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Price and non-price decision making factors of groundnut area in Karnataka: A supply response approach

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Abstract
In this study, an attempt has been made to examine the acreage response of groundnut by using the Nerlovian partial adjustment model. The secondary data from 2002-03 to 2018-19 years on area, production, yield, rainfall *etc.*, for main crop and competitive crop were collected from various official sources. The competitive crop was selected on the basis of statistical criterion by calculating the correlation coefficient between crop area. Negative association was found between lag yield of rice crop. The coefficient of lag area under groundnut crop was positive and significant at one percent level. The regression coefficient of lag area under groundnut crop was 0.70 percent indicated that 1 percent increase in previous year area of groundnut results into 0.70 percent increase the area under groundnut crop.

Keywords: Nerlovian partial adjustment model, groundnut, oilseed, acreage response

Introduction
The main reason for growing the groundnut is for its edible seeds. It is abundant in dietary minerals, vitamins and essential nutrients. China is the largest groundnut producer, accounting for 26.49 percent of total world groundnut production followed by India (10.14%), Nigeria (6.70%), Sudan (4.26%). USA (3.75%) *etc.*, (FA0, 2020). India is the second world's greatest oilseed producer, but it cannot supply enough vegetable oils to meet domestic demand. However, its performance was unimpressive, and it continues to rely on oilseed imports (Jainuddin *et al.*, 2019) [2]. Since domestic production of edible oils has not been able to keep up with consumption growth, the difference between the two is being filled by imports (FAO, 2021) [1]. The Indian government was allocating millions of focusing on oilseeds projects and policies, such as NODP (1985), TMV (1986), OPDP (1991) under TMO, ISOPOM (2004), and NMOOP (2014), in order to close the gap between supply and demand for oilseeds and to support the expansion of the oilseed industries in our nation. The right resource allocation decisions on farms are greatly aided by knowledge of supply response. Long-term planning can also help planners and policymakers allocate resources and meet production goals. The choice of the farmers as to how they allocate the land for crop in comparison to competing crops determines the sustainability of the production of groundnuts. According to price and non-price factors, rational farmers typically decide how much land to plant with crops (Mulla *et al.*, 2019) [3]. Knowledge of supply response is extremely beneficial in agricultural decisions on resource allocation. Agricultural pricing policy is crucial for farm decisions regarding the distribution of resources. Estimates of supply responsiveness provide useful guidelines for the formulation of economic policy and are used as a tool to assess the efficacy of price policies in the allocation of farmers' resources. In addition to prices, there are numerous other non-price factors that affect supply, including the climate, rainfall, irrigation, technology, *etc*. The main reason for growing the groundnut, a legume plant, is for its edible seeds. It is abundant in dietary minerals, vitamins, and essential nutrients. As a result, it plays a significant role in our daily diet. Karnataka is the sixth largest state in area and production of oilseeds in India, whereas second largest in area, production and yield of oilseeds in South India. Groundnut growing districts are Chitradurga, Bellary, Tumkur, Yadgir, Koppal, Gadag and Belgaum in Karnataka state.

Sources of data
The study was based on secondary data from 2002-03 to 2018-19. The data of area, production, productivity and irrigated area of groundnut were collected from Directorate of

Economics and Statistics, Directorate of Agriculture, Cooperation & Farmers Welfare, Government of India and Indiastat.com. Rainfall data was collected from Indian Meteorological Department, Government of India.

Methodology

Acreage Response

To examine the acreage response of cash crops the Nerlovian partial adjustment model using price and non-price factors of main crop and competitive crop was considered. The competitive crops were selected on the basis of logically as well as statistically by calculating the correlation coefficient between crop area.

In the present study Nerlovian model was used in both linear and log-linear forms. The best fits log linear forms was selected on the basis of the coefficient of multiple determination (R^2). Care was taken for the presence of auto correlation and problem of multicollinearity in time series data over the period of the study of the variables by using Durbin Watson d’ statistic and correlation matrix between independent variable.

$$A_t= b_0+ b_1A_{t-1}+ b_2Y_{t-1}+ b_3IR_t+ b_4 SR_t +b_5PR_t+ b_6YR_t^c+ U_t$$

In the double log or log linear form, this module would be as following

$$A_t= b_0+ b_1\log A_{t-1}+ b_2\log Y_{t-1}+ b_3\log IR_t+ b_4\log SR_t +b_5\log PR_t+ b_6\log YR_{t-1}^c+ U_t$$

A_t = Area of *kharif* groundnut at time t (ha)
A_{t-1} = Area of *kharif* groundnut lagged by one year (ha)
Y_{t-1} = Yield of *kharif* groundnut lagged by one year (kg/ha)
IR_t= Irrigated area under *kharif* groundnut at time t (ha)
SR_t = Sowing month rainfall (mm)
PR_t = Price risk of *kharif* groundnut crop at time t (Rs/q)
Y^C_{t-1} = Yield of the competing crop lagged by one year (kg/ha)
U_t = Disturbance term

Detection of Autocorrelation

To determine whether auto correlation existed in the time series data collected throughout the study period, the Durbin Waston d statistic was computed. Durbin-Watson test for serial correlation is inappropriate for models including a lagged dependent variable as an explanatory variable; there is always likelihood of autocorrelation in autoregressive models than the d-statistic test would suggest. The combination of autocorrelation and lagged dependent variable results in biased parameter estimates because the error term is correlated with a regressor. For such models, called autoregressive models, Durbin has developed the so-called h statistic to test the first order autocorrelation which is defined as follows (Gujarati and Porter, 2009) [8].

$$h= \rho \sqrt{n/1-n [var (\alpha)]}$$

ρ = 1-1/2 d
d = Durbin Watson value (DW)
var (α) = $(s.e)^2$
pr ($-1.96 \leq h \leq 1.96$) = $1 - \alpha$

Where n is total number of sample, var (α) is the variance of the coefficient of the lagged dependent variable, s.e is the standard error and ρ estimate the first order autocorrelation. If the value of Durbin h statistic is in between -1.96 and 1.96 then there will be no autocorrelation.

