Economic Affairs, Vol. 67, No. 05, pp. 849-858, December 2022
DOI: 10.46852/0424-2513.5.2022.20

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Research Paper

Farmers Acreage Allocation Response in districts of Chhattisgarh Plains Zone: An Acreage Response Analysis of Paddy, Wheat and Gram

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Received: 18-07-2022 **Revised:** 22-10-2022 **Accepted:** 15-11-2022

ABSTRACT

The study has been undertaken with the major objective to estimate the acreage allocation decision of paddy, wheat and gram farmers in selected districts (viz., Raipur, Mahasamund, Dhamtari and Durg) of Chhattisgarh plains zone with using 20 years (2000-01 to 2019-20) of secondary data of area and yield of paddy, wheat and gram and the different variables identified viz., lagged relative prices, current season rainfall, area and yield of competing crop maize, wheat and gram. Findings of the study include that the lagged area along with the current year rainfall had significantly contributed more in increasing acreage allocation of farmers of paddy under Raipur and Dhamtari districts. The area under wheat in Dhamtari district had declined, this decline was significantly contributed by lagged relative prices, area and lagged yield under gram. While the acreage of wheat in Durg district had found increased which was contributed more by the significant move with the last year's absolute area and yield, current season rainfall and lagged relative prices. The lagged area, lagged relative prices, lagged yield and current season rainfall had highly significantly helped to boost the gram in terms of absolute area and had maximum area in Durg compare to other selected district of Chhattisgarh plains. The lagged relative prices, area of wheat and lagged yield of wheat had significant led to decrease area under gram in Raipur as well as in Mahasamund district over the study period. Further, the estimates of short-run and long-run price elasticities with respect to acreage of paddy, wheat and gram indicated the inelastic supply of these crops. Study suggested need for education and training to the farmers in respect of new crop production technology, etc., which will help in bringing about the desired changes in the cropping pattern.

HIGHLIGHTS

- Area under wheat in Dhamtari district had declined, this was significantly contributed by lagged relative prices, area and lagged yield under gram, while area under gram increased.
- Elasticities in paddy, wheat and gram crops indicating that farmers were relatively market oriented in their crop allocation decisions.

Keywords: Acreage Response, Chhattisgarh Plains, Gram, Paddy, Wheat

One of the most important issues in agricultural economic development is supply response. The issue of agricultural supply response to price and non-price factors has been widely studied in the literature. An econometric model to study acreage response is of great importance in agricultural planning, more so, when it involves the manipulation of price structure. The Indian economy has faced dramatic changes over the past decades, strongly influenced productivity leaps in agriculture enabled by the

How to cite this article: Wasnik, S.B., Pandey, S., Patel, P. and Patel, M. (2022). Farmers Acreage Allocation Response in districts of Chhattisgarh Plains Zone: An Acreage Response Analysis of Paddy, Wheat and Gram. *Econ. Aff.*, **67**(05): 849-858.

Source of Support: None; **Conflict of Interest:** None

green revolution (Meenakshi, 2017 and Mohan *et al.* 2017). Supply behaviour models are based on generally accepted notion that, current decisions are influenced by experience related to past decisions or past behaviour. The supply response equations can be used to forecast agricultural supplies in the future (Vikas *et al*. 2018). The precise econometric specification of this influence, subsequently spelled out in detail, was based on different variants of the theory of distributed lags. One commonly used model in supply response analysis based on time-series data is the Adaptive Expectations (or Distributed Lags) Model developed by Marc Nerlove (1958).

In India, paddy, wheat and gram has highest per centage share in terms of area and production to the area and production of total food grains among total cereals and pulses as well as the gross cropped area (GCA) during 2019-20. Similarly, in Chhattisgarh State the situation was same (Wasnik, 2022a). Central state of India i.e., Chhattisgarh known for rice cultivation and called 'rice bowl of India'. Since the State have been formed, there is two decadal increases of total food grains of the States in which area increase by 9.03 per cent from 2000-01 (4.93 million ha) to 2019-20 (5.37 million ha) similarly, production was on the boom that it raises by more than 3 times from 2000-01 (2.90 million tonnes) to 2019-20 (9.37 million tonnes) (Wasnik *et al.* 2022b). The fluctuations in acreage of major crops in Chhattisgarh State have always been a matter of concern and have recently assumed grave dimension. For the present study, selected four districts viz., Raipur, Mahasamund, Dhamtari and Durg, were the representatives of Chhattisgarh plains zone. Many of the crops were grown in this selected area varying from food grains to vegetable crops of which paddy, wheat and gram were selected purposively for this study as these are having maximum production as compared to other crops of selected four districts of Chhattisgarh plains. In order to provide an objective measure of response to changes in prices the estimates of price elasticities for the acreage response functions for paddy, wheat and gram for Chhattisgarh plains. It was thus felt necessary to study district-wise acreage supply response behaviour of the farmers of these districts under selected crops, which then help them in land allocation decision.

