CHAPTER - IV

Supply Responses in Paddy Crop
In India, rice production is an important part of the national economy. India is the world's second largest producer of white rice, accounting for 20 per cent of all world rice production. Production increased from 53.6 million tons in 1980 to 74.6 million tons in 1990, a 39 percent increase over the decade. By 1992, rice production had reached 111 million tons, second in the world only to China with its 182 million tons. Since 1950 the increase has been more than 350 percent. Most of this increase was the result of an increase in yields; the number of hectares increased only 40 percent during this period. Yields increased from 1,336 kilograms per hectare in 1980 to 1,751 kilograms per hectare in 1990. The per-hectare yield increased more than 262 percent between 1950 and 1992.

The total food grains production in the country increased from 217.28 million tonnes in 2006-07 to 230.78 million tonnes in 2007-08. In 2008-09, the food grains production increased to an all-time record of 234.47 million tonnes comprising 118.14 million tonnes of Kharif food grains and 116.33 million tonnes of Rabi food grains. The country's rice production declined to 89.13 million tonnes in 2009-10 crop years (July-June) from 99.18 million tonnes in the previous year due to severe drought that affected almost half of the country. Despite a severe drought in most parts of the country, the food grains production during 2009-10 only declined to 218.21 million tonnes due to the resilience shown by the farmers.
timely action taken by extension officials, scientists and the State & Central Governments. India could achieve a record rice production of 100 million tonnes in 2010-11 crop years on the back of better monsoon this year.

Andhra Pradesh is the third largest producer of rice in India. It contributes about 11 per cent of the total rice production of India. It occupies about 8.5 per cent of the rice producing area of the country. About one-fourth of the total cultivated area of the state is devoted to rice. The yield has increased considerably with the introduction of the Package Technology (Green Revolution) The Godavari-Krishna Delta and the adjoining coastal plains form one of the most outstanding rice producing tracts of the country in Andhra Pradesh. About 20 Districts are producing rice in the state. The main rice producing districts are:- West Godavari, East Godavari, Krishna, Guntur, Nalgonda, Srikakulam, Karimnagar, Nizamabad, Nellore, Prakasam, Medak, Anantapur, Mahobubnagar, Warangal, and Chittoor. West Godavari, East Godavari and Krishna, are the three most important rice producing districts of the whole of India and accounts for 7 per cent of the total rice production of India.

Some of the major problems in rice cultivation:
1. India's population is expected to be 1.2 billion by 2012. The demand for rice in India is projected at 128 million tonnes for the year 2012 and will require a production level of 3,000 kg/ha significantly greater than the present average yield of 1,930 kg/ha. Major constraints to rice production that India faces are land, water, labour and other inputs such as fertilizers, pesticides and insecticides, and even high quality germ plasma, without affecting the already degraded and stressed agricultural environment.

2. The problems/constraints in rice production vary from state to state and area to area. About 78% of the farmers are small and marginal in the country and they are poor in resource.

3. The problems of flash floods, water logging/ submergence due to poor drainage are very common in East India.

4. Continuous use of traditional varieties due to the non-availability of seeds and farmers lack of awareness about high yielding varieties.

5. Low soil fertility due to soil erosion resulting in loss of plant nutrients and moisture.


7. The Eastern region experiences high rainfall and severe flood almost every year which lead to heavy loss.

8. Heavy infestation of weeds and insects/pests.
9. Delay in monsoon onset often results in delayed and prolong transplanting and sub-optimum plant population (Mostly in rain-fed lowlands).

10. In the years of scanty or adverse distribution of rainfall, the crop fails owing to drought etc.

**Analysis:**

**Equation --3**

It was best fitted the log-linear regression models to study the supply response of paddy (selected oilseeds crop). The analysis was carried out for three regions namely Rayalaseema, Coastal Andhra, Telangana separately and Andhra Pradesh state as a whole. For convenient study, region-wise analysis was taken to evaluate and analyse the results. The inter-regional analysis was also given to compare the combined and individual effect of independent variables on dependent variable of paddy crop among the three regions and state as a whole. In the present study, the dependent variable was the area under paddy crop in current year \(A_t\), and the independent variables are lagged farm harvest price \((P_{t-1})\) and lagged year area \((A_{t-1})\). The results are drawn to study the combined and individual effect of both lagged price \((P_{t-1})\) and lagged area \((A_{t-1})\) on current year cropping area of paddy. The data was fed to equation -3 which is
supply (area) response function and the results were shown in the following tables.

