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Research Note

A REGIONAL ANALYSIS OF SUPPLY RESPONSE OF RICE IN ANDHRA PRADESH

J. Krishnaiah

I. INTRODUCTION

Rice accounts for 78 per cent (9.6 million tonnes) of total foodgrain production (12.3 million tonnes) in Andhra Pradesh. Out of a total production of 9.6 million tonnes coastal Andhra, Rayalaseema and Telangana contributes respectively 5.5, 0.7 and 3.4 million tonnes.

Out of the total quantity of 12.6 million tonnes of rice procured in India, Andhra Pradesh contributes 3.3 million tonnes next to Punjab with a contribution of 4.8 million tonnes. Rice is purchased by the Government through Government and Cooperative agencies to safeguard the interests of farmers. The minimum support prices should provide sufficient incentive to allocate more area under the crop. But, the minimum support price of Rs. 230/- quintal announced for 1991-92 season with an increase of Rs. 25/- quintal over previous year could not arouse the desired response from the farmers of Andhra Pradesh. This is evident from the decline in the market arrivals from 1.04 million tonnes in the marketing year 1989-90 to 0.42 million tonnes in 1990-91. In the light of this economic background, any attempt to stuuy producers' response to price changes and their adjustment behaviour assumes a lot of significance.

Farmers' response to price changes can be grouped under three categories viz., output response, area response and yield response. In case of

The author is an Associate Professor, Department of Agricultural Economics, Andhra Pradesh Agricultural University, India. He is indebted to an anonymous referee for valuable comments on the earlier version of the paper.

rice, these studies in Andhra Pradesh are limited (Cummings, 1975, P. 25; Rao and Pandey, 1976, P. 46; Reddy, 1989, P. 447). The magnitude of farmers' response to price varies with the crop and for the same crop among different regions because of variations in resource endowments. So, an attempt has been made to estimate the responsiveness of farmers to price and non-price variables in respect of area, production and yield of rice in different regions of Andhra Pradesh for the period 1956-57 to 1987-88.

II. MODEL SPECIFICATION

The responses in area, production and yield of rice at the state and regional level were measured by applying Nerlovian Partial Adjustment Model. Different variables like price of rice lagged by one year (P_{t-1}), the price of its competing crop namely sugarcane lagged by one year (P^c_{t-1}), sowing season rainfall (SSR_t), Southwest monsoon rainfall (SWM_t) and time trend (T_t) were selected to study the area, production and yield responses separately.

The data for the period 1956-57 to 1987-88 at the regional and State level (time series and cross section) were collected from season and crop reports and statistical abstracts published by the Bureau of Economics and Statistics, Government of Andhra Pradesh, The double-log form of the Nerlovian partial adjustment model was employed in view of its suitability to the data. Three different response models were developed separately for area, production and yield responses.

a) Area response model:

$$\log A_t^* = b_o + b_1 \log P^c_{t-1} + b_2 \log P_{t-1} + b_3 \log SSR_t + b_4 T_t + U_t \quad \ldots (1)$$

$$\log A_t - \log A_{t-1} = B (\log A_t^* - \log A_{t-1}),\ 0 < B < 1 \quad \ldots (2)$$

Where A_t^* = The planned or long run equilibrium area

P_{t-1} = Own price of the crop in year t-1

P^c_{t-1} = Price of competing crop in year t-1

A_t & A_{t-1} = Actual area in t and t-1

SSR_t = Sowing season rainfall in year t

T_t = Times trend

B = Coefficient of adjustment

U_t = Error term

The equation (1) can not be estimated because it includes un-observable variable. If (1) is substituted in (2), an estimable equation results as shown below.

$$\log A_t - \log A_{t-1}$$

$$= B [(b_0)+b_1 \log P^c_{t-1} + b_2 \log P_{t-1} + b_3 \log SSR_t + b_4 T_t + U_t) - \log A_{t-1}]$$

$$= Bb_0 + Bb_1 \log P^c_{t-1} + Bb_2 \log P_{t-1} + Bb_3 \log SSR_t + Bb_4 T_t + BU_t - B \log A_{t-1}$$

$$\log A_t = Bb_0 + Bb_1 \log P^c_{t-1} + Bb_2 \log P_{t-1} + Bb_3 \log SSR_t + Bb_4 T_t + BU_t - B \log A_{t-1} + \log A_{t-1}$$

$$= Bb_0 + Bb_1 \log P^c_{t-1} + Bb_2 \log P_{t-1} + Bb_3 \log SSR_t + Bb_4 T_t + \log A_{t-1} (1-B) + BU_t$$

$$= C_0 + C_1 \log P^c_{t-1} + C_2 \log P_{t-1} + C_3 \log SSR_t + C_4 T_t + C_5 \log A_{t-1} + V_t \quad \ldots. (3)$$

