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An analysis of supply response of rapeseed-mustard in different regions of Uttar Pradesh

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Abstract

The continuing imbalance between increasing demand and slow growth in supply of oilseeds is a major concern which needs to be addressed seriously. The increase in the production of oilseed has to come through increase in acreage and /or productivity of the oilseeds. Uttar Pradesh is a very important state in the country from agricultural point of view, which occupying second position in rapeseed-mustard production. In Uttar Pradesh, an attempt was made to examine the economic factors on supply response of rapeseed-mustard in different regions, and at aggregate level. The present study evaluated the impact of price and selected non-price factors on the area of rapeseed-mustard, and to analyse the short and long-run price elasticities. This macro framework study used 20 years (1989–90 to 2008–09) secondary data regarding area, productivity, farm harvest price of crops, farm harvest price of competing crops, monsoon season rainfall, percentage irrigated area of crops, and competing crop (gram). The double log Nerlovian lagged adjustment model used in present study postulates that the actual acreage under a crop in each period is adjusted in a proportion to the difference between the desired acreage in the long run equilibrium, and the actual acreage under it in the preceding year. The short-run price elasticities of acreage are directly obtained from logarithmic form of the model function. As the value of coefficient of adjustment usually lies between zero and one, the value of 'B' close to the unity indicates that the adjustment process is very fast. When the value of 'B' is close to zero, the implication is that the adjustment process is very slow to the changing prices and other non-prices factors. If the value of 'B' is greater than one it would mean that the farmers over adjust to the planned acreage. Speed of adjustment implies the number of years required to realize 95 per cent of the price effect which was estimated using the formula suggested by Krishna, (1992). The results showed that acreage response of rapeseed-mustard to the price of rapeseed-mustard was positive and significant in all regions of Uttar Pradesh, except Bundelkhand region. The response to the price of competing crop (gram), however, was positive and significant only in case of Central region. The lagged yield of rapeseed-mustard was found to be positive and significant only in Bundelkhand region. Rainfall had strong impact on acreage under rapeseed-mustard both at aggregate and regional levels. The percentage irrigated area showed positive and significant impact in all regions, except the Central region. The percentage irrigated area of competing crop gram was positive and significant only in the Central region, but it was negative and significant at state level. Lagged area under the concerned crop was positive and significant for Western, Central, and state as a whole. In all the cases, price as well as yield risk did not play any significant role in acreage allocation of rapeseed-mustard, except in the Central and Bundelkhand regions where the yield risk was positive and significant. The short run price elasticities varied from region to region. The impact of prices was the highest in the Western and lowest in the Central region. The comparative closeness of long run elasticity to the short run elasticity in central region revealed a greater degree of adjustment in this region. The results of speed of adjustment showed that the farmers of Central and Bundelkhand regions would take less number of years to realize 95% of price effect as compared to the farmers of other regions.

Introduction

Production of oilseed in India during 1950–51 was 5.16 mt, which has increased to 32.87 mt in 2012-13. India ranks third in the world in oilseed Brassica production after China and Canada. In domestic agriculture oilseeds occupy 14% of the country's gross cropped area, and nearly 6% of the gross national product. India accounts for 12–15% of world's oilseed area, 7–8% of world's oilseed output, and 6–7% of world's vegetable oil production (Anonymous).

According to an estimate by National Council of Applied Economic Research (NCAER), in the year 2000–2001, the demand for edible oil was projected at 10 million tons against the domestic production of 6.7–7.0 mt. The shortfall of 3.0–3.3 mt was expected to be met by importing edible oil. The NCAER predicts that in the year 2015, the demand for edible oil in India would be 20 mt per annum. Considering the present domestic edible oil supply of 7 mt per annum, a shortfall of 13 mt per annum is envisaged in the year 2015. To bridge this gap, a growth rate of 15% per annum would be required in edible oil production in the country. Currently, edible oil growth rate in India is only 4%. In the event of failure to achieve the required growth rate, India would continue to spend huge foreign exchange on import of edible oil.