**Rayalaseema Region:**

From the table 4.1, the value of multiple correlation coefficient \( R^2 \) is 0.5784. It is observed that the combined effect of both independent variables on dependent variable, area under the paddy crop in the Rayalaseemaregion is observed to be nearly 58 per cent. From F-test statistic, this collective effect \( R^2 \) of both independent variables is found to be significant (5.7820). The coefficient of \( R^2 \) is 0.2767. The value of coefficient of constant term i.e., \( b_0 \) is 7.5777.

Hence, the coefficient of lagged price \( (P_{t-1}) \) is -0.1164. It shows that the paddy area of the current year is not price responsive. It means there was negative and insignificant relationship between area and price of paddy crop in Rayalaseema region. It indicates as the price of paddy increases the area under paddy may be drop insignificantly by its growers i.e. the area under paddy. The coefficient of lagged area \( (A_{t-1}:0.4489) \) is positive and significant. It indicates that the effect of lagged area on current year cropping area of paddy is 44.89 per cent. It means there was adhesive relationship between dependent and independent variables in Rayalaseema region.

**Table: 4.1**
### Estimated supply response function of Paddy for Equation-3

<table>
<thead>
<tr>
<th>Regions</th>
<th>Estimated Values</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>b₀</td>
<td>Pₜ₋₁</td>
<td>Aₜ₋₁</td>
<td>R²</td>
<td>R²</td>
<td>F</td>
</tr>
<tr>
<td>Rayalaseema</td>
<td>7.5777 (2.6017)</td>
<td>-0.1164 (0.0888)</td>
<td>0.4489* (0.1876)</td>
<td>0.5784</td>
<td>0.2767</td>
<td>5.7820*</td>
</tr>
<tr>
<td>Coastal Andhra</td>
<td>11.0296 (2.8741)</td>
<td>0.1010* (0.0704)</td>
<td>0.2071* (0.2033)</td>
<td>0.1647</td>
<td>0.0921</td>
<td>2.2686*</td>
</tr>
<tr>
<td>Telangana</td>
<td>9.1751 (2.7468)</td>
<td>-0.0803 (0.0720)</td>
<td>0.3779* (0.1894)</td>
<td>0.2081</td>
<td>0.1392</td>
<td>3.0218*</td>
</tr>
<tr>
<td>Andhra Pradesh State</td>
<td>7.7925 (2.7571)</td>
<td>0.0109 (0.0466)</td>
<td>0.4814* (0.1856)</td>
<td>0.2462</td>
<td>0.1807</td>
<td>3.7566*</td>
</tr>
</tbody>
</table>

**Note:** Figures in parentheses are standard error of the estimates.

*Significant at five per cent probability level.

**Coastal Andhra region:**

Form the estimated equation-3, the multiple correlation coefficient (R²) indicates the collective effect of both independent variables on dependent variable i.e., area under the paddy crop in the Coastal Andhra region is to be 16 per cent. From F-test statistic, this collective effect (R²) of independent variables is found to be significant (2.2686). The coefficient of R² is 0.0921. The factor figure of the lagged price (Pₜ₋₁) is 0.1010. It shows that the area under the paddy crop is positive and significant. It means as the price of paddy increases the area under paddy crop may be raised significantly by its growers. So, it is drawn that area under paddy crop in Coastal Andhra region is suggestively price responsive. The coefficient of
lagged area ($A_{t-1}$) is 0.2071. This figure indicates that if there was any increase in independent variable the dependent variable also will increases insignificantly. So, it was found that in the view of the equation – 3 both the independent variables are affecting significantly with its progressive nature in the study area. The value of coefficient of constant term i.e., $b_o$ is 11.0296.

**Telangana region:**

As revealed in the given below table 4.6, the fraction of multiple correlation coefficient ($R^2$) is 0.2081. It is observed that the combined effect of both the independent variables (lagged price and lagged yield) on dependent variable (area under the paddy crop of the current year) in Telangana region in the study period is observed to be 20.8 per cent. From F-test statistic, this collective effect ($R^2$) of independent variables is found to be significant (3.0218). The coefficient of adjusted multiple correlation coefficient ($\bar{R}^2$) is 0.1392. The value of coefficient of constant term is 9.1751.

