



AN ECONOMIC ANALYSIS AND CONSUMPTION PATTERN OF AGROCHEMICALS IN PADDY CULTIVATION IN BASTAR PLATEAU OF CHHATTISGARH, INDIA

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Abstract

The present study is based on economic analysis of paddy production with the objective to work out the consumption pattern of agrochemicals, cost and returns of *kharif* paddy in the study area. The present study was conducted in Bastar plateau of Chhattisgarh, India. Out of seven blocks in the district, two blocks, namely Jagdalpur and Bastar were selected randomly for the study. Five villages were selected from each of the two blocks and ten respondents were selected from each village. In all, 10 numbers of villages and 100 respondents were selected for the study. The primary data were collected for year 2014-15. The major findings of this study revealed that on an average, the consumption of agrochemicals of *kharif* paddy (variety-Arize 6444) was calculated as use of insecticide was higher in case of Imidacloprid 17.8% SL (-24.18 per cent) followed by Chlorpyrifos 50% + Cypermethrin 5% EC (-72.97) and lowest in Deltamethrin 1% + Triazophos 35% EC (-91.04 per cent), herbicide gap was higher in case of Oxadiazil (-23.84 per cent) followed by Pyrazosulphuran + Ethyl 10% WP (-41.40) and lowest in Pendimethylene (-81.40 per cent), fungicide was higher in case of Propiconazole 25% EC (-35.18 per cent) followed by Tricyclazole (-69.60) and lowest in Carbendazim 12% + Mancozeb 63% WP (-79.40 per cent) and fertilizers gap was higher in case of nitrogen (-18.05 per cent) followed by phosphorus (22.31 per cent) and potash (-37.06 per cent). Overall, on an average the per hectare cost of cultivation of *kharif* paddy (variety- Arize 6444) was calculated as Rs. 36095.93, on an average yield of *kharif* paddy was observed for (variety- Arize 6444) 41.37 quintals and average cost of production per quintal of *kharif* paddy in variety- Arize 6444 (Rs. 871.61). The input-output ratio was *kharif* paddy was variety-Arize 6444 (1:1.73).

Key words : Paddy, economic analysis, input wise cost of cultivation, net rupees per rupee of investment, cost concepts, measures of farm profit.

Introduction

Paddy is the most important and extensively grown food crop in the World. It is the staple food of more than 60 per cent of the world population. Paddy is mainly produced and consumed in the Asian region. India has the largest area under paddy in the world and ranks second in the production after China. Country has also emerged as a major rice consumer. Rice is primarily a high energy calorie food. The by-products of paddy are also used for preparing various industrial products especially in textile industries as it contains good amount of starch. The straw of paddy is used for packing. It is a good source of fodder and may be used as litter. Rice bran is a source of edible oil. The bran is also used in manufacturing cardboard. Looking to the importance of

the crop, it is required to increase the production of paddy and mere attaining the level of food requirement of population is not sufficient because India is already importing pulses and oilseeds from other countries, so we will have to produce that quantity of cereals, which can be exported after meeting the requirement of the domestic population. This will compensate with the cost incurred for the import of other crops and provide strength to Indian economy.

Materials and Methods

Primary data was collected for the year 2014-15. Multi-stage sampling design was adopted for the ultimate selection of paddy growing farmers. The Chhattisgarh is divided into 3 agro-climatic zones and Bastar district was randomly selected from selected Bastar plateau of Chhattisgarh, India. Two blocks Jagdalpur and Bastar

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Table 1 : Insecticide quantity used in paddy for different varieties during *kharif* season (a.i.per/ha).

