.71)
12	Rental value of land	10500 (44.44)	10500 (37.85)	10500 (36.97)	10500 (35.47)	10500 (39.00)
	Sub total	11197.04 (47.39)	11240.19 (40.52)	11260.04 (39.65)	11264.33 (38.05)	11235.28 (41.74)
C	**Total Cost (A+B)**	23627.15 (100.00)	27738.85 (100.00)	28398.95 (100.00)	29603.16 (100.00)	26919.85 (100.00)

Note: Figures in the parentheses indicate percentage to the total cost of cultivation.

Table 2: Yield, cost and return of wheat on the sample farms (Rs./ha)

S. No.	Particulars	Marginal	Small	Medium	Large	Average
1	Total cost (Rs.)	23627.15	27738.85	28398.95	29603.16	26919.85
2	Yield (Qtl)	22.75	24.65	26.16	27.87	24.77
3	Gross return (Rs.)	39471.25	42767.75	45387.6	48354.45	42975.08
4	Net return (Rs.)	15844.1	15028.9	16988.65	18751.29	16055.23
5	Cost of production (Rs./qtl)	1038.56	1125.31	1085.59	1062.19	1086.81
6	Input-Output ratio	1:1.67	1:1.54	1:1.60	1:1.63	1:1.60

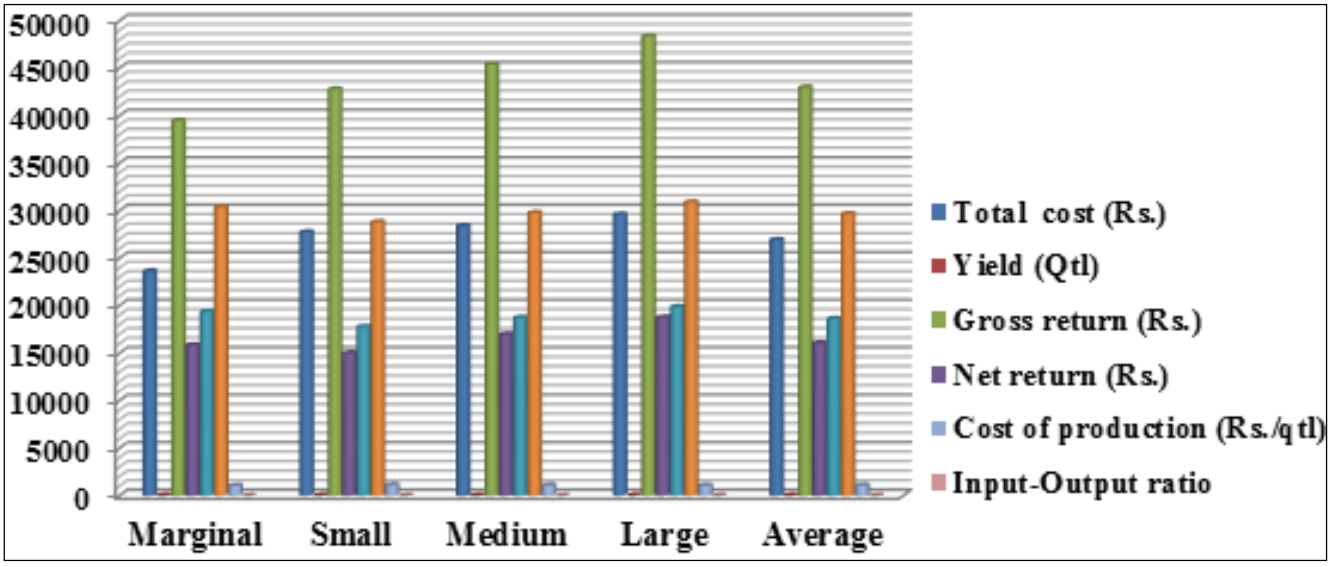

Fig 1: Yield, cost and return of wheat on the sample farms (Rs./ha)

Yield of biomass from mechanically and manually harvested Wheat

The perusal of Table 3 revealed that the total overall yield of mechanically and manually harvested wheat straw was estimated to be 5.11 and 24.75 quintal per hectare in 2017-18. It was found that the overall yield of biomass from mechanically harvested wheat crop was estimated to be 5.11 (17.13%) quintals per hectare. The farm wise analysis show that the yield of mechanically generated wheat straw was 1.35 (4.99%), 3.85 (13.02%), 9.25 (28.99%), and 10.97 (32%) quintals per hectare in marginal, small, medium and large farms. It was found that the overall yield of biomass from manually harvested wheat crop was estimated to be 24.75 (82.87%) quintals per hectare 2017-18. The farm-wise analysis shows that the yield of manually generated wheat straw was 25.72 (95.01%), 25.73 (86.98%), 22.66 (71.01%), and 23.31 (68%) quintals per hectare in marginal, small, medium and large farms respectively.