The combined effect of two the independent variables (lagged price and lagged area) on the dependent variable area under the paddy crop are significantly at 5 per cent probability level. These two variables shows 20.81 per cent of variation in paddy area in the region. This variation is significant and proved by F-test statistics. The coefficient of lagged price
(P_{t-1}) is (-0.0803) negative and insignificant. For every one unit in lagged price, 0.08 units of cropped area may be decreased but this decrease is not significant. It also indicates as the price of paddy increases the area under paddy may be drop insignificantly by its growers. So, the area under paddy is non-price responsive. Contradictorily, the effect of lagged area (A_{t-1}) on current year cropping area (A_t) is positive and significant at 5 per cent of probability level. It means there was adhesive relationship between dependent (A_t) and independent variable (A_{t-1}) in the study region. It reveals that the lagged areas’ effect on current years’ area is positive and significant.

Andhra Pradesh state:

The multiple correlation coefficient (R^2) tells us that the combined effect of both independent variables namely, lagged price (P_{t-1}) and lagged area (A_{t-1}) on dependent variable i.e., area under the paddy crop (A_t) in as a whole of Andhra Pradesh state is to be 24 per cent and this collective effect is tested to be significant (3.7566) by F-test statistic. The coefficient of \overline{R}^2 is 0.1807.

It was also estimated to find the individual effect of both independent variables, i.e., lagged price (P_{t-1}) and lagged area (A_{t-1}) separately. The coefficient of the lagged price (P_{t-1}) is 0.0109. It shows that the effect of lagged price is positive and but insignificant. It means as the price of
paddy increases the area under paddy crop may be raised insignificantly by its growers. So, it is drawn that area under paddy crop in Andhra Pradesh is non-price responsive. The coefficient of lagged area \((A_{t-1})\) is 0.4814. This figure indicates that the effect of the independent variable on the dependent variable is positive and insignificant. Hence, the current years, paddy area is significantly depending on lagged years, area of paddy.

So, it was found that in the view of the equation – 3, though both independent variables are affecting the current year area under the paddy positively but the effect of lagged area \((A_{t-1})\) is significant at 5 per cent of probability level. The value of coefficient of constant term i.e., \(b_0\) is 7.7925.

**Inter-regional Analysis:**

Accordance with the equation-3, the effect of lagged price \((P_{t-1})\) on cropped area \((A_t)\) is positive in Coastal Andhra region and state as a whole. But in Rayalaseema and Telangana regions, it is shows negative effect on cropped area of paddy. The effect of lagged area \((A_{t-1})\) on cropped area \((A_t)\) is positive and significant in all regions and state as a whole in the study period. The combined effect of both independent variables on dependent variable is calculated by the multiple regressions coefficient \((R^2)\) and is similar in all regions including state as a whole. It is tested by F-test statistic as significant at 95 per cent of confidence.
Equation -- 6

To study the combined effect of all independent variables namely, lagged price \((P_{t-1})\), lagged yield \((Y_{t-1})\), the coefficient of variation of preceding three years price \((CV_p)\), the coefficient of variation of preceding three years yield \((CV_Y)\), current year rainfall \((R_t)\) current irrigated area \((I_t)\), dummy variable \((D)\) (the effect of the left out variables like new technology, HYV, use of fertilisers and chemicals etc.,) and lagged area \((A_{t-1})\) on dependent variable (current cropping area of paddy \((A_t)\)) it is adopted the equation-6, shown in methodology. The findings of all variables are given in table-4.2.

Rayalaseema Region:

The combined effect of all independent variables namely, lagged farm harvest price \((P_{t-1})\), lagged yield \((Y_{t-1})\), the coefficient of variation of preceding three years price \((CV_p)\), the coefficient of variation of preceding three years yield \((CV_Y)\), current year rainfall \((R_t)\), current irrigated area \((I_t)\) and lagged year area \((A_{t-1})\) on dependent variable cropping area of the current year \((A_t)\) is roughly cent (100) per cent and is tested by F-test statistic as significant. The value of adjusted multiple correlation \((\overline{R}^2)\) is 0.9699.

The coefficient of lagged price \((P_{t-1})\) is -0.0013. It shows that the area of paddy is non-price responsive. It means there was negative and
insignificant relationship between cropping area of paddy and price of paddy in Rayalaseema region. It indicates as the price of paddy increases the area under paddy may be insignificantly decrease by its growers. The coefficient of \( Y_{t-1} \) (lagged yield) is -0.0015. This negative and insignificant figure also indicates that if there was any increase in the independent variable, the dependent variable will decrease insignificantly. So, there is no effect of lagged yield on cropping area of paddy.