Where $C_0 = Bb_0$, $C_1 = Bb_1$, $C_2 = Bb_2$, $C_3 = Bb_3$, $C_4 = Bb_4$, $C_5 = (1-B)$, $V_t = BU_t$

b) Production response model:

$$\log Q^*_t = b_0 + b_1 \log P^c_{t-1} + b_2 \log T_t + b_3 \log SSR_t + b_4 \log SWM_t + U_t \quad \ldots. (4)$$

$$\log Q_t - \log Q_{t-1} = B (\log Q^*_t - \log Q_{t-1}),\ 0 < B < 1 \quad \ldots. (5)$$

Where Q^*_t = The planned output

SWM_t = South West Monsoon Rainfall in year t
Q_t and Q_{t-1} = Output in years t and t-1 respectively
The notations P_{t-1}, Tt, SSRt, B, and U are same as explained earlier.

If (4) is substituted in (5), we get $\log Q_t = C_0 + C_1 \log Pc_{t-1} + C_2 \log T_t + C_3 \log SSR_t + C_4 \log SWM_t + C_5 \log Q_{t-1} + V_t$ .... (6)

c) Yield Response Model:

$\log Y^*_t = B_0 + b_1 \log P_{t-1} + b_2 \log T_t + b_3 \log SSR_t + b_4 \log SWM_t + U_t$ .... (7)

$\log Y_t - \log Y_{t-1} = B (\log Y^*_t - \log Y_{t-1}), 0 < B < 1$ .... (8)

Where Y*t = The planned yield

Y_t and Y_{t-1} = Yield in years t and t-1 respectively. Other notations appearing in this model are same as explained earlier.

If (7) is substituted in (8), we get

$\log Y_t = C_0 + C_1 + \log P_{t-1} + C_2 \log T_t + C_3 \log SSR_t + C_4 \log SWM_t + C_5 \log Y_{t-1} + V_t$ .... (9)

Coefficient of Adjustment

The 'B' (0 < B < 1) coefficient in the Nerlovian partial adjustment model gives the coefficient of adjustment. If it is nearer to one, it indicates that the farmers have no constraints in adjusting their area to the desired level in a short period. But, if it is nearer to zero, then it implies that the farmers will take long time to adjust.

Price Elasticities

The coefficients of prices in the area, production and yield response equations represent their short-run price elasticities.

The long run price elasticities were obtained by the following formula.

$$E^P_{(L)} = \frac{E^P_{(S)}}{B}$$

Where, $E^P_{(L)}$ = Long run price elasticity

$E^P_{(S)}$ = Short run price elasticity

B = Coefficient of adjustment

= 1 - coefficient of lagged dependent variable.

Speed of Adjustment

Speed of adjustment implies the number of years required to realise 95 per cent of the price effect. It was estimated using the formula.

$(1 - B)^N = 0.05$

Where, B = Coefficient of adjustment and

N = Number of years

III. ESTIMATED RESULTS

Area Response

The estimated area responses of rice for the State and different regions are presented in Table 1. The coefficients of own price and that of competing crop lagged by one year, sowing season rainfall and time trend have shown expected sign at State level. It is strange that, time trend but not the price variables was significant in Coastal Andhra. It emphasises that area allocation decisions are guided by the availability and rate of diffusion of technology.