S. no.	Name of insecticide	Recommended Dose	Name of insect	Insecticide quantity used in different varieties during <i>kharif</i> season (per/ha)					
				Arize-6444	MTU-1010	MTU-1001	Karma Masuri	Safri	Overall
1.	Acephate 75% SP	337.50 gm a.i./ha	Cutworm, stemborer	78.34	122.47	126.84	113.21	16.52	91.47
	Gap			-259.16	-215.03	-210.66	-224.29	-320.98	-246.03
	Gap %			-76.78	-63.71	-62.42	-66.45	-95.11	-72.89
2.	Chlorpyrifos 50% + Cypermethrin 5% EC	550 ml a.i./ha	Leaf folder	148.64	152.44	159.87	144.28	112.34	143.52
	Gap			-401.36	-397.56	-390.13	-405.72	-437.66	-406.48
	Gap %			-72.97	-72.28	-70.93	-73.76	-79.57	-73.91
3.	Imidacloprid 17.8% SL	22.25 ml a. i./ha	Aphid	16.87	18.11	19.54	17.64	15.47	17.53
	Gap			-5.38	-4.14	-2.71	-4.61	-6.78	-4.72
	Gap %			-24.18	-18.61	-12.18	-20.72	-30.47	-21.21
4.	Chlorpyrifos 20% EC	510 gm a.i./ha	Stemborer, Gallmidge	95.34	110.21	115.45	85.24	64.25	94.09
	Gap			-414.66	-399.79	-394.55	-424.76	-445.75	-415.91
	Gap %			-81.31	-78.39	-77.36	-83.28	-87.40	-81.55
5.	Deltamethrin 1% + Triazophos 35% EC	432 ml a.i./ha	Aphid, Cutworm	38.71	42.34	43.51	36.84	10.24	34.33
	Gap			-393.29	-389.66	-388.49	-395.16	-421.76	-397.67
	Gap %			-91.04	-90.19	-89.93	-97.47	-97.63	-92.05

Source: Improved cultivation practices for Dry land crops in Bastar plateau Agro-climatic Zone of C.G. (IGKV/Pub./T.bl./2014/18)

were randomly selected from bastar district and a total of 100 farmers were interviewed. The zone was the first stage, district was the second stage, blocks were the third stage and villages were the fourth stage. Households of farm categories were the ultimate stage. To estimate the consumption of agrochemicals in *kharif* paddy (variety-Arize 6444) and cost of cultivation of *kharif* paddy (Variety- Arize 6444) slanted method was adopted which include cost A_1 , A_2 , B_1 and Cost C. Total cost of cultivation is calculated separately for the different category of farmers as well as for overall farmers collectively. Both, variable and fixed cost is included for the calculation of cost of cultivation.

Interest on capital

It was calculated at the rate of 4 per cent per annum for half of the crop period for working capital and 7 per cent per annum for the crop period in case of fixed capital.

Rental value of owned land

It was calculated based on the prevailing rates in the sampling villages.

Depreciation

It represents 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:

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

Input output ratio

It is ratio between input and output and computed by dividing value of total output by value of total input.

$$\text{Input output ratio} = O/I$$

Where,

I = Total input and

O = Total output

Table 2 : Herbicide quantity used in different varieties during *kharif* season (a.i. per ha).

S. no.	Name of insecticide	Recommended dose	Name of weeds	Insecticide quantity used in different varieties during <i>kharif</i> season (per/ha)					
				Arize-6444	MTU-1010	MTU-1001	Karma Masuri	Safri	Overall
1.	Oxadiazil	90 gm a.i./ha	Gengarva, Narjava	68.54	66.14	71.36	67.81	64.35	67.64
	Gap			-21.46	-23.86	-18.64	-22.19	-25.65	-22.36
	Gap%			-23.84	-26.51	-20.71	-24.65	-28.5	-24.84
2.	Pyrozosulphuran + Ethyl 10% WP	25 gm a.i./ha	Sanwa, Motha, Chunchuniya, Jalkumbhi, Tinpatiya	14.65	16.54	18.12	15.47	13.22	15.60
	Gap			-10.35	-8.46	-6.88	-9.53	-11.78	-9.40
	Gap %			-41.40	-33.84	-27.52	-38.12	-47.12	-37.60
3.	Butachlore	1250gm a.i./ha	Narrow leaf-Sanva, Wild, Kodo, Motha, Bhengra	587.58	598.17	612.32	581.65	577.47	591.44
	Gap			-662.42	-651.83	-637.68	-668.35	-672.53	-658.56
	Gap %			-52.99	-52.15	-51.01	-53.47	-53.80	-52.68
4.	Pendimethylene-	1000 gm a.i./ha	Sanwa, Choti dudhi, Jangli chaulai	185.98	187.45	192.85	184.68	181.14	186.42
	Gap			-814.02	-812.55	-807.15	-815.32	-818.86	-813.58
	Gap%			-81.40	-81.25	-80.72	-81.53	-81.88	-81.36
5.	Ethoxysulfuran (15 WDG)	15 gm a.i./ha	Narjava, Motha, kaonwakaini, Chunchuniya	5.72	7.86	8.56	6.78	4.98	6.78
	Gap			-9.28	-7.14	-6.44	-8.22	-10.02	-8.22
	Gap %			-61.86	-47.60	-42.93	-54.08	-66.80	-54.80
6.	Chlormuron 10% + Metasulfuron	4 gm a.i./ha	Jalkumbhi, Motha, Narjava, Bhengra	1.22	1.24	1.35	1.19	1.12	1.23
	Gap			-2.78	-2.76	-2.65	-2.81	-2.88	-2.77
	Gap%			-69.50	-69.00	-66.25	-70.25	-72.00	-69.25
7.	2,4-D	625 gm a.i./ha	Motha, Jalkumbhi, Bhengra, Gokhru	168.89	171.65	176.12	167.24	165.14	169.81
	Gap			-456.11	-453.35	-448.88	-457.76	-459.86	-455.19
	Gap %			-72.97	-72.54	-71.82	-73.24	-73.57	-72.83

