ACREAGE RESPONSE OF CHICKPEA IN INDIA: A STATE LEVEL ANALYSIS (1974-75 TO 2008-09)

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ABSTRACT

Pulses have been the low performing crops in India during the past four decades despite rising demand and increasing prices. In view of demand and supply gap, current research studies are the need of the hour to improve pulse production. This paper is a modest attempt to examine the factors influencing the acreage response in three major gram producing states, namely, Madhya Pradesh, Maharashtra and Rajasthan for the period 1974-75 to 2008-09. Acreage analysis reveals that price factors are important in Madhya Pradesh and Rajasthan whereas non price factors are important in Maharashtra. It is suggested that concerted efforts are required through extension services for immediately propagating the pulse varieties and technologies developed in the research organizations to the farmer's field to increase production of pulses.

KEY WORDS: ACREAGE RESPONSE, PRICE FACTORS, NON PRICE FACTORS, LAGGED AREA, COMPETING CROPS

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1. Introduction

Pulses are an important source of protein for the masses in India. Chickpea (gram/chana), pigeonpea (arhar/tur dal), urad bean (urad dal), mung bean (moong) and lentil (masoor) are main five pulses grown in India and accounted for nearly 80% of the total pulse production in the country[1]. Pulses improve soil fertility, require less water and their rotation with cereals control diseases and pests. Although, India is the largest producer and consumer of pulses in the world, accounting for about 25 per cent of global production, 30 per cent of global consumption and about 33 per cent of the world's area under pulses, the productivity of pulses in India has been very low at 622 kg/ha. , compared to the highest yields of approximately 1908 kg/ha. in Canada and US during 2007[2]. Also, the per capita net availability of pulses has declined from 69 grams/day in 1960-61 to 51 grams/day in 1970-71, 42 grams/day in 1990-91 and 36 grams/day in 2007-08 (Agricultural Statistics at a Glance, Ministry of Agriculture, 2010).

For more than fifty years from 1953-54 to 2007-08, the total area under pulses cultivation in India has remained virtually stagnant (fluctuating between 20-24 million hectares). Pulses are grown in both kharif and rabi seasons, with rabi pulses accounting for more than half of the total pulses production in the country. The total area under rabi pulses has declined from 123.58 lakh hectares during Triennium Ending 1987-88 to 120.56 lakh hectares during 1997-98 and then increased to level of 123.15 lakh hectares during Triennium Ending 2008-09[3].

With the population growth rate at 1.58%, India is predicted to have more than 1.53 billion people by the end of 2030. The pace of increase in Indian population is far more than the increase in pulses production. According to Agbola and Damoense, 2004, the gap between production and consumption of pulses is widening in India. Thus, to bridge the demand-supply gap, India is continuously importing pulses (Refer to Figure 1).

[1] Department of Agriculture and cooperation, 2007
[2] National Bank for Agriculture & Rural Development, Mumbai, 2010
[3] The Commission for Agriculture Costs and Prices, 2010-11