In the world, India ranks first in castor, sesame and safflower, second in groundnut, third in rapeseed-mustard, fourth in linseed, and fifth in soybean. Although, rapeseed-mustard is grown all over India in different ecosystems and cropping sequences, it is mainly confined to north western and central regions. Four states namely, Rajasthan, Uttar Pradesh, Haryana and Madhya Pradesh account for nearly 78% of the acreage and 80% of the production of rapeseed-mustard. Rajasthan occupies a prime position amongst the states. Uttar Pradesh is the second largest rapeseed-mustard producing state with an acreage of 11.48 lakh ha, 13.35 lakh tonnes production, and with an average yield of 8.97 Qt/ha yield in 2012-13. The state of Uttar Pradesh is divided in to four regions: Central, Western, Eastern and Bundhelkhand regions.

Although, government devises different policy instruments, their success or failure depend mainly upon the way the farmers react and how the land, and the other resources are allocated to a particular crop. In Indian agriculture, food grain production increased tremendously, but output of oilseeds increased very slowly. The important factors causing low and fluctuating production of rapeseed-mustard include cultivation of crop mostly on marginal and sub-marginal lands of poor fertility, low adoption of improved production technology, deterioration in soil health, depletion of the natural resource base, genetic potential of varieties, fluctuations in price, and unremunerative prices.

The edible oil and oilseed sector in India faces many challenges in the new environment of liberalized trade. The impact of liberalization on the growth of agriculture crucially depends on how the farmers respond to various price incentives. Non-price factors including rainfall, irrigation, market access for both production inputs and outputs, and literacy seem to dominate farmers' decision problem [Krishna (1962), Gulati and Kelly (1999), and Narain (1965)]. The studies of Krishnan (1962) and Behrman (1968) established that farmers, even in the less developed countries, respond very positively and significantly to the price changes. The economic environment and incentives are changing rapidly due to one or other factors, and farmers are responsive to these changes even in the oilseed sector. Expected prices and risks are important determinants of oilseed production. The prices have positive effect while price risks have adverse effect on oilseed production.

In view of the above facts, it is imperative from policy makers' stand point to know the farmers' response in allocating their scarce resources in oilseed production in general, and rapeseed-mustard production in particular in an agriculturally important state of Uttar Pradesh towards price and non-price changes. The present study, therefore, was undertaken to estimate: a) the supply response of rapeseed-mustard; b) to estimate the short run and long run price elasticities of acreage; and c) to estimate the speed of adjustment in the area under rapeseed-mustard in different regions of Uttar Pradesh.

Data

The macro framework study in Uttar Pradesh used 20 year's secondary data (1989–90 to 2008–09) pertaining to area, productivity, farm harvest price of crops, farm harvest price of competing crops, monsoon season rainfall, percentage irrigated area under rapeseed-mustard, and competing crops. Based on correlation coefficients, although, wheat, gram, lentil, maize, and barley were identified as the competing crops, gram had the highest negative correlation coefficient with rapeseed-mustard. Gram, therefore, was taken as competing crop of rapeseed-mustard in the analysis.

Analytical Framework

Since, the acreage under crop is affected by changes in price and non-price factors, the farmers make adjustment in their acreage (supply) accordingly. Under such conditions, the double log Nerlovian lagged adjustment model was considered appropriate for examining the farmers' acreage response behaviour. In the present study, double log Nerlovian lagged adjustment model has been used under a crop, using this model, the actual acreage in each period is adjusted in proportion to the difference between the desired acreage in the long run equilibrium and the actual acreage under it in the preceding year. The lags in the adjustment behaviour may be due to technological constraints or lack of knowledge about the market or fear of risk, etc. According to this hypothesis, the change in actual acreage is only a proportion to the difference between the desired acreage in the long run equilibrium and actual acreage in the preceding year. Mathematically it can be expressed as follows;