In the case of Rayalaseema, it is the price of the competing crop lagged by one year that is more significant in allocating area under the crop rather than own price. This will suggest that the farmers of this region are concious of inter-crop price parity and prefer better remunerative crops to rice. It may also be due to the aggregation bias. It may be mentioned here, that the inter district variations were not explicitly considered by using district dummies (See Singh *et al.,* 1974). Apart from this, sowing season rainfall, time trend and area lagged by one year are other factors influencing acreage allocation decisions reflecting the rational behavior and expectation of farmers. It also suggests that this region is endowed with conditions favourable to area expansion under rice. In the case of Telangana all the independent variables included in the function except time trend turned out to be significant. This suggests that the technology has not percolated to the

Table 1. Estimates of Area Response Functions of Rice in Different Regions of Andhra Pradesh.

Region	Constant	Regression Coefficient of					R^{-2}	d-statistic
		P_{t-1}	P^{c}_{t-1}	SSR_t	T_t	A_{t-1}		
Coastal Andhra	5.38	0.01	0.01	0.11**	0.05**	0.19	0.82	1.41
		(0.01)	(0.02)	(0.02)	(0.02)	(0.11)		
Rayalaseema	2.83	0.02	-0.15**	0.16**	0.08**	0.45**	0.84	0.96
		(0.04)	(0.03)	(0.03)	(0.03)	(0.06)		
Telangana	3.74	0.19	-0.08**	0.19	-0.01	0.21**	0.99	1.80
		(0.02)	(0.01)	(0.01)	(0.01)	(0.03)		
Andhra Pradesh	6.14	0.10**	-0.09	0.16	0.08	0.10	0.89	1.97
		(0.02)	(0.02)	(0.03)	(0.02)	(0.07)		

Note : Figures in parentheses indicate standard error

** : Indicate significance at 1% level

expected depth among rice farmers. So, it warrants strengthening extension agency in this region.

Production Response

Estimated results of production response model are presented in Table 2. It can be observed that price, South West monsoon period rainfall and technology are the key factors determining production of the rice in the state and its regions. South West monsoon rainfall was found to be more useful in Telangana region and less useful in Coastal Andhra. This is understandable since Coastal Andhra has assured irrigation facilities in most of the districts. This rice growing farmers in the districts of Srikakulam and Vizianagaram depend on rainfall since the irrigation facilities are inadequate. While trend was significant in al regions, it turned out to be insignificant at the State level. This suggests that, not all rice growing farmers of the State are technologically progressive. The results on production response indicate that the farmers of Telangana region realise more production gains through technology adoption compared to those in other regions. But, the results of area response proved clearly that there was no gain through area expansion. This lends support to the view that Telangana region has no potential to increased rice production through area expansion (Krishnaiah and Moorthy, 1988; p. 42). So, production gains in Telangana should come mainly from yield improving methods, The differences in soils, climate, farmer's behaviour patterns including managerial skills, and socio-economic infrastructure could corraborate this view. This might also be due to the practice of monocropping in coastal Andhra (rice followed by rice) while crop rotation followed in Telangana enabled it to realise the untapped potential.

Yield Response

The estimated yield response functions are presented in Table 3 which indicate that price and previous year's yield played a positive role in Andhra Pradesh and its three regions. This is in consonance with the behaviour of the farmers to assume that the current year's price and yield should be at least

Table 2. Estimates of Production Response Functions of Rice in Different Regions of Andhra Pradesh.

Region	Constant	Regression Coefficient of					R^{-2}	d-statistic
		P_{t-1}	SSR_t	SWM_t	T_t	Q_{t-1}		
Coastal Andhra	2.02	0.21**	-0.01	0.31**	0.07**	0.36**	0.99	1.89
		(0.02)	(0.01)	(0.03)	(0.01)	(0.03)		
Rayalaseema	1.63	-0.03	-0.05	0.50**	0.13**	0.22**	0.93	1.74
		(0.03)	(0.03)	(0.05)	(0.22)	(0.05)		
Telangana	-0.7	0.19**	0.02	0.77**	0.22**	0.20**	0.95	1.68
		(0.16)	(0.07)	(0.07)	(0.05)	(0.24)		
Andhra Pradesh	2.42	0.31**	-0.17	0.54**	0.04	0.24*	0.95	1.85
		(0.05)	(0.08)	(0.09)	(0.03)	(0.09)		

Note : Figures in parentheses indicate standard errors

** : Indicate significance at 1% level

* : Indicate significance at 5% level

Table 3. Estimates of Yield Response Functions of Rice in Different Regions of Andhra Pradesh.