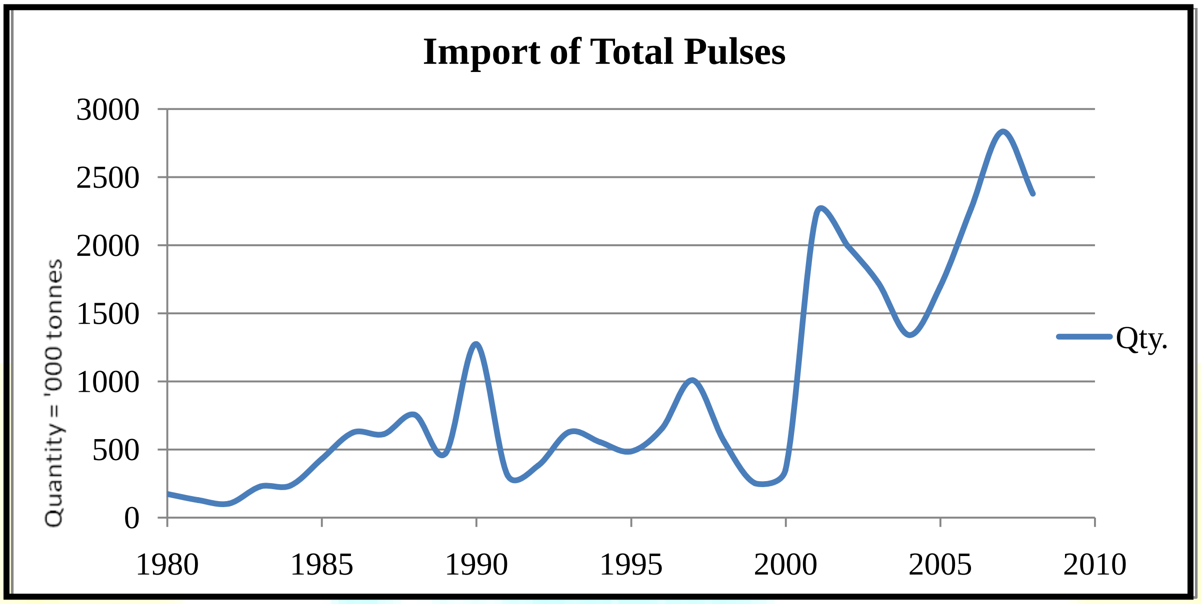

Figure 1 : Import of Total Pulses in India
Source: Ministry of Commerce and Industry, Kolkata 2010

As apparent in figure 1, there is a significant jump in the import of pulses from 1980-81 to 2008-09. In volume terms, pulse imports have increased at a rate of 1.29 per cent while the domestic production has increased at the rate of 0.33 per cent for the period 1985-86 to 2001-02 (Sathe and Agarwal, 2004). Before economic reforms, almost all agricultural imports were strictly controlled through quantitative restrictions and licenses. Importables were categorised into prohibited list, special import license list, restricted list, canalised list and free list. Since 1991, the number of lists has been reduced to prohibited list, special list and free list. Pulses fall under the special list, that is, imports are subjected to licensing. Import duty on pulses has varied depending on domestic availability, price movements and farmer's interest. From 1988 to 1995-96, import duty was around 10 per cent, except in 1989-89, when it was increased to 35 per cent. In 1996-97 duty was decreased to 5 per cent, and in November 1998, pulses imports were made duty free. However, in March 2001, import duty of 5 per cent was again imposed. Then the budget 2002-03 raised duty from 5 per cent to 10 per cent. In June 2006, the government had withdrawn 10 per cent duty on pulses and since then, import of pulses is duty free.

According to Kadakia and Jacob (2009), India has the potential to produce more than double the current output of pulses. Based on expected population growth, India will require around 38 million tonnes of pulses by 2017-18 to avoid protein deficiency. If India has to meet the projected demand, it would have to either double its acreage at current yield levels or double the yield keeping acreage constant. Since either of the above may not be feasible in isolation, the country needs to look at a mix of both.

The Government of India has taken concrete efforts by establishing Indian Institute of Pulse Research, Central Research Institute on Dry land Agriculture and Directorate of Pulse Development in the country to increase the production of pulses. Pulses has been further included as one of the three components (paddy, wheat and pulses) in The National Food Security Mission which ensures the food security for the masses through area expansion and productivity enhancement.

Despite these earnest efforts, cultivation in marginal soils, non availability of improved quality seed, lack of adequate extension services, price variability, production risk, and absence of a major technological breakthrough has been some of the prominent factors behind the low productivity level of pulses in India. According to Joshi and Saxena (2002), failing to introduce corrective measures for improving production may result into shrinkage of area under pulses, thus, adversely affecting the producers of pulse crops.

