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Research Article

ACREAGE RESPONSE OF SESAMUM IN SAURASHTRA REGION

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Abstract: The study on was undertaken with the main objectives *viz*; to assess the compound growth rate and instability, acreage response and factors considered by the famers for acreage allocation. The study was conducted in Junagadh and Rajkot districts of the Saurashtra region of Gujarat. Purposive sampling technique was used to select the two districts of Saurashtra region. Total 120 sesamum growers. *i.e.* 60 *kharif* and 60 summer sesamum growers were selected for the study. The secondary data were collected for the period 1995-96 to 2018-19 and 2010-11 to 2018-19 for analysis of acreage response of *kharif* and summer sesamum, respectively. The compound growth rate, coefficient of variation, Nerlovian model and Garrett's ranking technique were used to analyzed the collected data. The results revealed that the compound growth rates of the area, production and yield of *kharif* sesamum showed declining trend in Junagadh and Rajkot districts. The compound growth rates of productivity of summer and total sesamum increased significantly in both of the districts. In general, instability in area and production found higher than that in yield. The study on acreage response of *kharif* sesamum, revealed that, one year the lagged area was found to be positively influential factors in the farmers regarding area allocation to *kharif* sesamum in all the models of Junagadh and Rajkot districts. The *kharif* sesamum growers of Junagadh district are traditional in nature, they have not responded to the price and non price factors too. Whereas, farmers of Rajkot district exhibited rational behaviour to price factors and non price factors *i.e.* negative response to area under competing crop, lagged price and yield risk. In both the districts, summer sesamum growers consider the factors like area and price of competing crop, lagged yield and total rainfall. The positive and significant impact of total rainfall was found on summer sesamum acreage because it needs assured irrigation facility. The higher value of long run elasticity (LR) indicated that the farmers were relatively market oriented in their decision in the long run than in short run in respect to the sesamum in Junagadh and Rajkot districts. According to farmers opinions, for *kharif* sesamum, the low cost of cultivation of sesamum and price of sesamum during last year were the common factors considered by farmers while acreage allocation in both of the districts. In the summer sesamum the low cost of cultivation of sesamum was found common factor while acreage allocation in both of the districts.

Keywords: *Sesamum, Growth rate, Acreage response*

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Introduction

Sesamum (*Sesamum indicum* L.) is an ancient oil yielding crop and popularly known as "Queen of Oilseeds". Sesamum ranks third in production among the oilseed crops. The major oilseeds grown in the country on 246.05 lakh ha and producing 31.82 million tonnes of total oilseed [1]. The largest producer of sesamum seeds in 2017 was Myanmar [2]. India account for the largest area under sesamum cultivation in the world, contributing nearly 25 percent to international trade. Japan is the largest importer in world. India has the largest acreage but per hectare yield is comparatively lower than that obtaining in other countries. India is one of the largest exporters of sesamum seeds exporting 3,25,908 tonnes of seeds annually [3]. Gujarat is the only state which has an Agri-Export Zone (AEZ) for sesamum seeds in the country. Amreli, Bhavnagar, Surendranagar, Rajkot and Jamnagar form part of the AEZ for sesamum seeds. The sesamum crop is cultivated under 1.76 lakh ha and produces about 8.36 lakh tonnes with productivity of 469.59 kg/ha [4,5]. In which major area of sesamum is confined to Surendranagar, Junagadh, Jamnagar, Amreli, Rajkot, Kutch, Devbhumi Dwarka and Mehsana districts of the state. Thus, the study of acreage response of sesamum assumes due importance as far as stability of production is concerned. With this view, the present study is carried out with following objectives.