DATA AND METHODOLOGY

The present study was carried out entirely upon the secondary data was obtained from the Chhattisgarh state government officials such as Department of Agriculture, Land Record & Revenue Department and Directorate of Economics and Statistics Govt. of Chhattisgarh State. This data was further divided into sub-periods i.e., period I (2000-01 to 2009-10), period II (2011-12 to 2019-20) and Overall period (2000-01 to 2019-20).

(a) Acreage response analysis

(i) Nerlove Adjustment Lag Model: Supply response analysis involves solving of distributed lag because of generally accepted notion that the current decision is influence by experiences related to past decisions or past behaviour. Nerlove developed two distributed lag models. The choice between different lag models depends upon whether postulated lags are formulations of technological, institutional setting or expectational behaviour of the sector concerned. The Nerlovian co-efficient of adjustment provides information about the speed of adjustment of acreage to changing the level of the explanatory variable in the supply response equation.

The adjustment lag model in its simplest form can be explained as below:

$$A_t^* = b_0 + b_1 P_{t-1} + U_t \qquad \ldots(1)$$

Where, long-run equilibrium acreage for a crop is a function of its price during preceding year :

$$A_t - A_{t-1} = \beta\,(A_t^* - A_{t-1}) : 0 < \beta \qquad \ldots(2)$$

Where, β is the coefficient of adjustment which means that in each period actual acreages were adjusted in proportion to the difference between the equilibrium acreage desired in the long-run and observed acreage under the crop concerned in the previous years.

Equation (2) may be written as,

$$A_t - (1-\beta)\,A_{t-1} = \beta\,(A_t^*) \qquad \ldots(3)$$

Multiplying equation (1) by we get

$$\beta\,A_t^* = \beta\,b_0 + \beta\,b_1\,P_{t-1} + \beta\,U_t \qquad \ldots(4)$$

Substituting values of βAt from equation (3) in equation (4) we get—

$$A_t = \beta\, b_0 + \beta\, b_1\, P_{t-1} + (1-\beta)\, A_{t-1} + \beta\, U_t \qquad \text{…(5) or}$$

By using appropriate notations, the above equation is written as,

$$A_t = a_0 + a_1\, P_{t-1} + a_2\, A_{t-1} + V_t \qquad \text{…(6)}$$

Where,

$a_0 = \beta\, b_0$

$a_1 = \beta\, b_1$

$a_2 = (1-\beta)$

$V_t = \beta\, U_t$

However, in real world situation, the acreage allocation of the crop is influenced by a large number of variables. Therefore, efforts were made to develop different types of theoretical models for empirical tests envisaging lagged prices, area under competing crops, lagged yields and rainfall for selected crops.

(ii) Identification of competing crops: The competing crops are defined to be those crops which directly or indirectly affect the area allocation of crops or the crops for which farmers had a choice to use land in place of selected crop.

Table 1: Main and their corresponding competing crops

Main crops	Competing crops
Paddy	Maize
Wheat	Gram
Gram	Wheat

(iii) Estimation of Nerlovian adjustment model: Acreage response to price is conditioned by several factors like soil type, rainfall, irrigation, technical constraints such as crop rotational requirements etc., which affect acreage allocation among crops. These factors differ considerably from region to region. Therefore, acreage response is also expected to vary among regions. This fact has prompted to examine the acreage response to relative prices of paddy, wheat and gram in selected districts of Chhattisgarh plains zone. The following modified version of Nerlovian adjustment model were used in its simplest form for the purpose of this study:

$$A_t = a + b_1\, A_{t-1} + b_2\, RP_{t-1} + b_3\, Y_{t-1} + b_4\, R_t + b_5\, Ac_t + b_6\, Yc_{t-1} + u_t$$

Where,

A_t = Acreage of selected major crops during current year ('000 hectares)

A_{t-1} = Acreage of selected major crops during preceding year ('000 hectares)

RP_{t-1} = Price of the crop relative to substitutable/competing crop during preceding year

Y_{t-1} = Yield of selected major crops during preceding year (Kg/Ha)

R_t = Rainfall during current season (mm)

Ac_t = Area under competing crop ('000 hectares)

Yc_{t-1} = Yield of competing major crops during preceding year (Kg/Ha)

u_t = Error term

a = Intercept

b_1 to b_6 = Regression co-efficient of respective variable

The rule applied to visualize the magnitude of multicollinearity will be the correlation coefficient between a pair of independent variables. The multicollinearity was considered 'high' if it is greater than 0.80 (Heady and Dillon, 1961). The data were also tested for the presence of autocorrelation in the model by using Durbin-Watson statistic. The level of significance of overall regression were tested by applying 'F' test.