Reddy (2004) has argued that the cost of production was about 20-40 per cent higher than the minimum support price announced by the government for pulses. On the other hand, for wheat and paddy minimum support prices was higher or equivalent to the cost of production. This shows a clear bias against pulses farmers in fixing minimum support prices in India.

However, the existing literature in the context of price and non-price factors affecting the acreage response for pulse crops is mixed. Some studies have concluded that there is a positive relationship between acreage response and prices of pulses while others have observed a reverse phenomenon. Chickpea, being a major pulse crop occupies around two-fifths of the total area under all the pulses[4]. The aim of the paper is to examine the price and non price factors affecting the acreage response of chickpea in three major chickpea producing states.

[4] Department of Agriculture and Cooperation, 2004-05

2. Methodology

Chickpea is raised as a rabi crop particularly in those areas that receive rainfall of less than 10 cm during the winter season. At times, it is sown mixed with wheat and it is basically the crop of central and northern India. Madhya Pradesh, Rajasthan and Maharashtra are the top three chickpea producing states in India contributing more than 60 per cent to the overall production for the three years ending 2008-09 (Refer to Table 1).

Table 1: Share of Major Three States in 2006 to 2008 in Area and Production of Chickpea

Years	**2006-07**		**2007-08**		**2008-09**	
State	% to All – India (Area)	% to All – India (Production)	% to All - India (Area)	% to All – India (Production)	% to All – India (Area)	% to All – India (Production)
Madhya Pradesh	32.84	38.07	32.36	30.26	35.99	39.47
Rajasthan	13.48	13.74	16.31	9.91	15.96	13.90
Maharashtra	17.49	14.53	11.12	19.48	14.48	10.96

Source: Agricultural Statistics at a Glance, 2010

Madhya Pradesh is the leading producer of chickpea in India. It offers a host of post harvest facilities like cold storages, depots and warehouses to support its Agro based industries.

Using Nerlovian adjustment lag model as the basic framework, acreage response function for Madhya Pradesh, Rajasthan and Maharashtra is discussed, based on the time series data covering the period 1974-75 to 2008-09.

Various price and non-price factors influence the farmer's decision regarding land allocation to various crops. The price factors include input and output prices. This range from last year's harvest price of the crop, availability of minimum support price, last year's harvest price of the competing crop to prices of fertiliser, power, seed, water, insecticides and availability of credit. Non price factors includes last year's acreage and yield, availability of improved seeds and irrigation, rainfall, facility of procurement by government agencies, resistance of crop to pest attacks, extension services, home consumption, availability of alternative crops, credit and assured market (Tuteja,2006). However, crop-specific information on all these variables is lacking. Owing to this difficulty, the acreage response model is based on a few variables for which data are available. Using Nerlovian adjustment lag model, the reduced form of equation for the acreage response function for chickpea is specified as follows:

$$Area_t = a + b_1 Area_{t-1} + b_2 Price\ risk_{t-1} + b_3 Rainfall_{t-1} + b_4 Rfhp_{t-1} + b_5 Ryield_{t-1} + b_6 Yield\ risk_{t-1} + u_t$$ [5]

Relative FHP is calculated taking into the account the weighted share of competing crops[6] in total area, that is:

$$\text{Relative FHP} = \text{Price of chickpea} / (n_{w*}p_w + n_{m*}p_m/n_w + n_m)$$ [7]

However, due to unavailability of FHP of mustard in Maharashtra, output of value at current and constant prices has been used to get a price index as a close proxy for FHP in Maharashtra.