Source: Improved cultivation practices for Dry land crops in Bastar plateau Agro-climatic Zone of C.G. (IGKV/Pub./T.bl./2014/18).

Results and Discussion

Consumption of agrochemicals in *kharif* paddy (Variety- Arize 6444)

The consumption of agrochemicals in cultivation of *kharif* paddy (variety-Arize 6444) grown in the study area (tables 1, 2, 3 and 4) shows use of insecticide in *kharif* paddy was higher in case of Imidacloprid 17.8%

SL (-24.18 per cent) followed by Chlorpyrifos 50% + Cypermethrin 5% EC (-72.97) and lowest in Deltamethrin 1% + Triazophos 35% EC (-91.04 per cent), use of herbicide in *kharif* paddy gap was higher in case of Oxadiazil (-23.84 per cent) followed by Pyrozosulphuran + Ethyl 10% WP (-41.40) and lowest in Pendimethylene (-81.40 per cent), use of fungicide in *kharif* paddy was

Table 3 : Fungicide quantity used in different varieties during *kharif* season (a.i.per/ha).

S.no.	Name of fungicide	Recommended dose	Name of diseases	Fungicide quantity used in different varieties during <i>kharif</i> season (per/ha)					
				Arize-6444	MTU-1010	MTU-1001	Karma Masuri	Safri	Overall
1.	Hexaconazol 5% EC	75ml a.i./ha	Blast and Sheath blight	20.65	23.51	25.11	27.51	24.17	24.19
	Gap			-54.35	-51.49	-49.89	-47.49	-50.83	-50.81
	Gap %			-72.46	-68.65	-66.52	-63.32	-67.77	-67.75
2.	Propiconazole 25% EC	125ml a.i./ha	Sheath rot	80.64	82.27	84.15	85.78	78.31	82.23
	Gap			-44.36	-42.73	-40.85	-39.22	-46.69	-42.77
	Gap %			-35.48	-34.18	-32.68	-31.37	-37.35	-34.21
3.	Tricyclazole	15 gm a.i./ha	Blast	4.56	5.98	7.68	6.87	3.85	5.78
	Gap			-10.44	-9.02	-7.32	-8.13	-11.15	-9.22
	Gap %			-69.60	-60.13	-48.80	-54.20	-74.33	-61.46
4.	Carbendazim 12% + Mancozeb 63% WP	562.50gm a.i./ha	Blast, Brownspot, Sheath blight, false smut	115.86	121.54	124.65	126.47	123.10	122.33
	Gap			-446.64	-440.96	-437.85	-436.03	-439.40	-440.17
	Gap %			-79.40	-78.39	-77.84	-77.52	-78.12	-78.25

Source- Improved cultivation practices for Dry land crops in Bastar plateau Agro-climatic Zone of C.G. (IGKV/Pub./T.bl./2014/18).

Table 4 : Fertilizer quantity used in different variety during *kharif* season. (kg/ha)

Fertilizer (Kg/ha)	<i>Kharif</i> Season					
	Arize-6444	MTU-1010	MTU-1001	Karma Masuri	Safri	Overall
RIL						
N	120	80	100	100	100	100
P	80	50	60	60	60	62
K	50	40	40	40	40	42
FIL						
N	98.34	74.92	87.10	83.98	81.03	85.07
P	62.15	44.41	52.03	49.89	49.91	51.67
K	31.47	29.79	31.35	31.26	28.96	30.56
Gap						
N	-21.66	-5.08	-12.9	-16.02	-18.97	-14.93
P	-17.85	-5.59	-7.97	-10.11	-10.09	-10.32
K	-18.53	-10.21	-8.65	-8.74	-11.04	-11.43
Gap %						
N	-18.05	-5.64	-12.09	-16.02	-18.97	-14.15
P	-22.31	-9.32	-13.28	-16.85	-16.82	-15.72
K	-37.06	-25.52	-21.62	-21.85	-27.6	-26.73