(b) Short-run and long-run elasticity: In the present study, short-run and long-run price elasticities of acreage for selected major crops were estimated from the estimated equations. The elasticities of variable show that the influence of unit changes in variable on acreage decision of crop. The coefficient of adjustment i.e., 'β' were obtained by subtracting coefficient of lagged acreage from unity. In the linear function, long run price elasticity of acreage was obtained by multiplying the estimate of the slope of long-run supply function by the ratio of price to acreage at a particular point. Usually, this point is taken to be the average price and average acreage for the period of analysis. Short-run price elasticity of acreage was obtained by multiplying long-run price elasticity by 'β', the coefficient of adjustment.

The levels of significance of short-run and long-run elasticities thus calculated was tested.

Short Run Elasticity (SRE) = $b_2\left(\frac{\overline{RP_{t-1}}}{\overline{A_t}}\right)$ and

Long Run Elasticity (LRE) = $\left(\frac{b_2}{1-b_1}\right)\left(\frac{\overline{RP_{t-1}}}{\overline{A_t}}\right)$

Since, the coefficient of adjustment $\beta = (1\text{–}b_1)$ is never greater than unity.

(c) Specification of variables in the regression model

(i) Current acreage (A_t): The dependent variable included in the analysis was the acreage under selected major crop in '000 hectares during current year. The area consists of all types of strains, irrigated as well as unirrigated and also grown during agricultural year.

(ii) Lagged acreage (A_{t-1}): The current year area was mainly affected by the area of selected crop in '000 hectares during preceding year when the conditions are not abnormally changed. This variable was included in the model as proxy for traditional cropping pattern is also expected to affect the decision of the area allocation.

(iii) Lagged relative prices (RP_{t-1}): Relative price is the ratios of the price of the main crop relative to the price of the competing crop. Ratio of harvest price of the crop to the harvest price of substitute/competing crop which obtained by deflating the prices of the competing crop. Price index of the crop relative to substitutable crop in preceding year added as a separate independent variable influencing acreage allocation. The relative changes in prices received by the farmers for the produce and paid by them for meeting input requirements and consumer demands influence his economic activities.

(iv) Lagged yield (Y_{t-1}): The per hectare yield of selected major crop was measured in kilograms. The variable was included in the model since, the acreage allocation during the current year is also likely to be affected by the productivity of the crop during the preceding year.

(v) Annual rainfall (R_t): The amount of total rainfall received during sowing season of the crop in the current year *t* for the crop in '*mm*' was included as a separate variable because the decision of area allocation depends on the rainfall which results into potential irrigation during the season.

(vi) Acreage under competing crops (Ac_t): The area under competing crops in '000 hectares were also considered as independent variables in model developed for the selected major crops. Because, there is inverse relationship between area under competing crops and selected major crop.

(viii) Lagged yield under competing crops (Yc_{t-1}): The lagged yield of competing crops measured in kilogram per hectares was considered another independent variable in the estimation of acreage response model.

RESULTS AND DISCUSSION

(a) Acreage response function

The results of the estimated linear acreage response functions of paddy, wheat and gram for Raipur, Mahasamund, Dhamtari and Durg districts of Chhattisgarh plains with different sets of explanatory variables (viz., lagged area, lagged relative price, lagged yield, current season rainfall, area and lagged yield under competing crop maize)and the results of the structural coefficients, their standard errors, values of R^2, *F* values and Durbin-Watson statistics were given in the respective tables for all three time periods separately viz., period I (2000-01 to 2009-10), period II (2010-11 to 2019-20) and overall period (2000-01 to 2019-20).

Acreage response of paddy: From Table 2, during entire period, the estimated value of R^2 depicting 91, 86 and 91 per cent variation was explained by these 6 independent factors for paddy in Raipur, Mahasamund and Durg district, respectively. While Dhamtari district had non-significant R^2 for entire period. The lagged area, lagged yield and current season rainfall had positive and highly significant influence indicating that current year acreage had moved in accordance with those variables in Raipur district. Similarly, farmers of Raipur district do not take into account the last year's price of paddy while allocating the area under paddy for current year acreage. The area under maize had competitive behaviour with the current acreage of paddy in Raipur district.