Value of output at current prices = (Current production)*(Current prices)

Value of output at constant prices = (Current production)*(Constant- base year prices)

Price Index = (VO at current prices) divided by (VO at constant prices)

Note: Splicing have been used to convert the price index into recent base (2004-05)

[5] Area $_t$ = Area in hectares under chickpea in year t, Area $_{t-1}$ = Area in hectares under chickpea in the year t-1, Price risk $_{t-1}$ = Price risk measured in terms of coefficient of variation of past three years, Rainfall $_t$ = Pre-sowing rainfall (mm) in the year t, Rfhp $_{t-1}$ = Relative farm harvest price in the year t-1, Ryield $_{t-1}$ = Relative yield in the year t-1, Yield risk $_{t-1}$ = Yield risk measured in terms of coefficient of Variation of past three years, u_t = Disturbance term

[6] According to Kelly and Rao, 1994 and Tuteja, 2006, wheat and rapeseed/mustard are the two principal competing crops of chickpea

[7] $n_w = a_w/a_T$; (area of wheat / total area), p_w = FHP of wheat, $n_m = a_m/a_T$; (area of mustard / total area), p_m = FHP of mustard

In addition, **Relative yield is calculated** as follows:

$$\text{Relative Yield} = \text{Yield of chickpea} / (s_{w*}y_w + s_{m*}y_m/s_w + s_m)^8$$

Time series analysis starts with checking stationarity of all the variables so as to ensure that the mean and variance are constant over time and the value of covariance between the two time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed. Stationarity of all the variables has been checked with the help of Augmented Dicky Fuller test (ADF), which has a Null Hypothesis as $H_{0:}$ Series is non stationary i.e. they have unit root. All variables are stationary at level form.

However, Durbin – Watson d Test for detecting serial correlation is inapplicable in models where one of the independent variable (area in our case) is the one period lagged value of dependent variable. Thus, serial correlation has been checked by using the LM Test (Lagrange Multiplier). The null hypothesis of no serial correlation is not rejected.

Initially, both irrigation and rainfall were taken in the model but because of multi collinearity between the two, irrigation has been dropped. Again, FHP and relative yield in the case of Maharashtra and only relative yield in the case of Rajasthan are not entered in the acreage response model of these states because of multi collinearity problem between these variables. However, these variables are included while framing the model for Madhya Pradesh.

3. Results and Discussions

Using Ordinary Least Squares (OLS) method, regression results of log-linear forms for the acreage response of the top three chickpea producing states are representated in Table 2.

Table 2 : Regression Results

States	**Madhya Pradesh**	**Maharashtra**	**Rajasthan**
Variables	Coefficient	Coefficient	Coefficient

[8] $s_{w} = a_w/a_T$; (area of wheat / total area), y_w = yield of wheat, $s_m = a_m/a_T$; (area of mustard / total area), y_m = yield of mustard

Log(area(-1))	0.487 (0.155)*	0.804 (0.1)*	0.276 (0.164)**
Log(Price risk)	-0.001 (0.030)	-0.019 (0.036)	-0.160 (0.099)**
Log(rainfall)	0.175 (0.107)**	0.197 (0.118)**	0.403 (0.141)*
Log(Rfhp)	0.324 (0.092)*	-	0.398 (0.388)
Log(Ryield)	0.016 (0.170)	-	-
Log(yieldrisk)	-0.021 (.015)	-0.005 (0.044)	-0.012 (0.1)
Adjusted R^2 R^2	0.59 0.66	0.79 0.82	0.40 0.49

Source: Econometric Software E-Views

* Significant at 1% Level; **Significant at 10% Level

Area in hectares under chickpea in the year t-1 (area $_{t-1}$)

Lagged area is positive and significant in all the three states. It is significant at 1 % level in Madhya Pradesh and Maharashtra whereas it is significant at 10 % level in Rajasthan. Thus, area in the year t-1 is an important factor in determining the current acreage decision of the farmer.

Price risk $_{t-1}$

Price risk is insignificant in Madhya Pradesh and Maharashtra whereas it is significant at 10 % level in Rajasthan. Insignificance of price risk in Madhya Pradesh and Maharashtra indicate that there are some other non price factors such as yield and rainfall which are more important in influencing acreage allocation decision of farmers.

Pre-sowing rainfall (mm) in the year t

Pre-sowing rainfall emerged as one of the important factors in determining chickpea acreage in all the three states. This coefficient has attained a positive sign as expected in all the three states indicating that good pre-sowing rainfall conditions influence farmer's acreage allocation decisions favorably.