The coefficient of variation of preceding three years price (\( CV_p \)) shows an inverse relationship between dependent and independent variables. The effect of the both variables, the coefficient of variation of preceding three years yield (\( CV_Y; 0.0004 \)) and current year rainfall (\( R_t; 0.0010 \)) on dependent variable is positive but not significant. Contradictorily, the coefficient of irrigated area (\( I_t \)) is showing its positive and significant effect on current year cropped area (\( A_t \)). It indicates as the irrigated area of paddy increases the area under paddy certainly raised significantly by its growers i.e. the area under paddy is perfectly irrigated area and rainfall responsive. The coefficient of lagged area (\( A_{t-1}; 3.6599 \)) is positive and significant. It means the dependent variable is deciding positively by independent variable. The portion of this effect on dependent variable is 366 per cent. The constant or intercept term is 0.2179.
### Table: 4.2
Estimated supply response function of Paddy for Equation-6

<table>
<thead>
<tr>
<th>Regions</th>
<th>Estimated Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated Values</td>
</tr>
<tr>
<td></td>
<td>$b_0$</td>
</tr>
<tr>
<td>Rayalaseema</td>
<td>0.2179 (0.0112)</td>
</tr>
<tr>
<td>Coastal Andhra</td>
<td>0.1602 (0.0064)</td>
</tr>
<tr>
<td>Telangana</td>
<td>1.7567 (3.2496)</td>
</tr>
<tr>
<td>Andhra Pradesh State</td>
<td>0.7050 (0.6559)</td>
</tr>
</tbody>
</table>

**Note:** Figures in parentheses are standard errors of the estimates.

*Significant at five per cent probability level.
Coastal Andhra region:

The collective affective of all independent variables on dependent variable i.e., current year cropping area of paddy in the Coastal Andhra is 95 per cent. This collective effect of independent variables on dependent variable is tested by F-test statistic as significant (13.1315) during the study period. The value of adjusted multiple correlation ($\bar{R}^2$) is 0.9099.

The coefficient of lagged area ($A_{t-1}$; -0.0006), the coefficient of lagged price ($P_{t-1}$; -0.0003), current year rainfall ($R_t$; -0.0011), the coefficient of variation of preceding three years yield ($CV_y$; -0.0001) and the coefficient of variation of preceding three years price ($CV_p$; -1.3981) are having negative relationship with dependent variable but not significant at 5 per cent probability level. It means the dependent variable is affecting damagingly by independent variables of the coefficient of lagged area ($A_{t-1}$), the coefficient of lagged price ($P_{t-1}$), current year rainfall ($R_t$), the coefficient of variation of preceding three years yield ($CV_y$) and the coefficient of variation of preceding three years price ($CV_p$).

So, there is no scope to improve the cropping area ($A_t$) by increasing the above said variables in Coastal Andhra region. Contradictorily, the coefficient of lagged yield ($Y_{t-1}$; 0.0006) and the coefficient of irrigated area ($I_t$; 0.9907) are showing its positive and significant effect on current year cropped area ($A_t$) except the coefficient of lagged yield. It indicates as
the irrigated area of paddy increases the area under the paddy crop raised 99 per cent by its growers i.e. the area under paddy is perfectly irrigated area responsive in Coastal Andhra region and this growth is significant at 5 per cent probability levels. The value of coefficient of $b_0$ (constant) is 0.1602.

**Telangana region:**

All the independent variables i.e., lagged farm harvest price ($P_{t-1}$), lagged yield ($Y_{t-1}$), the coefficient of variation of preceding three years price ($CV_p$), the coefficient of variation of preceding three years yield ($CV_Y$), current year rainfall ($R_t$), current irrigated area ($I_t$) and lagged year area ($A_{t-1}$) showing collective effect on the dependent variable i.e., cropping area of the current year ($A_t$) is 73.60 per cent and is tested by $F$-test statistic (5.9255) as significant. The value of adjusted multiple correlation coefficient ($\bar{R}^2$) is 0.6118.