Region	Constant	Regression Coefficient of					R^{-2}	d-statistic
		P_{t-1}	SSR_t	SWM_t	T_t	Y_{t-1}		
Coastal Andhra	2.68	0.19**	-0.09**	0.19**	0.02	0.42**	0.99	1.33
		(0.02)	(0.03)	(0.03)	(0.01)	(0.03)		
Rayalaseema	4.50	0.14**	0.05	0.02	0.04*	0.23**	0.95	1.874
		(0.03)	(0.03)	(0.04)	(0.02)	(0.07)		
Telangana	3.33	0.16**	0.05	0.15	0.10**	0.23**	0.96	1.29
		(0.04)	(0.04)	(0.04)	(0.03)	(0.08)		
Andhra Pradesh	2.24	0.17**	0.04	0.08	0.01**	0.49**	0.95	2.20
		(0.04)	(0.06)	(0.06)	(0.02)	(0.08)		

Note : Figures in parentheses indicate standard error

** : Indicate significance at 1% level

* : Indicate significance at 5% level

equal to or greater than those of previous year (Sawant, 1978). Rainfall during south-west monsoon period exerted positive influence in coastal Andhra and Telangana. It was because of the fact that dough stage (stage of grain formation) requires water and moist conditions. Rainfall during southwest monsoon period could help in better grain formation in coastal Andhra and Telangana. In this connection, it may be mentioned that the rainfall used in the model during south-west monsoon period was 407 millimeters in coastal Andhra and 594 millimetres in Telangana as against a normal rainfall of 603 millimetres and 764 millimetres respectively. Since the actual utilisation was less than the normal requirement, one expects a positive response. But, however, the sowing season rainfall has shown negative influence in coastal Andhra. This is because 85 per cent of the area under rice in the region is under irrigation while the same is 76 per cent in Telangana and 52 per cent in Rayalaseema. Thus, the rise of water both by irrigation and rainfall in excess of the requirement, probably would have become counter productive in Coastal Andhra. The time trend which is a'proxy' for technology and shows "catch all effect" was not significant in Coastal Andhra while it is the most significant factor in improving yields in Telangana and Rayalaseema. This implies that yields and production can be further increased only through the implementation of yield improvement programmes in both Rayalaseema and Telangana regions, but not in Coastal Andhra.

Price Elasticities and Their Comparison with Earlier Studies in the Region

The estimated short and long run elasticities for area, production and yield of rice with respect to lagged rice price are presented in Table 4. In case of area response, the elasticity was minimum, but not significant in coastal Andhra while it was maximum in Telangana. In case of production and yield responses, the elasticity was maximum in coastal Andhra and minimum in Rayalaseema. It is because of the differences in the resource endowments. In the case of costal Andhra, sugarcane, chillies, tobacco and cotton are the

most important competing crops. Besides, the rice fields are being converted into fish ponds in recent years in this region. Thus, the area allocation decisions of the farmers in coastal Andhra depend, not on the price variables, but on the non-price variables like technology and irrigation etc. Though technology is available, irrigation was not so assured in Telangana. So, the farmers in that region are price conscious. When a comparison is made between Telangana and Rayalaseema, it could be mentioned that the differences in the elasticity coefficients might be attributed to the progressiveness of the farmers' resource potentials especially productivity of soils and irrigationfacilities. The short run price elasticity estimates in the present study varied from 0.01 to 0.10 in case of area, 0.19 to 0.31 in case of production and 0.14 to 0.19 in case of yield. The long run elasticities ranged respectively from 0.01 to 0.24, 0.24 to 0.41 and 0.19 to 0.34. However, the production response is inelastic, though negative, to price changes in Rayalaseema while area response is inelastic though positive, in coastal Andhra and Rayalaseema. The short run price elasticities of area were 0.22, 0.19, 0.06 and 0.35 for coastal Andhra, Rayalaseema,Telangana and Andhra Pradesh respectively for the period 1954-55 to 1970-71 according to Rao and Pandey (1976). The long run elasticities were 0.38, 0.19, 0.08 and 0.46 respectively. Reddy (1989) reported the short run price elasticities for area as 0.19, 0.12, 0.24 and 0.20 for the regions and state in the order mentioned above. The long run elasticities were 0.29, 0.19, 0.39 and 0.33 for the period 1963-64 to 1983-84.