Positive lagged area signified that the farmers of Mahasamund district were given due consideration

Table 2: Estimated acreage response function of paddy in selected district during 2000-01 to 2019-20

Factors/ Periods	Raipur			Mahasamund			Dhamtari			Durg		
	Period I	Period II	Overall Period	Period I	Period II	Overall Period	Period I	Period II	Overall Period	Period I	Period II	Overall Period
Constant	354.56	186.54	442.80	96.92	133.03	91.87	248.76	147.56	136.99	327.82	366.96	387.91
	(0.89)	(0.61)	(2.45)**	(0.33)	(0.72)	(1.73)	(1.45)	(1.19)	(2.24)**	(1.05)	(2.45)*	(2.98)**
A_{t-1}	0.30	-0.03	0.87	0.6525	0.5708	0.6868	-0.3012	0.3739	0.0347	0.2039	0.2545	0.7438
	(0.43)	(-0.06)	(5.32)***	(0.70)	(0.67)	(3.12)***	(-0.55)	(0.44)	(0.08)**	(0.37)	(0.84)	(5.12)***
RP_{t-1}	0.187	-0.539	-3.698	0.0326	-0.0626	-0.0234	-0.4285	0.1818	-0.1325	-0.3180	-1.7157	-2.7289
	(0.33)	(-0.18)	(-2.92)**	(0.05)	(-0.37)	(-0.17)	(-0.90)	(0.37)	(-0.39)	(-0.50)	(-0.92)	(-2.47)**
Y_{t-1}	-0.004	0.042	0.046	-0.0063	-0.0113	0.0070	0.0193	0.0245	0.0049	0.0195	-0.0652	0.0167
	(-0.19)	(0.57)	(1.28)***	(-0.38)	(-0.73)	(1.22)	(0.53)	(1.14)	(0.39)	(0.86)	(-1.13)	(0.54)
R_t	-0.002	0.136	0.049	0.0038	-0.0017	0.0032	-0.0400	0.0031	0.0055	-0.0091	0.1236	0.0400
	(-0.20)	(0.74)	(1.00)***	(0.22)	(-0.10)	(0.51)	(-0.65)	(0.11)	(0.28)**	(-0.45)	(1.18)	(0.90)
Am_t	0.008	0.424	-0.027	-0.0936	-0.1679	-0.1021**	-0.0811	-0.0033	-0.0094	0.0377	-0.1670	-0.1489**
	(1.03)	(1.63)	(-0.84)**	(-0.48)	(-0.98)	(-1.45)	(-0.61)	(-0.31)	(-1.73)**	(0.13)	(-1.32)	(-1.34)
Ym_{t-1}	-0.005	-0.165	-0.019	0.0073	-0.0194	-0.0120	-0.0083	-0.0004	-0.0012	0.0304	-0.0676	-0.0916
	(-0.51)	(-1.22)	(-0.52)	(0.19)	(-0.48)	(-1.24)	(-0.35)	(-0.01)	(-0.15)	(0.58)	(-0.97)	(-1.60)
R^2	0.62	0.89	0.91	0.31	0.81	0.86	0.82	0.47	0.48	0.71	0.90	0.91
F-value	0.81	4.05	21.22***	0.22	2.10	13.83***	2.30	0.44	1.99	1.24	4.49	22.47***
D-W Stat	1.83	1.87	2.54	2.11	2.05	2.18	2.95	1.66	1.83	1.46	1.76	1.57

Note: *** and *** represent significant at 5% and 1%, respectively.*

to last year's area under paddy while deciding the current year area. The competitive behaviour between area of paddy and maize was observed in Mahasamund district. The lagged yield and current season rainfall had insignificant influence on area allocation decision of farmers of paddy in Mahasamund.

The lagged area and current season rainfall had significantly influenced in increasing the acreage allocative efficiency of the paddy farmers of Dhamtari district in current year. The of area of maize indicated competitive behaviour with current acreage of paddy, whereas lagged relative price and lagged yield maize had negative sign but they did not show any significant influence on area allocation decision of farmers under paddy in Dhamtari district.

It was revealed that only lagged area had positive influence on area allocation decision indicates that the farmers are responsive and due considering previous year area of paddy to the current year acreage allocation decision of paddy in Durg district. The lagged relative price had negative and significant influence on acreage allocation decision of paddy indicated their competitive behaviour with the current acreage of paddy farmers in Durg district. The area of maize had negatively significant influenced on current acreage allocation of paddy indicated the competitive behaviour in between them in Durg district.