Note: FIL= Field Input Level, RIL= Recommended Input Level

Source: Improved cultivation practices for Dry land crops in Bastar plateau Agro-climatic Zone of C.G. (IGKV/Pub./T.bl./2014/18)

higher in case of Propiconazole 25% EC (-35.18 per cent) followed by Tricyclazole (-69.60) and lowest in Carbendazim 12% + Mancozeb 63% WP (-79.40 per cent) and use of fertilizers in *kharif* paddy percentage gap was higher in case of nitrogen (-18.05 per cent) followed by phosphorus (22.31 per cent) and potash (-37.06 per cent).

Input wise cost of cultivation of *kharif* paddy for variety- Arize 6444

The present section deals with the economics of cultivation of *kharif* paddy (Variety- Arize 6444) grown in the study area. (table 5) clearly shows input wise cost of cultivation of paddy (Variety- Arize 6444) per hectare, which is highest in case of medium farms and lowest in case of small farms. Cost of cultivation showed increasing trend from marginal to medium farmers. It is due to the fact that medium farmers could incur more expenditure on modern farm inputs like quality seed, fertilizers, plant protection chemicals, hired labours etc. The major share of cost among different cost items were found in labour which is 46.94 per cent to the total cost of cultivation out of which 32.41 per cent contribution was of human labour and bullock and machine labour together contribute 14.52 per cent. Total labour cost was increased from marginal to large farms but its contribution in total cost was found

Table 5 : Input wise cost of cultivation of *kharif* paddy for variety- Arize 6444 at sampled households. (Rs/ha.)

S. no.	Particulars	<i>Kharif</i> paddy (Variety- Arize 6444) (Rs/ha.)				
		Marginal	Small	Medium	Large	Overall
A	Input Cost					
1.	Human labour					
	a) Family	6321.74 (18.76)	3856.65 (10.73)	2358.21 (6.34)	423.16 (1.14)	3444.53 (9.54)
	b) Hired	4125.21 (12.24)	7958.32 (22.15)	9898.35 (26.59)	10983.62 (29.66)	8255.69 (22.87)
	Total human labour	10446.95 (31.01)	11814.97 (32.88)	12256.56 (32.93)	11406.78 (30.80)	11700.20 (32.41)
2.	Bullock and Machinery					
	a) Bullock	193.23 (0.57)	175.25 (0.48)	145.25 (0.39)	-	152.11 (0.42)
	b) Machine	4358.25 (12.94)	4895.65 (13.62)	5486.48 (14.74)	5798.35 (15.65)	5090.85 (14.10)
	Total machine and bullock labour	4551.48 (13.51)	5070.90 (14.11)	5631.73 (15.13)	5798.35 (15.65)	5242.96 (14.52)
3.	Total labour cost	14998.43 (44.52)	16885.87 (46.99)	17888.29 (48.06)	17205.13 (46.45)	16943.16 (46.94)
4.	Seed	708.18 (5.07)	1884.41 (5.24)	1966.17 (5.28)	2208.15 (5.96)	1912.14 (5.29)
5.	Manure and Fertilizer	3325.32 (9.87)	3486.32 (9.70)	3598.75 (9.67)	3875.21 (10.46)	3533.11 (9.78)
6.	Plant protection	1862.35 (5.53)	1985.54 (5.53)	2130.21 (5.72)	2178.38 (5.88)	2032.21 (5.63)
7.	Irrigation Charges	1021.41 (3.03)	975.68 (2.72)	956.24 (2.57)	914.85 (2.47)	971.18 (2.69)
8.	Interest on working capital	221.25 (0.65)	284.81 (0.79)	322.41 (0.86)	346.11 (0.93)	292.63 (0.81)
	Sub total	23136.94 (68.68)	25502.63 (70.98)	26862.07 (72.18)	26727.83 (72.17)	25684.50 (71.16)
B.	Fixed Cost					
9.	Land revenue & taxes	10 (0.02)	10 (0.02)	10 (0.02)	10 (0.02)	10 (0.02)
10.	Interest on fixed capital	240.54 (0.71)	237.75 (0.66)	236.07 (0.63)	234.98 (0.63)	237.39 (0.65)
11.	Depreciation	298.93 (0.88)	179.46 (0.49)	107.54 (0.28)	60.87 (0.16)	164.04 (0.45)
12.	Rental value of land	10000 (29.68)	10000 (27.83)	10000 (26.87)	10000 (27.00)	10000 (27.70)
	Sub total	10549.47 (31.32)	10427.21 (29.02)	10353.61 (27.82)	10305.85 (27.83)	10411.43 (28.84)
C.	Total cost (A+B)	33686.41 (100)	35929.84 (100)	37215.68 (100)	37033.68 (100)	36095.93 (100)

Note: Figure in the parenthesis indicate percentage to the total cost of cultivation (A+B).