Detection of Multicollinearity

The zero order correlation matrixes were computed for testing the problem Multicollinearity of for time series data of the selected variables.

Here, some information about the variables are given

(1) Current acreage

The dependent variable in the analysis was current acreage (A_t) Acreage under groundnut crop in "000 hectares. It is important to check if it positively affects on production of groundnut crop or not. So, it sound important independent variable in production response.

(2) Lagged acreage (A_{t-1})

The current crop area was mostly influenced by the area of groundnut crop 000 hectares during the previous year when conditions were not abnormally changed. This variable was added in the model as a proxy for traditional cropping patterns and it is also expected to influence the area allocation choice. Farmers determine their projected yield and output by looking at the previous year's area and production. Farmers were thought to favourably react to the previous year's allocated area when assigning land for the following year.

(3) Previous year’s yield of crop (Y_{t-1})

The yield of the previous year's groundnut crop was measured in kilogrammes per hectare. The key component of gross profit is yield. It is reasonable to suppose that farmers consider the lag yield of groundnut crop when making current acreage decisions. The variable was included in the model because crop productivity in the previous year is anticipated to influence land allocation in the current year.

(4) Irrigation area (IR_t)

One factor influencing the area and productivity of the groundnut crop is the availability of irrigation. Although groundnuts are rainfed, they are produced under irrigation. The concerned crop's irrigated area in the current year (IR_t) was chosen as the model's independent variable.

(5) Risk factors Fluctuations in prices reflect condition of demand and supply including uncertainties and imperfections in marketing systems. The risk factor was measured as the standard deviation of the preceding three years price.

(6) Previous year yield of competitive crop

The area allocation of crops was significantly impacted by the competitor crop's lag yield. Lagged yield by a year was therefore selected as a variable since it influences the choices made about the distribution of resources.

Results and Discussion

The impact of both price and non-price factors on farmers' decisions to allocate groundnut crop area in the state of Karnataka was investigated using the acreage response function. Table 1 shows the outcomes of this fitted model. To estimate the producers' response, a linear Nerlovian lagged adjustment model was fitted using price and non-price variables. The model was developed using a large number of variables, however it was chosen based on the regression coefficient, a number of significant variables, the desired sign of the estimates, and the highest R^2.

Table 1: Estimated coefficients of acreage response of groundnut in Karnataka state

Variables	Coefficients	S.E	t-value
(Constant)	-0.057	2.524	0.023
Area under groundnut crop at t^{-1}	0.702	0.157	4.471***
Yield of groundnut at t^{-1}	-0.074	0.159	0.469
Irrigated area under groundnut crop	0.495	0.368	1.346
Sowing month rainfall	0.212	0.180	1.180
Price risk of groundnut	-0.046	0.060	0.759
Yield of rice at t-1	-0.602	0.267	2.254**
R^2	0.822		
Adjusted R^2	0.715		
D-W test	2.174		

The actual area of the groundnut crop was expressed in terms of price and non-price factors in the context of the groundnut area as a linear function of the following, lagged area under groundnut crop, lagged yield of groundnut crop, irrigated area under groundnut crop, sowing month rainfall, price risk of groundnut crop and lagged yield of rice crop.

The two explanatory variables that were found most significant in determining the area allocation of groundnut crops were the lag area under the crop and the lag yield of the rice crop. In the state of Karnataka, rice was regarded as a crop that competed with groundnuts during the *kharif* season. The multiple determination coefficient came out to be 0.82 percent. It showed that these six independent variables accounted for approximately 82% of the variation in the area planted to groundnuts. The variance inflation factor (VIF) was employed in a multivariate regression model to assess multicollinearity between the independent variables. The results of variance inflation factors of explanatory variables were found within a limit.

The Durbin-Watson statistics was 2.17 which indicated the absence of serial correlation between the independent variables used in the model. Coefficients of lag area under groundnut crop and lag yield of rice crop were 0.70, and -0.60, respectively. The regression coefficient of lag area under groundnut crop was 0.70 percent indicated that 1 percent increase in previous year area of groundnut results into 0.70 percent increase the area under groundnut crop. The coefficient of lag area under groundnut crop was positive and significant at one percent level. This showed that the farmer continuously grow the groundnut crop in every *kharif* season and they does not want to change it. Another reason might be farmer's know how about groundnut farming from their experience and its cultural practices have substantial bearing on its cultivation. So, it was found that lag area under groundnut crop had a positive effect on area allocation. The results are in same as the reported by Khairnar (1989) [6], Khandare (2003) [7], Patil *et al.*, (2012) [5] and Nadaf (2021) [4] found positive and significant response of lagged area to area allocation in their study. Mulla (2019) [3] reported that everyone percent increase in lag area under groundnut crop, it lead to 0.90 percent expansion of area under groundnut crop.

Conclusion

India is the second world's greatest oilseed producer, but it cannot supply enough vegetable oils to meet domestic demand. In this study it was revealed that lagged area under groundnut crop and lagged yield of competitive crop (rice) significantly impact on decision of groundnut area. supply responsiveness provide useful guidelines for the formulation of economic policy and are used as a tool to assess the efficacy of price policies in the allocation of farmers' resources.

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