$$A^*_t = b_0 + b_1 P_{t-1} + b_2 P^c_{t-1} + b_3 Y_{t-1} + b_4 RP_t + b_5 RY_t + b_6 MR_t + b_7 IR_t + b_8 IG_t + U_t \quad \text{..... (1)}$$

$$A_t - A_{t-1} = B(A^*_t - A_{t-1}) 0 < B < 1 \text{.....(2)}$$

The final equation of the model can be obtained as follows:

$$\log A_t = \log C_0 + C_1 \log P_{t-1} + C_2 \log P^c_{t-1} + C_3 \log Y_{t-1} + C_4 \log RP_t + C_5 \log RY_t + C_6 \log MR_t + C_7 \log IR_t + C_8 \log IG_t + C \log A_{t-1} + V_t \text{.....(3)}$$

The coefficients and error term of equation (3) are related to those of equation (1) and to the coefficient of adjustment as follows:

$C_0 = b_0B$; $C_1 = b_1B$; $C_2 = b_2B$; $C_3 = b_3B$; $C_4 = b_4B$; $C_5 = b_5B$; $C_6 = b_6B$; $C_7 = b_7B$; $C_8 = b_8B$;

$C = 1–B$; $V_t = U_tB$

where, A_t = area under rapeseed-mustard (in ha) in the't' year

P_{t-1} = farm harvest price of rapeseed-mustard (Rs/qt) lagged by one year

P^c_{t-1} = farm harvest price of gram (Rs/qt) lagged by one year

Y_{t-1} = yield of rapeseed-mustard (qt/ha) lagged by one year

RP_t = price risk

RY_t = yield risk

MR_t = rainfall during monsoon period in mm in 't' year

IR_t = percentage irrigated area of rapeseed-mustard in 't' year

IG_t = percentage irrigated area of gram in 't' year

A_{t-1} = area under rapeseed-mustard (in ha) lagged by one year

V_t = a disturbance term

In the present study, the Nerlovian model has been used in both linear and log-linear forms in each case. The models were estimated by ordinary least squares method. For the sake of discussion, the best fits were selected on the basis of the coefficient of multiple determination (R^2), absence of multicollinearity, autocorrelation, and the significance of the explanatory variables.

Short Run and Long Run Price Elasticity Analysis

The short-run price elasticities of acreage are directly obtained from logarithmic form of the model.

$$\text{Long run price elasticity of acreage} = \frac{\text{Short - run price elasticity}}{1 - C}$$

where, 1 – C = (B) coefficient of adjustment

As the value of coefficient of adjustment usually lies between zero and one, the value of 'B' close to the unity indicates that the adjustment process is very fast. When the value of 'B' is close to zero, the implication is that the adjustment process is very slow to the changing prices and other non-prices factors. If the value of 'B' is greater than one, it would mean that the farmers over adjust to the planned acreage.

Speed of Adjustment

Speed of adjustment implies the number of years required to realize 95 per cent of the price effect, it was estimated using the formula suggested by Krishna (1992):

$(1 – B)\ N = 0.05$ or

$$N = \frac{\text{Ln } 0.05}{\text{Ln } (1 - B)}$$

where,
B = Coefficient of adjustment and
N = Number of years

Results and Discussion

The results of the study show the relationship of different price and non-price factors with area of the crop. This discussion is with respect to each of the four economic regions as well as at the aggregate Uttar Pradesh level.

Functional analysis of supply relationships

The main purpose of this study was to test the degree of responsiveness of the farmers in different regions of Uttar Pradesh, and the state as a whole, to change in price and non-price factors, and thereby, to test the hypothesis if farmers' resource allocation decisions were in conformity with the basic assumption that they respond positively and significantly to price changes and non-price changing factors. In the analysis, mean (weighted average) and mode of farm harvest prices in two forms i.e. relative and absolute, were tried alternatively, and in different combinations. Finally, the mean (weighted average) farm harvest prices were taken because these yielded better results than others. The magnitude and significance of the regression coefficients for various explanatory variables, as discussed below, suggest distinct regional patterns of responsiveness of farmers to various factors for rapeseed-mustard in Uttar Pradesh.