Objectives

To study the growth and instability of sesamum crop
To study the acreage response of sesamum crop
To study the factors considered by farmers in acreage allocation under sesamum crop

Materials and Methods

Selection of the study area and sampling procedure

The study was conducted in Junagadh and Rajkot district of the Saurashtra region of Gujarat. It was selected based on three years average cultivated area of sesamum crop. This occupied highest area of sesamum in Junagadh followed by Rajkot district of the state. Therefore, Junagadh and Rajkot districts were selected purposively for the study. Purposive sampling technique was used to select the two districts of Saurashtra region. Two talukas were selected from each selected district. This was followed by random selection of 15 *kharif* and 15 summer sesamum growers from each selected taluka. Thus, total 120 sesamum growers. *i.e.* 60 *kharif* and 60 summer sesamum growers were selected for the study.

Nature and source of data

The questionnaire comprised of factors considered by farmers for allocation of acreage under sesamum crop and their production constraints. The survey was conducted during 2017-18. The secondary data and other relevant information were gathered from the office of Director of Agriculture, Government of Gujarat, Gandhinagar and Department of Agricultural Economics JAU, Junagadh. The secondary data about rainfall, farm harvest price, area and production of

sesamum and yield of competing crop groundnut were collected for the period 1995-96 to 2018-19 and 2010-11 to 2018-19 for analysis of acreage response of *kharif* and summer sesamum, respectively.

Tools and techniques used

The compound growth rates (CGRs) of area, production and productivity of sesamum were estimated by using the exponential function of the following specification:

$Y_t = ab^t$ (1)

Where,

Y_t = Dependent variable (area / production / yield)

t = Time variable in years taking the value of 1, 2, 3,...,n

a = Intercept

b = Regression coefficient (1+r)

r = Compound growth rate.

Subsequently, the compound growth rate (%) was computed as under:

Compound growth rate (r) = [(Antilog of log b) -1]*100 (2)

Instability indices

Instability indices were measured by using Cuddy- Della Index. Cuddy-Della Index is most commonly used measures of instability of time series data and is universally acceptable and is given as follows:

$Ix = CV\sqrt{(1 - R^2)}$ (3)

$CV\ (\%) = (SD/\bar{X})*100$ (4)

Where,

Ix = Instability index

CV = Coefficient of variation

R^2 = Coefficient of multiple determination

$\bar{X}$ = Mean value

SD = Standard deviation.

Acreage response model

All the econometric models used to estimate agriculture area response, the Nerlovian model is considered one of the most influent and successful, judged by the large number of studies which utilize this approach (Brauke, 1982).

The econometric model to be employed may be stated as.

The long-run supply A_t^* is assumed, in the Nerlovian framework, to be related to Pt (the price) in a simple linear manner:

$A_t^* = a + bP_{t-1} + U_t$ (1)

Variation in A_t^* is connected with variation in observed or actual supply by assuming the following relationship between the actual and long-run desired level of supply.

$A_t - A_{t-1} = \gamma (A_t^* - A_{t-1})$ .....$0 \leq \gamma \leq 1$ (2)

The current supply, then is:

$A_t = A_{t-1} + \gamma (A_t^* - A_{t-1})$ (3)

The coefficient 'γ' is known as Nerlovian coefficient of adjustment and is based on Hick's elasticity of expectations. The forces which cause the difference between the short-run and long-run elasticities of supply was also determine 'Y'. The value of 'γ' near to zero means that the farmers are very slowly adjusting to the changing prices and other factors. 'Y' closer to one means that the adjustment is quick to the changing levels of prices and other factors. If γ is >1, this adjustment process is marked by over adjustment. If γ< 0, then, the relationship is perverse, with the expectations moving down if the last year's expectations proved too pessimistic and moving upward if last year's expectations were unduly optimistic. Therefore, one would expect the value of 'γ' to be greater than zero, but rarely much greater than unity.

Now, by substituting the values of A_t^* in equation 2, we get.