Table 3: Yield of biomass from mechanically and manually harvested wheat crop under different farm size groups (Q./ha)

S. No.	Particulars	Area harvested (ha)			Yield (Q./ha)		
		Mechanically	Manually	Total	Mechanically	Manually	Total
1	Marginal	0.02 (18.18)	0.09 (81.82)	0.11 (100.00)	1.35 (4.99)	25.72 (95.01)	27.07 (100.00)
2	Small	0.05 (31.25)	0.11 (68.72)	0.16 (100.00)	3.85 (13.02)	25.73 (86.98)	29.58 (100.00)
3	Medium	0.08 (27.59)	0.21 (72.41)	0.29 (100.00)	9.25 (28.99)	22.66 (71.01)	31.91 (100.00)
4	Large	0.16 (38.10)	0.26 (61.90)	0.42 (100.00)	10.97 (32.00)	23.31 (68.00)	34.28 (100.00)
5	Overall	0.05 (25.00)	0.15 (75.00)	0.20 (100.00)	5.11 (17.13)	24.75 (82.87)	29.86 (100.00)

Note: Figures in the parenthesis indicate percentage of the total.

Utilization pattern of wheat straw

The results presented in Table 4 revealed that the wheat biomass in Rajnandgaon is used in various forms such as fodder, littering material, etc. It was observed that 72.49% of wheat straw was used as fodder at the overall level. In Table 4.37 farm-wise analysis shows that the 87.99%, 76.30%, 61.02% and 54.00% of wheat straw was used as fodder in marginal, small, medium and large farms respectively. The quantity of biomass used for littering material was estimated to be 3.27% in the overall level. The farm-wise analysis shows that 1.99%, 2.68%, 5.01% and 3.18% of wheat straw was used as a littering material by the respondents in marginal, small, medium and large farms respectively".

The results further show that the overall level, 5.86% of the wheat straw was disposed of in 2017-18. The farm-wise analysis shows that 2.03%, 7.51%, 5.99% and 7.00% of farmers sold their wheat straw/husk in the above said farms respectively. The results further revealed that 7.64% quintals of biomass of the wheat straw was collected by the labour and others to clear the fields. The overall level, 1.01% quintals per hectare biomass of wheat used for other purpose in 2017-18. It was found that 2.99%, 7.12%, and 11% and 13.01% quintals per hectare of wheat straw was collected by others by the respondents in marginal, small, medium and large farms respectively.

The results presented in table 4 revealed that at the overall 8.77% of the quintals per hectare of wheat stubble was burned in 2017-18. The farm-wise analysis show that 3.99%, 5.22%, 13.48% and 19.43% quintals per hectare of wheat stubble was burned by the respondents in marginal, small, medium and large farms respectively. The overall level, 1.96% quintal per hectare biomass of wheat used for other purpose in 2017-18.

Table 4: Utilization pattern of wheat straw at the sampled household (Q/ha)

S. No.	Particulars	Marginal	Small	Medium	Large	Overall
1	Fodder	23.82 (87.99)	22.18 (76.30)	19.47 (61.02)	18.51 (54.00)	21.64 (72.49)
2	Littering material	0.54 (1.99)	0.85 (2.68)	1.6 (5.01)	1.09 (3.18)	0.98 (3.27)
3	Collected by the labour	0.81 (2.99)	2.07 (7.12)	3.51 (11.00)	4.46 (13.01)	2.28 (7.64)
4	Sold	0.55 (2.03)	2.37 (7.51)	1.91 (5.99)	2.4 (7.00)	1.75 (5.86)
5	Burned	1.08 (3.99)	1.77 (5.22)	4.3 (13.48)	6.66 (19.43)	2.62 (8.77)
6	Others	0.27 (1.00)	0.34 (1.17)	1.12 (3.51)	1.16 (3.38)	0.59 (1.96)
	Total	27.07 (100.00)	29.58 (100.00)	31.91 (100.00)	34.28 (100.00)	29.86 (100.00)

Note: Figures in the parenthesis indicate percentage of the total.

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