Factors Determining Supply Behaviour of Rapeseed-Mustard

The impact of the explanatory variables on the behaviour of rapeseed-mustard growing farmers across the four regions of Uttar Pradesh was analysed. There is a general notion that farmers do respond to the price change. The magnitude and significance of the regression coefficients for various explanatory variables have been presented in table 1. An examination of the table suggests that the pattern of responsiveness of farmers to various price and non-price factors for rapeseed-mustard in different regions of Uttar Pradesh was different.

One year lagged price of rapeseed-mustard emerged as a major determinant of supply behaviour of the farmers. The regression coefficients and the price elasticities varied from region to region in terms of

Table 1: Factors determining supply behaviour of rapeseed-mustard

Variables/ Regions	Western	Central	Bundelkhand	Eastern	Whole UP
Constant (A_t)	-1.447	12.45	2.6556	1.176	2.982
Lagged Price of Rapeseed-Mustard (P_{t-1})	0.633*** (0.350)	0.208**** (0.168)	-0.426 (0.437)	0.526** (0.257)	0.235*** (0.157)
Lagged Price of Gram (P^c_{t-1})	-0.117 (0.260)	0.397** (0.151)	0.196 (0.444)	-0.045 (0.355)	-0.354** (0.147)
Lagged Yield of Rapeseed-Mustard (Y_{t-1})	-0.103 (0.175)	0.003 (0.085)	0.291**** (0.227)	-0.02 (0.240)	0.079 (0.107)
Price Risk (RP_t)	-0.039*** (0.022)	0.006 (0.014)	-0.029 (0.033)	0.019 (0.022)	-0.015 (0.011)
Yield Risk (RY_t)	0.017 (0.029)	0.052* (0.019)	0.315** (0.154)	0.007 (0.039)	0.021 (0.018)
Monsoon Period Rainfall (MR_t)	-0.089 (0.118)	0.118*** (0.067)	0.928* (0.206)	0.22**** (0.159)	0.155** (0.092)
% Irrigated Area Under Rapeseed-Mustard (IR_t)	3.608* (1.230)	-0.578** (0.244)	0.87* (0.161)	2.156* (0.489)	2.589* (0.528)
% Irrigated Area Under Gram (IG_t)	-0.215 (0.294)	0.283*** (0.150)	-0.392 (0.341)	0.094 (0.242)	-0.600* (0.196)
Lagged Area under Rapeseed-Mustard (A_{t-1})	0.414* (0.086)	0.079**** (0.065)	0.083 (0.102)	0.114 (0.110)	0.029* (0.037)
Coefficient of Multiple Determination (R^2)	0.890	0.76	0.87	0.89	0.93
d-statistic	2.01	2.14	2.23	2.03	2.12

Note: *, **, *** and **** indicate significant at 1, 5, 10 and 20 per cent probability levels, respectively.

magnitude and significance. The regression coefficienst of lagged price were 0.633, 0.208, -0.426, 0.526 and 0.235 in case of Western Region, Central Region, Bundelkhand Region, Eastern Region, and Uttar Pradesh as a whole, respectively; except for Bundelkhand, the regression coefficient were high for all other regions including Uttar Pradesh as a whole (table 1). Manghas *et al*. (1966), Gajja *et al*. (1983) and Girija Shankar and Shrivastava (1992) in their study also found positive and significant response of prices to area allocation.

The regression coefficients of lagged price of competing crop acreage under rapeseed–mustard in case of Western, Central, Bundelkhand and Eastern Regions,and Uttar Pradesh as a whole respectively, were -0.117, 0.397, 0.196, -0.045 and -0.354. One year lagged price of competing crop showed significant and positive impact on acreage only in case of Central Region and at aggregate level. In all other regions the acreage was not affected by the lagged price of competing crop (table 1).