$A_t - A_{t-1} = \gamma (a + bP_{t-1} + U_t - A_{t-1})$ or

$A_t - A_{t-1} = a\gamma + b\gamma P_{t-1} + \gamma U_t - \gamma A_{t-1}$ or

$A_t = a\gamma + b\gamma P_{t-1} + \gamma U_t + A_{t-1} - \gamma A_{t-1}$

$= a\gamma + b\gamma P_{t-1} + \gamma U_t + (1- \gamma) A_{t-1}$

$A_t = A + BP_{t-1} + CA_{t-1} + V_t$ (4)

Where, $A = a\gamma$, $B = b\gamma$, $C = (1- \gamma)$, and $V_t = \gamma U_t$.

The equation 4 is the computational equation. The parameters of which was estimated by the least squares' method under the usual assumption in linear as well as double log (Cobb-Douglas) form. The reduced form would remain basically the same even if we include more independent variables of the two functional forms, linear model was used for the interpretation of the results.

Using the adjustment lag model as the basic frame of analysis, the response relationship in the study was estimated with consideration of the following different variables.

A_t^* = Desired area in year t

A_t = The actual area in year t (ha)

A_{t-1} = Area in previous year (ha)

A_{t-2} = Area in period t-2 (ha)

AC_t = Area under competing crops in period t (groundnut)

P_t^* = Price of *kharif* sesamum in current year

P_{t-1} = Farm harvest price in period t-1 (Rs/qtl)

P_{t-2} = Farm harvest price in period t-2 (Rs/qtl)

PC_{t-1} = Farm harvest prices of competing crops in period t-1 (groundnut)

GI_{t-1} = Gross income in period t-1, ($GI_{t-1} = Yield_{t-1} * FHP_{t-1}$) (Rs/ha)

GIC_{t-1}= Gross income from competing crops in period t-1(Rs/ha)

Y_{t-1} = Yield in period t-1(kg/ha)

RS_t = Sowing month rainfall (mm)

TR_t = Total rainfall in period t(mm)

Σy = Yield risk, standard deviation of the preceding three years' yield of the crop

σP = Price risk, standard deviation of the preceding three year' price of the crop

σR = Return risk, standard deviation of the preceding there years' gross return of crop

e_t = Random error term

t = Year

In order to measure acreage response to different kinds of variables separately, the above all independent variable were grouped into four different models given below:

The models used for *kharif* sesamum are given below:

Model 1 (M1):

$A_t = a + b_1 A_{t-1} + b_2 A_{t-2} + b_3 Y_{t-1} + b_4 P_{t-1} + b_5 P_{t-2} + e_t$

Model 2 (M2):

$A_t = a + b_1 A_{t-1} + b_2 AC_t + b_3 Y_{t-1} + b_4 P_{t-1} + b_5 PC_{t-1} + b_6 RS_t + e_t$

Model 3 (M3):

$A_t = a + b_1 A_{t-1} + b_2 Y_{t-1} + b_3 GI_{t-1} + b_4 GIC_{t-1} + b_5 \sigma_R + e_t$

Model 4 (M4):

$A_t = a + b_1 A_{t-1} + b_2 Y_{t-1} + b_3 P_{t-1} + b_4 PC_{t-1} + b_5 \sigma_Y + b_6 \sigma_P + e_t$

The models used for summer sesamum are given below:

Model 1 (M1):

$A_t = a + b_1 A_{t-1} + b_2 A_{t-2} + b_3 Y_{t-1} + b_4 P_{t-1} + b_5 P_{t-2} + e_t$

Model 2 (M2):

$A_t = a + b_1 A_{t-1} + b_2 AC_t + b_3 Y_{t-1} + b_4 P_{t-1} + b_5 PC_{t-1} + b_6 TR_t + e_t$

Model 3 (M3):

$A_t = a + b_1 A_{t-1} + b_2 AC_t + b_3 P_t^* + b_4 Y_{t-1} + b_5 TR_t + e_t$

Based on these models, coefficient of adjustment (Y), short-run (SR) and long-run (LR) elasticities (E) can be calculated as below.