Acreage response of wheat

During the period of 20 years, it was depicted from Table 3, that R^2 was highly significant and explained 83, 54, 68 and 97 per cent variation by 6 independent factors for wheat in Raipur, Mahasamund, Dhamtari and Durg district, respectively. In overall it was revealed that the farmers responsive to the current year area changes in acreage allocation decision for wheat were determined by the influence of lagged area, current season rainfall, lagged relative price and area of gram, thus these factors had motivated the farmers of Raipur district to allocate more acreage under wheat. Whereas, the regression coefficients of area under gram had indicated complementary nature of wheat and gram in acreage allocation decision of wheat.

The lagged area and current season rainfall both had help to move current acreage of wheat along with rainfall in Mahasamund district. Whereas,

Table 3: Estimated acreage response function of wheat in selected district during 2000-01 to 2019-20

Factors/ Periods	Raipur			Mahasamund			Dhamtari			Durg		
	Period I	Period II	Overall Period	Period I	Period II	Overall Period	Period I	Period II	Overall Period	Period I	Period II	Overall Period
Constant	5.35	-1.82	-0.76	2.10	-0.27	0.81	-1.63	-5.58	0.73	12.90	-1.13	-5.98
	(1.59)	(-0.26)	(-0.15)	(2.41)*	(-0.22)	(0.88)	(-0.25)	(-0.95)	(0.27)	(1.18)	(-0.38)	(-1.39)
A_{t-1}	-0.963	0.742	0.158	-0.4980	-1.8870	0.0156	0.4073	0.2264	0.1843	-0.2918	0.0907	0.0769
	(-7.81)***	(1.88)	(0.81)**	(-1.39)	(-4.12)**	(0.05)***	(0.82)	(1.15)	(1.05)***	(-0.58)	(2.26)	(0.89)***
RP_{t-1}	-0.005	0.136	0.076	-0.0289	0.0424	-0.0089	0.0639	-0.0082	-0.0283	-0.1327	-0.0760	0.1107
	(-0.12)	(1.81)	(1.54)**	(-1.99)	(2.59)*	(-0.86)***	(0.59)	(-0.27)	(-0.90)***	(-1.01)	(-1.47)	(2.12)*
Y_{t-1}	0.005	-0.001	0.000	0.0006	0.0031	0.0005	-0.0012	0.0028	0.0022	0.0192	0.0053	0.0738
	(5.40)**	(-0.43)	(-0.20)	(1.81)	(5.19)**	(1.61)	(-0.14)	(0.67)	(1.34)	(2.31)	(3.47)**	(2.61)***
R_t	-0.001	0.004	0.0012	0.0008	0.0003	0.0723	-0.0005	-0.0017	0.0064	0.0032	-0.0028	0.0214
	(-1.89)	(1.77)	(0.72)**	(2.42)*	(0.92)	(1.83)*	(-0.07)	(-0.94)	(0.54)*	(1.99)	(-1.82)	(1.83)***
Ag_t	0.553	-0.431	-0.716	3.6265	-11.6067	-2.2231	0.1500	-0.2282	-0.1677	0.0946	0.2601	-0.1772
	(3.19)**	(-1.04)	(-3.50)***	(2.55)*	(-4.50)**	(-2.06)*	(0.53)	(-3.37)**	(-3.62)***	(1.46)	(15.31)***	(-10.84)***
Yg_{t-1}	0.003	0.000	-0.001	-0.0007	-0.0016	-0.0007	0.0000	0.0017	-0.0624	-0.0090	0.0013	-0.0049
	(3.01)*	(-0.04)	(-0.54)	(-1.20)	(-3.36)**	(-1.21)	(-0.01)	(1.50)	(-0.41)***	(-1.84)	(0.61)	(-2.04)
R^2	0.98	0.82	0.83	0.93	0.95	0.54	0.50	0.95	0.68	0.88	1.00	0.97
F-value	25.41**	2.28	10.65***	6.79*	10.50**	2.53***	0.50	8.74*	4.70***	3.52	194.91***	69.45***
D-W Stat	2.29	2.13	1.41	1.95	1.09	1.33	1.63	2.28	1.46	2.22	1.82	1.72

Note:*, ** *and* *** *represent significant at 10%, 5% and 1%, respectively.*

the lagged relative price and area of gram had depicted the competitive behaviour between wheat and gram. However, the lagged yield of wheat and gram had failed to influence significantly on area allocation of wheat farmers in Mahasamund district.