Relative farm harvest price in the year t-1 (Rfhp $_{t-1}$)

Results show that this coefficient is significant at 1 % level in Madhya Pradesh and is insignificant for Rajasthan. The inference we might draw from the results is that, despite high prices, farmers do not realize reasonable returns for their output in Rajasthan because of lower and unstable yields as supported by insignificance of yield variable in the analysis and hence, they do not respond to the relatively high farm harvest prices of chickpea favorably.

This variable was not entered in case of Maharashtra because of multi collinearity problem. Even in studies by Satyapriya (1986) and Savadatti (2006), FHP variable did not make an entry to the model for the same reason.

Relative yield and yield risk in the year t-1: (Ryield $_{t-1}$) and (Yield risk $_{t-1}$)

Relative yield is insignificant in Madhya Pradesh indicating that the area allocated to the crop is not guided by yield factor in Madhya Pradesh. This shows that the yield of chickpea is incomparable to the yield of its competing crops which is maintained at a higher level in Madhya Pradesh. However, relative yield is not included into the acreage decision of Maharashtra and Rajasthan because of multi collinearity problem. Further, yield risk is insignificant in all the three states highlighting the importance of other non price factors such as rainfall in the states.

It is clear from the analysis that the non price factors namely, lagged area and pre sowing rainfall influences the farmer's decision to allocate land under chickpea favourably in all the three states. However, the significance of price factors varies from state to state.

4. Conclusions

Per capita net availability of pulses has decreased from 51 grams per day in 1970-71 to 36 gram per day in 2007-08. The revised balanced diet (1980) by Indian Council of Medical Research (ICMP) contains 50 gram of pulse and this level can barely be met taking into the account current level of Production. The production has been lagging behind the consumption and to bridge the gap the country has been importing pulses regularly. The grim scenario of pulses is attributed to the technical stagnation and supply side constraints emphasizing the fact that more needs to be done to alleviate the dismal situation of pulses production in order to make the country self sufficient.

In the major chickpea producing state of MP, relative FHP, lagged area and rainfall were found significant. In Rajasthan, apart from lagged area and rainfall, price risk was found significant. These results for MP and Rajasthan are different from past studies which indicated that the price response of chickpea is low and non price factors play a major role in farmer's decision about acreage allocation for chickpea. However, the results are consistent with findings in literature in case of Maharashtra where non price factors such as lagged area and rainfall played a major role in determining acreage under chickpea and thus affecting farmer's decisions in allocating area to crops.

During the past, the country has made special efforts for increasing pulse production by establishment of the different institutions, schemes and programmes like Indian Institute of Pulse Research, Central Research Institute on Dryland Agriculture and Directorate of Pulse Development. It is found that despite all the efforts, the area, production and productivity of pulses could not be increased significantly during the last six decades.

It is suggested that concerted efforts are required through effective extension services for immediately propagating the pulse varieties and technologies developed in the research organizations to the farmer's field. Stagnation in pulse productivity is a major hurdle which restricts the farmers to undertake pulse production. However, along with technological breakthrough, adoption of improved technology at a wider scale is the need of the hour. The Green Revolution paved the way for food security in India. No major technological breakthrough has emerged since then, and with the need for higher production, a second green revolution is inevitable.

REFERENCES

[1] Agbola, Frank W. and and Damoense Maylene Y. (2003). An Empirical Examination of Import Demand for Pulses in India. Paper presented at the 47th Annual Conference of the Australian Agricultural and Resource Economics Society,Australia, 11-14 February 2003.

[2] Ahmad, Shamim and Suheela Chishti (2002). Role of Private Sector in the Marketing of Pulses. Indian Journal of Agricultural Marketing ,16(3).

[3] Chopra, Kusum and Swamy (1975). Pulses: An Analysis of Demand and Supply in India, 1951 – 1971. Sterling Publishers, New Delhi.