Y = 1- Regression coefficient of one-year lagged acreage (A_{t-1}).

$$E(SR) = Regression\ coefficient\ of\ Price \times \frac{Mean\ price\ (P_{t-1})}{Mean\ acreage\ (\bar{A}t)}$$

E(LR)=SR/γ

The Garrett's ranking technique is adopted to analyze the problems faced in the production of sesamum and its marketing using the following formula separately for both the production and the marketing problems.

Percent position = 100 * (R_{ij}- 0.5)/N_j

Where,

R_{ij}= Rank given for i^{th} factor (constraint) by j^{th} individual

N_j = Number of factors (constraints) ranked by j^{th} individual

The relative position of each rank obtained from above formula was converted into scores by referring to the table given by Garrett and Woodworth in 1969 (transmutation of orders of merit into units of amount of scores) for each factor scores of all individuals was added and them divided by the total number of respondents for the specific factor (constraint) attributes.

Results

Growth rates in Area, Production and Yield

Trend of production can be studied by examining the compound growth rates. The compound growth rates of area, production and yield of *kharif* sesamum for the period from 1995-96 to 2018-19 of Junagadh and Rajkot districts [Table-1].

Table-1 *Compound growth rates of area, production and yield of sesamum in selected districts of Saurashtra region*

District	Area	Production	Yield
Kharif (1995-96 to 2018-19)			
Junagadh	-13.25*	-11.38	-1.39**
Rajkot	-15.59	-17.54	-2.49
Summer (2009-10 to 2018-19)			
Junagadh	-23.03	-0.09	9.49**
Rajkot	-22.6	-18.37	11.11***
Total (1995-96 to 2018-19)			
Junagadh	1.12	4.78	4.25**
Rajkot	-12.43	-12.92	5.55***

*Note: ***, ** and * indicate statistically significant at 1 %, 5 % and 10 %, respectively.*

The results revealed that the compound growth rate for *kharif* sesamum area was found negative (-13.25 %) and statistically significant at 10 percent level of significance in Junagadh district. In case of Rajkot district, compound growth rate of area under *kharif* sesamum was found negative (-15.59 %) but statistically non-significant. The compound growth rate for *kharif* sesamum production was found statistically non-significant in both Junagadh and Rajkot districts. In the Junagadh district, the compound growth rate of productivity of *kharif* sesamum found negative (-1.39 %) and statistically significant at 5 percent level of significance. In case of Rajkot district compound growth rate for *kharif* sesamum productivity was found negative (-2.49 %) but statistically non-significant. On the whole, the area and yield of *kharif* sesamum showed declining trend in Junagadh and Rajkot districts which implied that farmers of these districts might be shifting from sesamum to more remunerative crops like, groundnut and cotton crop due to declined in yield of *kharif* sesamum. The compound growth rates of area, production and yield of summer sesamum for the period from 2009-10 to 2018-19 of Junagadh and Rajkot districts are presented in [Table-1]. The results revealed that the compound growth rates for area and production of summer sesamum were found negative and non-significant in both of the districts. In the Junagadh district compound growth rate for summer sesamum productivity was found positive (9.49 %) and statistically significant at 5 percent level of significance. In Rajkot district, also compound growth rate for summer sesamum productivity was observed positive (11.11%) and statistically significant at 1 percent level of significance. Thus, the productivity of summer sesamum increased significantly in both the districts. The compound growth rates of area, production and yield of total sesamum for the period from 1995-96 to 2018-19 for Junagadh and Rajkot districts are presented in [Table-1]. The results revealed that compound growth rates for area (1.12 %), production (4.78 %) and yield (4.25 %) of total sesamum was found positive in the Junagadh district but of which productivity (4.25 %) was found statistically significant at 5 percent level of significance. In case of Rajkot district, the growth rate for area (-12.43 %) and production (-12.92 %) of total sesamum was found negative and statistically non-significant. But the growth rate of productivity was observed positive (5.55 %) and statistically significant at 1 percent level of significance. Thus, it is observed that the only productivity of total sesamum has increased during period (1995-96 to 2018-19) in both the districts.