Table 6 : Cost concepts in *kharif* paddy for (variety-Arize 6444) among various categories of farms (Rs/ha).

(Rs./ha)

Particulars	<i>Kharif</i> season (variety- Arize 6444)				
	Marginal	Small	Medium	Large	Overall
Cost A ₁	17124.13	21835.44	24621.40	26975.54	22468.02
Cost A ₂	17124.13	21835.44	24621.40	26975.54	22468.02
Cost A ₂ +F ₁	23445.87	25692.09	26979.61	27398.70	25912.54
Cost B ₁	27364.67	32073.19	34857.47	37210.52	32705.41
Cost C	33686.41	35929.84	37215.68	37633.68	36149.93

Measures of farm profit in *kharif* paddy for variety-Arize 6444

It is quite evident from table 7 that on an average, the total average cost, value of net income, family labour income and farm business income per hectare came to Rs. 36095.88, Rs. 26568.64, Rs. 30058.23 and Rs 40249.87 respectively from paddy crop. Gross income of the farms by main product and by product together was found to be Rs 62664.52 per hectare, which was found increasing from marginal to large farms.

Table 7 : Cost and return of *kharif* paddy on the sample farms for different group of farms (Variety- Arize- 6444). (Rs./ha)

S. no.	Particulars	<i>Kharif</i> Season (variety- Arize 6444)				
		Marginal	Small	Medium	Large	Overall
1.	Total Cost	33686.41	35929.84	37215.68	37033.68	36095.88
2.	Gross Income	57779.70	61751.60	64818.90	67537.10	62664.52
3.	Net Income	24093.29	25821.76	27603.22	30503.42	26568.64
4.	Family labour income	30415.03	29678.41	30091.58	30926.58	30058.23
5.	Farm Business Income	40655.57	39916.16	40195.50	41161.56	40249.87

Table 8 : Net returns per rupee of investment by size of farms in *kharif* paddy for Arize- 6444.

Category	Input(Rs)	Output(Rs.)	Input : Output Ratio
Marginal	33686.41	57779.70	1:1.71
Small	35929.84	61751.60	1:1.72
Medium	37215.68	64818.90	1:1.74
Large	37033.68	67537.10	1:1.82
Overall	36095.88	62664.52	1:1.73

maximum in case of small and medium farms which was 46.99 and 48.06, respectively. Total input cost was found 71.16 per cent, whereas total fixed cost was 28.84 per cent to the total cost. Rental value of land is highest among fixed costs, which is 27.70 per cent to the total cost of cultivation.

Cost concept wise income over different cost in *kharif* paddy (Variety-Arize-6444)

The cost and returns on the basis of cost concept in the production of paddy have been presented in the table 6, which portrays that, on an average cost A₁, cost A₂, cost A₁ + F₂, cost B₁ and cost C were worked out to Rs. 22468.02, Rs. 22468.02, Rs. 25912.54, Rs. 32705.41 and Rs. 36149.93 per hectare respectively on the sample farms. It was noted that rupees 10000 were considered as imputed rental value of owned land for one crop season. Cost A₁ is showing increasing trend from marginal to large sized farms because of more use of hired labour, plant protection chemicals, manure and fertilizers etc.

Whereas, net income was found maximum on large farms (30503.42 Rs./ha.) and minimum on medium farms (24093.29 Rs./ha.). Family labour income was found showing decreasing trend from marginal to large farms as contribution of family labour was more on marginal farms and decreased gradually with the increase in farm size.

Net returns per rupee of the investment of *kharif* paddy for variety-Arize 6444

Net returns per rupee of the investment for each category have been presented in table 8. Input output ratio was found maximum in case of marginal farms being 1:1.82 and shows a decreasing trend from large to marginal sized farms. It is due the fact that increased productivity on small to large farms was the result of extra cost incurred, which decreased the input output ratio. Secondly, family labours do work more efficiently on the farms and marginal farmers were using more family labours as compared to hired labours whereas contribution of family labour found decreasing with the increase in farm size. Overall input-output ratio was found 1:1.73 in the cultivation of paddy crop.

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