The lagged yield of the crop is another important variable in determining acreage under any crop in the current year. The regression coefficient values of lagged yield of rapeseed-mustard respectively, were -0.103, 0.003, 0.291, -0.020 and 0.079 in case of Western, Central, Bundelkhand and Eastern regions, and Uttar Pradesh as a whole; regression coefficient was significant only in case of Bundelkhand (table 1). The magnitudes and significance levels of regression coefficients clearly indicated that lagged yield had no impact on farmer's land allocation decision in different regions except Bundelkhand Region. Ashok (2004) also revealed similar results in his study where lagged yield had insignificant influence on acreage allocation.

In addition, the price risk associated with the crop was found to have important bearing on acreage allocation. The regression coefficients of price risk in case of Western, Central, Bundelkhand, and Eastern regions, and Uttar Pradesh as a whole, were –0.039, 0.006, –0.029, 0.019 and –0.015, respectively. A significant regression coefficient in case of Western region only, implied that the price risk had negative and significant effect on acreage allocation in case of Western Region only. At state level picture advocated that farmers in general are not conscious of the variation in prices.

Further, the yield variability of any crop also affects the rational farmers' land allocation decisions. The positive and significant regression coefficients of yield risk in case of Central and Bundelkhand Regions only, (0.052 and 0.315, respectively) implied that the farmers were somewhat aware of the yield risk in these regions. Prakash *et al*. (1997) found that prices and yields both govern the cropping pattern.

The monsoon period rainfall, a source of soil moisture and an important physical factor determines cropping patterns in any region. The regression coefficients were positive and significant in all regions, and Uttar Pradesh as whole, except the Western Region, with the magnitude of 0.118, 0.928, 0.220 and 0.155, respectively (table 1). This implied that the farmers' area allocation decision pertaining to rapeseed-mustard also depended upon the amount of rainfall received during the monsoon season. Tripathi and Gowda (1993) in their study on groundnut in Orissa however, found that the effect of rainfall was negative and statistically insignificant.

The irrigated area is considered to be a very important variable for rapeseed-mustard cultivation. The percentage irrigated area under rapeseed-mustard showed positive and significant impact in all regions except Central Region. The regression coefficient in case of Central Region was negative and significant with a magnitude of -0.578. Significant regression coefficients of all regions and at aggregate level except Central Region indicated that the farmers took proper consideration of irrigation while allocating resources to the crop.

The impact of percentage irrigated area under competing crop was positive and significant in Central region, whereas it was negative and significant at aggregate level, indicating that farmers were responding inversely to this variable at state level. In the other regions the coefficient was insignificant. This implied that farmers did not response to this variable.

The coefficient of adjustment, in the present context, indicates the nature of adjustment of the inter-crop acreage that farmer made response to changing circumstances. High or low values of adjustment coefficient would suggest whether adjustment is rapid or it is tardy through the magnitude of differences between the actual and desired levels. It was significant only in case of western and central regions and at aggregate levels. The adjustment coefficients of Bundelkhand and Eastern Region were insignificant.

The result indicates that farmers of Western and Central regions, and Uttar Pradesh as whole, were responsive to lagged area under rapeseed-mustard with the magnitude of regression coefficients of 0.414, 0.079 and 0.029, respectively. This implied that the farmers took their decisions about the area allocation, keeping in mind the last year's area which assumed to be an important factor.

Analysis of Short-Run and Long-Run Price Elasticities

The estimates of elasticity of supply and coefficients of adjustment presented in table 2 provide an objective measures of response and adjustment behaviour both at regional levels as well as at aggregate level (Uttar Pradesh as a whole). A comparison of the short-run elasticities given in the table 2 exhibited few revealing features with regard to variation in the degree of responsiveness of the farmers in different regions of Uttar Pradesh.