Instability in Area, production and Yield

The coefficient of variation (CV %) and instability index was used to measure the instability. Coefficient of variation and instability index of area, production and yield of *kharif* and summer sesamum for selected districts are given in [Table-2]. The results revealed that in case of *kharif* sesamum instability index for area (53.23 %) for Junagadh found statistically significant but in Rajkot district, instability index for *kharif* sesamum area (37.44 %) found statistically non-significant. The instability index for *kharif* sesamum production was found statistically non-significant in Junagadh and Rajkot districts. In Junagadh district, instability index for *kharif* sesamum productivity (39.70 %) was observed statistically significant while, instability index for *kharif* sesamum productivity (45.89 %) was found non-significant in Rajkot district. The coefficient of variation and instability index of area, production and yield of summer sesamum for selected districts are given in [Table-2].

Table-2 *Instability in area, production and yield of sesamum in selected districts of Gujarat*

District	Area		Production		Yield	
	CV %	CDV %	CV %	CDV %	CV %	CDV %
Kharif (1995-96 to 2018-19)						
Junagadh	89.49	53.23	101.79	73.85^{NS}	40.18	39.7
Rajkot	69.36	37.44 ^{NS}	99.78	65.65^{NS}	46.52	45.89^
Summer (2009-10 to 2018-19)						
Junagadh	90.21	57.39^{NS}	83.04	81.16^{NS}	38.87	24.11
Rajkot	109.43	84.00^{NS}	103.02	77.67^{NS}	49.07	32.01
Total (1995-96 to 2009-10)						
Junagadh	95.45	92.81^{NS}	102.97	87.80^{NS}	49.07	37.6
Rajkot	59.5	35.33^{NS}	82.37	59.10^{NS}	62.2	45.26

Note: CV- Coefficient of Variation (%), CDV- Cuddy Della Vella Index (%), NS - Non significant

The results revealed that the instability index for summer sesamum area and production was found statistically non-significant for Junagadh and Rajkot districts. The instability indexes for summer sesamum productivity were 24.11 percent and 32.01 percent in Junagadh and Rajkot districts, respectively and were found statistically significant. The coefficient of variation and instability index of area, production and yield of total sesamum for selected districts are given in [Table-2]. The results revealed that the instability index for total sesamum area and production was found statistically non-significant for Junagadh and Rajkot districts. The instability indexes for total sesamum productivity were 37.60 percent and 45.26 percent in Junagadh and Rajkot districts, respectively and were found statistically significant. The instability index worked out to measure the instability has also reflected the same trend as indicated by coefficient of variation. On the whole, the area of *kharif*, summer and total sesamum, in which only in *kharif* sesamum area (53.23 %) was observed unstablein Junagadh district and in case of the productivity of *kharif*, summer and total sesamum, the highest instability was observed in total sesamum productivity (45.26 %) in Rajkot district. In *kharif* sesamum, instability in area and production found slightly higher in Junagadh 9district as compared to Rajkot district, but it was observed reverse in case of yield instability. In summer sesamum, instability in area, production and yield found relatively low in Junagadh district as compared to Rajkot district. In case of total sesamum, the instability reflected is same as in case of *kharif* sesamum. In general, instability in area and production found higher than that in yield.