The coefficients of lagged area and current season rainfall indicated the current year acreage allocation of wheat moved in accordance with the changes in absolute area and rainfall in Dhamtari district. Whereas, the lagged relative price, area under competing crop gram and lagged yield under competing crop gram had competitive behaviour with the current acreage of wheat as well as these factors had significantly contributed in drastic decline in area of wheat in Dhamtari district of Chhattisgarh plains. This result was significantly contributed in another study by the same author (Wasnik *et al*. 2022c) that the area of wheat had showed declining trend.

The lagged area, lagged yield and current season rainfall had contributed significantly in increasing the acreage under wheat in Durg district. Similarly, lag relative prices had indicated the complementary relation between wheat and gram prices. Thus, these factors in turn lead to increase the acreage allocation decision of wheat farmers in Durg district. It revealed that gram and wheat were having competitive behavior for acreage allocation decision of wheat farmers in Durg of Chhattisgarh plains.

Acreage response of gram

During the overall period (2000-01 to 2019-20), the R^2 was highly significant explained 81, 78, 62 and 97 per cent variation by the selected 6 variables under study (Table 4). The lagged relative prices, area of wheat and lagged yield of wheat had negative and significant influence on acreage allocation decision of gram farmers indicating competitive nature. This led to decrease area under gram in Raipur district over the study period. The lagged area had positive and significant impact on area allocation of gram in Raipur district. Whereas, the regression coefficients of lagged yield, current season rainfall did not show any significant influence on acreage allocation decision farmers in Raipur of Chhattisgarh plains.

The previous year absolute area and yield of gram and current season rainfall all had positive sign but fail to impact significantly on area allocation of gram in Mahasamund district. Whereas, the regression coefficients of lagged relative prices, area of wheat and lagged yield of wheat indicates that these

Table 4: Estimated acreage response function of gram in selected district during 2000-01 to 2019-20

Factors/ Periods	Raipur			Mahasamund			Dhamtari			Durg		
	Period I	Period II	Overall Period	Period I	Period II	Overall Period	Period I	Period II	Overall Period	Period I	Period II	Overall Period
Constant	-9.62	11.76	-2.93	0.81	0.01	0.18	-24.65	31.70	-7.25	-4.54	26.83	-11.63
	(-6.85)***	(1.03)	(-0.72)	(8.28)***	(0.02)	(1.21)	(-4.12)**	(2.33)*	(-0.93)	(-0.14)	(1.88)	(-0.62)
A_{t-1}	0.419	0.816	0.334	0.6670	0.7944	0.5975	0.4946	-0.2347	0.1901	0.6399	-0.0870	0.0635
	(3.82)**	(1.01)	(1.70)***	(10.00)***	(0.83)	(3.29)	(3.38)**	(-2.02)	(1.08)*	(3.43)**	(-2.12)	(0.68)***
RP_{t-1}	0.036	-0.018	-0.096	-0.0048	-0.0063	-0.0735	0.0582	-0.0115	0.0264	-0.0563	0.0376	0.0712
	(3.94)**	(-0.85)*	(-0.95)***	(-9.07)***	(-0.77)*	(-2.05)***	(2.27)	(-0.66)	(0.99)*	(-0.31)	(1.40)	(1.19)***
Y_{t-1}	-0.002	-0.002	0.000	0.0003	0.0001	0.0000	-0.0073	-0.0057	0.0013	0.0435	-0.0053	0.0264
	(-1.92)	(-0.40)	(0.16)	(4.84)**	(0.26)	(-0.16)	(-1.67)	(-1.23)	(0.20)	(1.86)	(-0.59)	(2.00)***
R_t	0.001	0.003	0.012	-0.0002	-0.0002	0.028	0.0134	0.0097	0.0020	-0.0064	0.0112	0.0123
	(1.69)	(0.67)	(0.50)	(-9.44)***	(-0.77)	(2.45)	(2.40)*	(2.17)	(0.42)*	(-0.85)	(1.80)	(1.92)***
Aw_t	0.784	-0.053	-0.677	0.2802	-0.0432	-0.0970	1.2974	-4.1151	-2.8838	5.0336	-3.9442	-4.8094
	(4.32)**	(-0.10)*	(-3.74)***	(12.27)***	(-0.24)*	(-2.34)***	(2.97)*	(-4.26)	(-3.59)*	(3.46)**	(-16.66)*	(-8.80)**
Yw_{t-1}	0.001	-0.002	-0.0124	-0.0003	-0.0001	-0.0243	0.0161	-0.0158	-0.0042	-0.1001	-0.0226	-0.0370
	(1.41)	(-0.57)*	(-0.36)***	(-7.30)***	(-0.29)*	(-0.33)***	(2.78)*	(-1.37)	(-0.06)*	(-2.06)	(-3.48)*	(-2.48)**
R^2	0.99	0.63	0.81	0.99	0.51	0.78	0.96	0.97	0.62	0.97	1.00	0.97
F-value	36.60***	0.85	9.10***	54.57***	0.51	7.48***	12.27**	17.87**	3.52**	15.41**	195.45***	62.85***
D-W Stat	2.49	1.72	1.21	1.76	2.46	1.29	2.04	1.94	1.91	2.60	1.56	1.13