Table 2: Estimated coefficients of adjustment, price elasticities and percentage change in area and prices under rapeseed-mustard during 20 year period from 1989-90 to 2008-09

Regions	Coefficient of Adjustment	Short run Elasticity	Long run Elasticity	Change in area (%)	Change in prices(%)
Western	0.581	0.633***	1.089	-10	150
Central	0.921	0.208****	0.225	8	150
Bundelkh-and	0.934	-0.426	_	154	174
Eastern	0.886	0.326**	0.367	98	170
U.P.	0.705	0.235****	0.334	10	152

Note: **, ***, **** indicate the significance level at 5, 10 and 20 per cent respectively

An examination of table 2 showed that the range of short-run price elasticities varied from 0.208 in Central Region to 0.633 in Western Region. At the aggregate level, the price elasticity was found to be 0.235. In case of Bundelkhand region however, the elasticity could not be calculated as the price coefficient was insignificant.

It can be inferred that Western region witnessed the strongest impact of price on rapeseed-mustard acreage, followed by Eastern region. The short-run price elasticity was lowest in Central region. This phenomenon was indicative of the price consciousness on the part of the farmers and reflected their area allocation behaviour in accordance with the economic rationale. This means, that the farmers would allocate their limited land resources to the crop towards which the relative price movements tend to be favourable. This was however, quite logical and rational as the allocation of land to a better-priced crop would fetch more revenue to the farmers. The comparative closeness of long-run elasticity to the short-run elasticity in Central region reveals a greater degree of adjustment in this region.

Speed of Adjustment

The coefficient of adjustment, in the present context, indicates the nature of adjustment of the inter-crop acreage that farmer made response to changing circumstances. High or low values of adjustment coefficient suggest whether adjustment is rapid or it is tardy through the magnitude of differences between the actual and desired levels. The coefficient of adjustment and number of years required to realize 95 per cent price effect are presented in table 3. Compared to other regions, the results in table 3 indicate that the farmers of Central and Bundelkhand regions took less number of years to realize 95% of price effect. In case of

Table 3: Estimated adjustment coefficients and speed of adjustment of area to desired level

Region	1 – B (Coefficient of adjustment)	No. of years to realize 95% price effect (N)
Western	0.414	3.4
Central	0.079	1.2
Bundelkhand	0.083	1.2
Eastern	0.114	1.4
U.P.	0.295	2.5

Western Region, the number of years to adjust their area to a desired level was found to be higher than other regions. Therefore it can be inferred that the farmers of Western Region will take more years to adjust their area to reach at a desired level.

Policy Implications

The results obtained of present study regarding acreage responses of rapeseed-mustard in the four regions and state as a whole could be of immense use in prescribing policy measures to promote the supply of rapeseed-mustard. The main policy implications include the following. In agriculture, the continuous adjustment regarding area under different crops is a usual and common phenomenon. Influencing supply of rapeseed-mustard through price mechanism would mean and require simultaneous operations with regard to price of competing crop. Broadly, the pattern of prices of a crop in relation to its competing crop should be such that it would help in achieving the pattern of output. Hence, in order to further enhance the production of rapeseed-mustard, the on-going price policy should be directed towards assuring appropriate remunerative prices to the rapeseed-mustard producers of the state. This is the high time to think of incentive price rather than support price in agricultural price policy.

Price incentives along with suitable mechanisms for management of price and yield risks could be critical components of new policy strategy for improving production performance and growth in the oilseed sector. Better understanding of pattern in yield / revenue variability, farmer's expectation and response behavior to the changing incentive environment, and effects of price and price risks in oilseeds, in general, and rapeseed-mustard production in particular, are therefore, essential for internalizing them into policy designing.

Rainfall appears to be one of the important factors determining area response of rapeseed-mustard. In other words, even after decades of massive irrigation projects, Indian agriculture still remains weather-dependent. The risk arising due to uncertain weather conditions causing yield variations in several cases of rapeseed-mustard analysis, and thus warrants due attention.