Acreage response

This study pertains to *kharif* and summer sesamum. Four different models (M1 to M4) comprising different combinations of price, price derivatives and non-price factors were fitted for each season. The study was restricted only to main sesamum growing districts Junagadh and Rajkot. The acreage response to price and non-price factors were studied separately for each season, subsequently the acreage response was discussed across the seasons. With a view of estimating the acreage response of producers in terms of *kharif* sesamum area towards price and non-price factors, the actual area in the current year was expressed as a linear function of one and two year lagged area and farm harvest prices, one year lagged yield, sowing rainfall, current area of competing crop, one year lagged price of competing crop, gross income, gross income of competing crop, yield risk, price risk, and return risk. The regression coefficients of these explanatory variables are presented in [Table-3]. The value of R^2 found more than 60 percent in Junagadh district and more than 86 percent in Rajkot district in different models, indicated higher fitness of good of models in Rajkot district. The highest R^2 value indicating strong explanatory power of sets of independent variables included in these models. The results revealed that, one year the lagged area was found to be positively influential factors in the farmers regarding area allocation to *kharif* sesamum in all the models of Junagadh and Rajkot districts.

Table-3 *Regression estimates of acreage response function of kharif sesamum in Junagadh and Rajkot districts (1995-96 to 2018-19)*

Variable	Regression coefficients							
	Junagadh				Rajkot			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	31.3415	51.5395	38.6709	51.9724	116.681	536.2769	119.6346	248.583
A_{t-1}	0.3337**(0.1818)	0.3202*(0.1993)	0.3221**(0.1720)	0.3260*(0.1935)	0.9952****(0.2516)	0.7425****(0.1519)	0.7211****(0.1735)	0.7147****(0.1672)
A_{t-2}	0.1803(0.1871)				-0.2308(0.2568)			
AC_t		-0.0003(0.0145)				-0.0729**(0.0348)		
P_{t-1}	-0.0027(0.0040)	-0.0015(0.0045)		-0.0004(0.0055)	-0.0058(0.0140)	-0.0073(0.0117)		0.0096(0.0161)
P_{t-2}	-0.0005(0.0039)				-0.0068(0.0137)			
PC_{t-1}		-0.0098(0.0109)		-0.0097(0.0105)		-0.0649***(0.0273)		-0.0697***(0.0313)
GI_{t-1}			0.0002(0.0020)				0.0035(0.0063)	
GIC_{t-1}			-0.0006(0.0007)				-0.0030(0.0023)	
Y_{t-1}	-0.0078(0.0216)	-0.0052(0.0224)	0.0091(0.0210)	-0.0035(0.0227)	-0.0338(0.0856)	-0.0917(0.0751)	0.0376(0.0800)	-0.0367(0.0895)
RS_t		0.0171(0.0401)				-0.0374(0.1265)		
σ_Y				-0.0054(0.0525)				-0.08391612
σ_P				-0.0044(0.0135)				0.0104(0.0423)
σ_R			-0.0000(0.0041)				-0.0045(0.0131)	
R^2	0.6068	0.6061	0.6327	0.6049	0.8626	0.9098	0.8792	0.9006

Note: ****, ***, ** and * indicate statistically significant at 1 %, 5 %, 10 % and 20 %, respectively.

Table-4 *Regression estimates of acreage response function of summer sesamum in Junagadh and Rajkot districts (2009-10 to 2018-19)*

Variable	Regression coefficients					
	Junagadh			Rajkot		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Constant	1287.0985	248.994	-296.8125	153.9399	186.8843	-296.2383
A_{t-1}	0.0317(0.3670)	0.0776(0.2041)	0.4420 *(0.2621)	-0.1423(0.4673)	-0.3468(0.4419)	0.4428 *(0.2618)
A_{t-2}	-1.1232*(0.5350)			-0.0650(0.5223)		
AC_t		-0.2130(0.2755)	-0.1288(0.3436)		-0.1376(0.2360)	-0.1321(0.3444)
P_t^*			-0.0019(0.0078)			-0.0021(0.0080)
P_{t-1}	-0.0144(0.0277)	-0.0139(0.0106)		-0.0047(0.0119)	-0.0037(0.0093)	
P_{t-2}	-5.0505**(0.0235)			-0.0137(0.0115)		
PC_{t-1}		-0.0598 **(0.0200)			-0.0366*(0.0206)	
Y_{t-1}	-0.7628**(0.3312)	-0.1166(0.0758)	0.0179(0.1230)	-0.0681(0.0854)	-0.0768*(0.0462)	0.0188(0.1229)
TR_t		0.3220***(0.0864)	0.3923***(0.1128)		0.1440 *(0.0771)	0.3930***(0.1128)
R^2	0.7166	0.9797	0.9124	0.3491	0.8462	0.9127