Table 4. Estimated Price Elasticities of Area, Productionand Field Response Functions.

Region	Area		Production		Yield	
	Short run	Long run	Short run	Long run	Short run	Long run
Coastal Andhra	0.01	0.01	0.21	0.33	0.19	0.32
Rayalaseema	0.02	0.04	-0.03	-0.04	0.14	0.19
Telangana	0.19	0.24	0.19	0.24	0.16	0.21
Andhra Pradesh	0.10	0.11	0.31	0.41	0.17	0.34

Table 5. Estimated Coefficients and Speed of Adjustment of Actual area, Production and Yield to their Desired Level.

Region	Coefficient of adjustment (B)			No. of years required to realise 95% of price effect (N)		
	Area	Production	Yield	Area	Production	Yield
Coastal Andhra	0.81	0.64	0.58	1.81	2.93	3.45
Rayalaseema	0.55	0.78	0.77	3.74	1.98	2.06
Telangana	0.79	0.80	0.77	1.94	1.87	2.02
Andhra Pradesh	0.91	0.76	0.51	1.28	2.07	4.14

Thus, when a comparison of these estimates is made with those of the present study, one can observe that the former are higher in magnitude. This variation could be attributed to time, data and the choice of variables specified in the models.

Speed of Adjustment

The estimated coefficients and the speed of adjustment of actual area, production and yield to their desired level are presented in Table 5. Taken regionwise, the coefficient of adjustment (B) was maximum in coastal Andhra (for area) and Telangana (for production and yield). But, the area adjustment coefficient at state level was higher than all other regional coefficients. In respect of production, this coefficient was minimum in coastal Andhra (0.64) and maximum in Telangana (0.80). At state level this coefficient was higher than that of coastal Andhra and lower than that of Telangana and Rayalaseema. In respect of yield, the adjustment coefficient was minimum at state level (0.51) and maximum in Rayalaseema and Telangana (0.77).

These results clearly revealed the differential response of the regions. This could be, as already explained, due to the vairations in rate of adoption of technology, resource base, progressiveness and price consciousness of

farmers. The results imply that the farmers of coastal Andhra, compared to other regions, take less number of years to adjust their area to a desired level while it was the reverse situation in adjusting their production and yield. The farmers of Telangana regions are quick to realise the effect of price changes through production and yield adjustments.

IV. SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

Area, production and yield responses of rice in different regions of Andhra Pradesh for the period 1956-57 to 1987-88 were estimated. The following are the important findings of the study.

The non-price rather than price variables were significant in determining area response in coastal Andhra while production and yield responses were influenced by both price and non- price variables. The farmers of coastal Andhra are technology induced but not price conscious in case of area allocation decisions. The farmers of Telangana are responsive to price and non- price variables in area allocation, production and yield adjustment decisions. They exhibited potential to improve both yield and production. In the case of Rayalaseema, the price of competing crop exerts a stronger influence on area allocation decisions than own price.

The results of the study indicate that the area, production and yield of rice in different regions are elastic with respect to price and non-price variables. The short run price elasticities ranged from 0.01 to 0.19 in respect of area, from 0.19 to 0.31 in respect of production and from 0.14 to 0.19 in respect of yield while the long run elasticities ranged from 0.01 to 0.24, 0.24 to 0.41 and 0.19 to 0.34 in the order indicated.

The farmers of coastal Andhra, compared to other regions, take less number of years to adjust their area to a desired level while the opposite holds true in case of production and yield. The farmers of Telangana region are quick to realise the effect of price changes through production and yield adjustments.

Though the study has clearly revealed the differential response of rice farmers in the regions, the social, economic and political factors which contribute to these regional differences in farmers' responsiveness could not be accommodated and explained properly. So, future research effort may concentrate on quantification of these qualitative aspects to capture their effects in a reasonable way.

The present study yielded results with the following implications for policy:

1) The Government of Andhra Pradesh should concentrate the rice yield improvement programmes in Telangana and Rayalaseema regions. Input subsidies and other incentives may be offered to induce the farmers to realise the desired targets.

2) In order to effectively bring about adjustment in area allocation, production and yield, prices have to be announced before the sowing season with long run guarantee.

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