[4] Dey, A K and Banerjee ,B N (1991). Production and Marketing of Pulses and Oilseeds. Mittal Publications ,New Delhi.

[5] G. Mythili (2007). Supply Response of Indian Farmers: Pre and Post Reforms. Working Papers, Indira Gandhi Institute of Development Research, id:2633,

[6] Government of India. Agriculture Statistics at a Glance. Ministry of Agriculture, New Delhi, various issues.

[7] Government of India. Area and Production of Principal Crops in India. Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi, various issues.

[8] Government of India. Farm Harvest Prices of Principal Crops in India. Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi, various issues.

[9] Government of India. Central Statistical Organization, Ministry of Statistics and Programme Implementation, New Delhi, various issues.

[10] Government of India, India Meteorological Department, New Delhi, various issues.

[11] Government of India, Report of the Commission for Agricultural Costs and Prices, Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi, various issues.

[12] Gulati, Ashok and Kelly, Tim (1999). Trade Liberalisation and Indian Agriculture- Cropping Pattern Changes and Efficiency gains in Semi Arid Tropics", Oxford university Press.

[13] Gupta , S.K. and Mishra, A.M. (2002). Marketing and Processing of Pulses by Private Traders in Major Pulses Producing States of India. Indian Journal of Agricultural Economics, 16(3).

[14] Joshi, P.K. and Saxena, Raka (2002). A Profile of Pulses Production In India: Facts, Trends And Opportunities. Indian Journal of Agricultural Economics, Vol.57, No. 3 , July-Sept.

[15] Kadakia, Pratik and Jacob Jeffry (2009). Raising India's Pulse Rate" ,Tata Management Strategic Group.

[16] Kelly. T.G. and Parathasarthy Rao (1994). Chickpea Competitiveness in India. Economic and Political Weekly. Vol. 29, No. 26, June 25.

[17] Nerlove, M (958). The Dynamics of Supply: Estimation of Farmers Response to Prices. The Johns Hopkins University Press, Baltimore, U.S.A.

[18] Ramasamy, C. and Selvaraj, K.N. (2002). Slow Growth Crops: Coarse Cereals :Oilseeds and Pulses. Indian Journal of Agricultural Economics. Vol. 57 No. 3, July- Sept.

[19] Reddy, A. Amarender and Reddy, G.P.(2010). Supply Side Constrains in Production of Pulses in India : A Case Study of Lentil. Agricultural Economics Research Review, Vol. 23 , January- June.

[20] Renuka, Mahadevan (2003). Productivity Growth in Indian Agriculture : The Role of Globalisation and Economic Reform. Asia Pacific Development Journal, Vol. 10, No. 2, December.

[21] S.K. Srivastava, N. Sivaramane and V.C. Mathur (2010). Diagnosis of Pulses Performance of India" , Agricultural Economics Research Review, Vol. 23, pp 137-148, January-June

[22] Sathe , Dhanmanjiri and Agarwal , Sunil (2004). Liberalisation of Pulses Sector : Production, Prices and Imports. Economic and Political Weekly, Vol. 39, No. 30 ,pp 24-30, July

[23] Satyapriya, V.S. (1986). Pulses in India: Growth, Regional Distribution and Area Response, Institute for Social and Economic change, Bangalore.

[24] Savadatti, Pushpa M.(2007). An Econometric Analysis of Demand and Supply Response of Pulses in India" , Karnataka J. Agri. Sci., 20(3) (545-550)

[25] Tripathi , R.S.(1998). Production and Marketing of Pulses" , Mittal Publications, New Delhi.

[26] Tuteja , Usha (2002). Need For Private Initiatives In Marketing and Processing of Pulses In Haryana. Indian Journal of Agricultural Economics , 16(3).

[27] Tuteja, Usha (2006). Growth Performance and Acreage Response of Pulse Crops: A State-Level Analysis. Indian Journal of Agricultural Economics, vol.61, No. 2, April-June.