Note: *, ** *and* *** *represent significant at 10%, 5% and 1%, respectively.*

variables had strong competitive behaviour between wheat and gram which helped to reduce the acreage under gram in Mahasamund of Chhattisgarh plains. This similar type of result in declining area of gram in Raipur and Mahasamund districts were supplemented by the study of same author (Wasnik *et al*. 2022c).

The area and last year's yield of wheat had indicated competitive nature on area allocation of gram in Dhamtari district. Whereas, previous year absolute area of gram, lagged relative prices and current season rainfall indicated that these variables had helped in increase area positively under gram in Dhamtari district of Chhattisgarh plains. The coefficient of lagged area had positive sign but does not show any significant influence on area of gram.

The lagged yield and area under competing crop wheat indicated competitive behaviour for area and yield between wheat and gram crops in Durg district. Conversely, the regression coefficients of lagged area, lagged relative prices, lagged yield and current season rainfall had highly influence on acreage allocation decision of gram farmers and helped to boost the gram area in Durg district of Chhattisgarh plains.

(b) Estimation of short run and long run price elasticities for paddy, wheat and gram acreage

Estimation of short run and long run price elasticities for paddy acreage: From Table 5, the estimates of short-run elasticities for the entire study period of paddy were found to be negative for all the districts indicated that farmers were less conscious about the price change of all the districts this was due to competitive behaviour of the change in relative price. Thus, area under paddy has not moved in accordance with the change in relative price during entire period. Conversely, long-run elasticities of paddy for entire period were found positive and significant for all the districts thus depicted that the farmers were responded consciously to change in price. Thus, it was also concluded that farmers of Dhamatri district adjusted their acreage quickly to the changes in the factors affecting acreage during overall period. The main factors influencing acreages under paddy during 2000-01 to 2019-20 were lagged area, area under competing crop maize and lagged relative prices. However, factors influencing the acreage of paddy were differ from district to district.

Estimation of short run and long run price elasticities for wheat acreage: From Table 6, the

Table 5: Estimates of price elasticities of acreage response for paddy

Districts/ Periods	Short Run Elasticity			Long Run Elasticity			Coefficient of Adjustment		
	Period I	Period II	Overall Period	Period I	Period II	Overall Period	Period I	Period II	Overall Period
Raipur	0.03	-0.24	-0.95***	0.05	-0.23	0.75***	0.70	1.03	0.13
Mahasamund	0.01	-0.02	-0.01	0.04	0.05	0.03***	0.35	0.43	0.31
Dhamtari	-0.27	0.10	-0.08	-0.20	0.16	0.07**	1.30	0.63	0.97
Durg	-0.07	-0.99	-0.84**	0.08	1.33	0.03***	0.80	0.75	0.26

Note: *** and *** represent significant at 5% and 1%, respectively.*

Table 6: Estimates of price elasticities of acreage response for wheat

Districts/ Periods	Short Run Elasticity			Long Run Elasticity			Coefficient of Adjustment		
	Period I	Period II	Overall Period	Period I	Period II	Overall Period	Period I	Period II	Overall Period
Raipur	-0.03	1.41	0.57**	-0.02***	0.55	0.67**	1.96	0.26	0.84
Mahasamund	-0.91	1.31*	-0.28***	-0.61	-0.46**	0.28***	1.50	2.89	0.98
Dhamtari	1.28	-0.23	-0.65***	0.22	0.30	0.80***	0.59	0.77	0.82
Durg	-0.36	-0.35	0.37*	-0.28	0.38	0.40***	1.29	0.91	0.92