Another important factor appears to be the availability of irrigation. Oilseeds in Uttar Pradesh, in general, are grown on the disadvantaged lands, which has led to very low yields of the crop. Taken together with the above results, it is apparent that the most important policy variable from the viewpoint of long-run output response is the water input. Given that rainfall cannot be manipulated, availability of irrigation is the obvious one that policy can impinge upon. This also has a bearing on the influence of the risk variables.

Concluding Remarks

This study mostly supports the results of available literature that farmers' response to price is very good in the short run, and their adjustment mechanism towards reaching the desired level is fast for rapeseed-mustard. But the farmers, in general, did not take cognizance of price of competing crops of rapeseed-mustard; as it is reflected through the response to price of competing crop gram, which was found to be positive and significant only in case of Central region. Therefore, one can not simply dismiss that, efforts to improve agricultural growth through price incentives is a futile exercise. The notion that water supply for any crop is very important input verified and is supported by strong impact of rainfall and percentage irrigated area on acreage under rapeseed-mustard at aggregate level and at regional levels. Various discussions on the

supply response theme in the academic literature and in the policy arena clearly pointed out that turning attention to removing physical infrastructural constraints will go a long way in increasing the supply response. Price risk though is crucial adverse factor that influences acreage response, in general, but was not bothered by the farmers; as it did not play any significant role in acreage allocation of rapeseed-mustard except Western region. Agricultural diversification, risk management, and private sector involvement in agro-processing have opened up opportunities for sharing risk with the farmers. Though, yield risk due to adverse climatic condition is an equally important factor, but we could not be able to find significant effect of yield risk variable except Central and Bundelkhand. A comparison of the short-run elasticities indicates that Western region witnessed the strongest impact of price on rapeseed-mustard acreage. The short run price elasticities varied from region to region. And the comparative closeness of long run elasticity to the short run elasticity in Central region revealed a greater degree of adjustment. The speed of adjustment by farmers of Central and Bundelkhand Regions take less number of years to realize 95% of price effect as compared to the farmers of other regions.

References

Kumar A. 2004. Supply Response of Cassava in Tamil Nadu. *Indian J Agril Eco* 27: 67-73.

Behrman JR. 1968: Supply Response in Underdeveloped Agriculture: A Case Study of Four Major Annual Crops in Thailand: 1937-63. *North Holland Publishing Co.*

Narain D. 1965. The impact of price movements on areas under selected crops in India: 1900-1939. *Cambridge Univ Press*.

Gajja BL, Kalla JC and Vyas DL. 1983. Supply response of groundnut in Rajasthan. *Agric Situation in India* 38: 403-406.

Gulati A and Tim K. 1999. Trade Liberalization and Indian Agriculture. *Oxford Univ Press.*

Krishna R. 1962. A Note on the Elasticity of the Marketable Surplus of a Subsistence Crop. *Indian J Agril Eco* 17: 79-84.

Mangahas M, Recto AE and Ruttan VW. 1966. Price and market relationships for rice and corn in Philippines. *J Farm Eco* 48: 685-703.

Nerlove M. 1958. Distributed lags and estimation of long-run supply and demand elasticities: theoretical considerations. *J Farm Eco* 40: 301-311.

Nerlove M. 1958. Dynamics of supply estimation of farmer's response to price. *John Hopkins press*, Baltimore.

Prakash S, Buragohain T and Sharma A. 1997. Determinations of allocation of land among different crops under conditions of dynamic growth. *Scandinavian J Dev Alternat* 16: 5-31.

Rajkrishna. 1963. Farm supply response in India-Pakistan – a case study of Punjab region. *The Ecoc J* 73: 477-487.

Shankar G and Srivastava L. 1992. Supply response of FCV tobacco in West Godavari district of Andhra Pradesh. *J Agril Marketing* 35: 34-36.

Tripathi S and Gowda MVS. 1993. An analysis of growth, instability and area response of groundnut in Orissa. *Indian J Agril Eco* 48: 345-350.