The coefficient of lagged yield ($Y_{t-1}$) is -0.0073. This negative and insignificant figure indicates that if there was any increase in independent variable, the dependent variable will decrease. But this decrease is insignificant. So, there is no individually effect of lagged yield on cropping area of paddy in the region in the study period. The coefficient of variation of preceding three years price ($CV_p$) is also inversely effecting on dependent variable.
Contradictorily, the factor of lagged price ($P_{t-1}$) is 0.3244. It illustrates that the paddy cropping area is price responsive. It means there was positive and significant relationship between area and price of paddy crop and as the price of paddy increases the area under paddy may be raised significantly by its growers i.e. the area under paddy is price responsive in Telangana region. The effect of remaining independent variables i.e., the coefficient of variation of preceding three years yield ($CV_Y$), current year rainfall ($R_t$), the coefficient of irrigated area ($I_t$) and the coefficient of lagged area ($A_{t-1}$) are individually effecting the dependent variable as positive. But only the effect of current year rainfall ($R_t$), and lagged area ($A_{t-1}$) is significant. It means there was any increase in current year rainfall, and lagged area it must be rose the current year cropping of paddy as follow as 0.6557 per cent and 0.6098 respectively in Telangana region in the study period. The value of coefficient of constant term i.e., $b_0$ is 1.7567.

**Andhra Pradesh state:**

The collective affective of all independent variables specifically, lagged farm harvest price ($P_{t-1}$), lagged yield ($Y_{t-1}$), the coefficient of variation of preceding three years price ($CV_p$), the coefficient of variation of preceding three years yield ($CV_Y$), current year rainfall ($R_t$), current irrigated area ($I_t$) and lagged year area ($A_{t-1}$) on dependent variable i.e.,
current year cropping area in the Andhra Pradesh state as a whole is 98 per cent. This collective effect of independent variables on dependent variable is tested by F-test statistic as significant during the study period. The value of adjusted multiple correlation ($\bar{R}^2$) is 0.9706.

The coefficient of lagged yield ($Y_{t-1}$; 0.1263), the coefficient of variation of preceding three years price ($CV_p$; 0.047), the coefficient of variation of preceding three years yield ($CV_y$; 0.017), current year rainfall ($R_t$; 0.0559), the coefficient of irrigated area ($I_t$; 0.8666) and the coefficient of lagged area ($A_{t-1}$; 0.0103) are showing its individual effect on dependent variable positively but only the coefficient of lagged yield ($Y_{t-1}$) and current year irrigated area ($I_t$) are significant at 5 per cent probability level. It means both the above said independent variables are causing to grow the paddy cropped area in the study period in the study area i.e., Andhra Pradesh state as a whole. Contradictorily, the coefficient of lagged price ($P_{t-1}$; -0.0308) is showing insignificantly negative relationship with the dependent variable. The coefficient of the constant term is 0.7050.

**Inter-regional analysis:**

In continuation with the equation-6, in the view of inter-regional analysis, the effect of lagged price ($P_{t-1}$) on cropping area of ($A_t$) is negatively insignificant in all regions and Andhra Pradesh state a whole except in Telangana region. Similarly, the dependent variable is negatively
affected by lagged yield \((Y_{t-1})\) in Rayalaseema and Telangana regions. Contradictorily, in Coastal Andhra region and state as a whole is positively affected. But these both positive and negative effects are certainly insignificant. Whereas, the finding of coefficient of variation of preceding three years price \((CV_p)\) is negative in all regions except in state. But only in Rayalaseema region is significant. The coefficient of variation of preceding three years price \((CV_y)\) is negatively insignificant in Coastal Andhra region. But the effect of \(CV_y\) is positive and insignificant in remaining regions and state as a whole.

Other than the rainfall \((R_t)\) is also affecting the cropping area \((A_t)\) of paddy in Rayalaseema, Telangana and state as a whole is positively affected. But only in Coastal Andhra region is negatively insignificant. The dependent variable is positively caused by the irrigated area \((I_t)\) for a lot in Rayalaseema, Coastal Andhra regions and also in state as a whole, whereas in Telangana region is though positive it is insignificant.

In continuation of the above variables, the consequence of the left out variables like new technology, HYV (dummy variable) on current year cropped area of paddy \((A_t)\) is positively significant in Rayalaseema region except in remaining regions and state as a whole. The influence lagged area \((A_{t-1})\) on current year of cropped area of paddy is positive in
Rayalaseema, and Telangana regions and state except in Coastal Andhra region whereas only significant in Rayalaseema region in the study period.

There was found unique figures from multiple correlation coefficient ($R^2$) in all regions as well as state as a whole. It shows that the combined effect of all independent variables on dependent variable is in unique form and tested by F-test statistic as significant at 5 per cent probability level. The values of the adjusted multiple correlation coefficients ($\bar{R}^2$) are show as good as relation among the all independent variables and dependent variable in all regions and state except in Telangana region.