Note: **, ** and *** represent significant at 10%, 5% and 1%, respectively.*

Table 7: Estimates of price elasticities of acreage response for gram

Districts/ Periods	Short Run Elasticity			Long Run Elasticity			Coefficient of Adjustment		
	Period I	Period II	Overall Period	Period I	Period II	Overall Period	Period I	Period II	Overall Period
Raipur	0.89**	-0.61*	-2.77***	1.53**	0.33	0.42***	0.58	0.18	0.67
Mahasamund	-0.31***	-0.94**	-0.68***	0.92***	0.46	0.16	0.33	0.21	0.40
Dhamtari	1.28	-0.31	0.64*	2.54**	-0.25	0.80*	0.51	1.23	0.81
Durg	-0.13	0.37	0.29***	0.37**	-0.34	0.31**	0.36	1.09	0.94

Note: **, ** and *** represent significant at 10%, 5% and 1%, respectively.*

estimates of short-run elasticities for wheat were found to be negative and significant during for Mahasamund and Dhamtari district thus indicating farmers were less responsive to the price change in these districts, while price elasticity was found positive and significant under Raipur and Durg district indicating farmers of these district were very much conscious to the change in price of wheat. The long-run elasticities of wheat for entire period were found positive and significant for all the districts thus indicating that farmers were responded consciously to change in price. The main factors influencing acreages under wheat during 2000-01 to 2019-20 were lagged area, current year rainfall and lagged relative prices. However, factors influencing the acreage of paddy were differ from district to district. Thus, it was also found that farmers of nearly all the districts adjusted their acreage quickly to the changes in the factors affecting acreage during overall period.

Estimation of short run and long run price elasticities for gram acreage: From Table 7, the estimates of short-run elasticities for gram were found to be positive and significant for Dhamtari and Durg district during entire study period this indicates that the farmers were responded more to change in price. Whereas, in case of Raipur Mahasamund districts it was significantly negative indicating farmers in those districts were less responsive to the price change. The estimates of long-run elasticities for Raipur, Dhamtari and Durg districts was found positive and significant under gram indicating that the farmers were responsive change in relative price, while for Mahasamund district elasticity was positive but non-significant. Farmers of all the districts were adjusted their acreage under gram quickly, while farmers of Mahasamund district adjusted weakly.

Nearly all the factors were influenced the acreage under gram during 2000-01 to 2019-20 they are lagged relative prices, lagged yield and current season rainfall area of wheat and lagged yield of wheat.

In nutshell, study revealed that, at overall, long run price elasticities were greater than short run elasticities in paddy, wheat and gram crops indicating that farmers were relatively market oriented in their decisions in long run than in short run. The farmers were less responsive to the short-run price elasticities nearly in most of the districts thus depicted that current acreage under paddy, wheat and gram were strongly moved by the non-price factors. Thus, the negative short-run elasticities called for further investigation. It was also concluded that farmers from all the district adjusted their acreage quickly to the changes in the factors affecting acreage of wheat and gram during overall study period. Whereas the acreage adjustment was weak in case of paddy in all the district (except Dhamtari) this was due to less responsiveness of farmers to the change in prices. The estimated acreage response functions for paddy, wheat and gram had shown a sizeable range of total variation, in the area to be brought under these crops in current season in all the districts. However, factors influencing the acreage of gram were differ from district to district.

CONCLUSION

Under study, the increased paddy area in Raipur and Dhamtari districts revealed that the farmers where allocating more area for the paddy which was contributed significantly more by the previous year area and current season rainfall. Thus, concluding overall Raipur district had more area under paddy this result was supplemented more by the significant impact of previous year yield, while Dhamtari had maximum percentage increase in area of paddy.

It was also concluded that the farmers decision of area allocation for wheat in Dhamtari district had declined, this decline was significantly contributed by lagged relative prices, area and lagged yield under gram. While the increased of wheat acreage in Durg district depicted the farmers were allocating more area which was contributed more by the significant move with the last year's absolute area and yield, current season rainfall and lagged relative prices (complementary behaviour between wheat and gram prices).

The farmers of Durg district have paying more attention on area allocation decision to gram which significantly boost gram in terms of absolute area and had maximum area in Durg compare to other district of Chhattisgarh plains. Similarly, it was also concluded the significant increase of area under gram in terms of highest percentage in Dhamtari district of Chhattisgarh plains. Whereas, the farmers area allocation decision regarding gram led to decrease in Raipur as well as in Mahasamund district over the study period.

The overall greater long run price elasticities for paddy, wheat and gram crops indicating that farmers were relatively market oriented in their decisions in long run than in short run. Similarly, study has indicated the inelastic supply of paddy, wheat and gram crops based on the estimates of price elasticities.

Thus, the traditional cropping pattern played an important role in acreage allocation decision of the farmers in selected districts. This suggested the need of educating and training to the farmers in respect of new crop production technology, etc., which will help in bringing about the desired changes in the cropping pattern.

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