Note: ****, ***, ** and * indicate statistically significant at 1 %, 5 %, 10 % and 20, respectively. P_t^* = Price of kharif sesamum in current year

In Junagadh district, other price and non-price variables, found to have no any significant impact on acreage allocation under *kharif* sesamum. In case of Rajkot district, the area of competing crop was found to be negative and statistically significant at 10 percent level of significance. This indicated the competitive effect in terms of acreage allocation between *kharif* groundnut and *kharif* sesamum. The coefficient of one-year lagged farm harvest price was -0.0058 (M1), -0.0073 (M2) and 0.0096 (M4) in Rajkot district and were found non-significant in all the models of Rajkot district indicated that farmers are indifferent towards the lagged year farm harvest price of *kharif* sesamum. Two-year lagged farm harvest price was also found to be negative and non-significant. In case of Rajkot district lagged price of competing crop was found negative in M2 (-0.0649) and M4 (-0.0697) and were found statistically significant at 5 percent level of significance. This showed increased economic importance of competing crop. The coefficients of the gross income variable were found positive in Rajkot district (0.0035) but statistically non-significant showed no any effect of gross income on current acreage of *kharif* sesamum. In case of gross income of competing crop, the regression coefficient found negative but statistically non-significant in Rajkot district. Other factors like lagged yield, sowing month rainfall and risk of price and return have no any significant impact on acreage allocation under *kharif* sesamum in Rajkot district. But the coefficient of yield risk found negative and statistically significant in model-3 indicated the farmers' aversion towards the yield risk. Thus, it can be inferred that the *kharif* sesamum growers of Junagadh district are traditional in nature, they have not responded to the price and non-price factors too. Whereas, farmers of Rajkot district exhibited rational behaviour to price factors and non-price factors *i.e.* negative response to area under competing crop, lagged price and yield risk. With a view of estimating the acreage response of growers of summer sesamum towards price and non-price factors, the actual area in the current year was expressed as a linear function of one and two year lagged area and farm harvest prices, one year lagged yield, total rainfall, current area of competing crop, one year lagged price of competing crop and prices of *kharif* sesamum in current year. The regression coefficients of these explanatory variables are presented in [Table-4]. The value of R^2 in different models found reasonably high except the model-1 in Rajkot district. The results revealed that, the one-year lagged area was found positive in M3 (0.4420) and statistically significant at 20 percent in Junagadh district indicated moderate rigidity to adjust in acreage. But the coefficient of A_{t-2} found negative and statistically significant indicated negative response to two-year lagged acreage. The negative response to current acreage under competing crop (AC_t) was found in all the models, which is very obvious, but it was statistically non-significant. The negative response to P_{t-2} found statistically significant which indicates quite irrational behaviour of summer sesamum growers of Junagadh district. In model-2 the negative and significant response to price of competing crop was observed which indicated the existence of competition between summer sesamum and summer groundnut in term of acreage allocation. The negative response to one-year lagged yield not rational behaviour of summer sesamum growers of Junagadh district. The positive and significant impact of total rainfall was found on summer sesamum acreage because it needs assured irrigation facility. Thus, prices and acreage under competing and total rainfall are the major factors governing the acreage allocation under summer sesamum in Junagadh district. In case of Rajkot district one-year lagged area was found positive (0.4428) and significant at 20 percent level of significance in model-3. But the absolute magnitude of regression coefficients was less than 0.5 indicating greater speed of acreage adjustment on the part of farmers. The area of competing crop and current price of *kharif* sesamum were found to have negative and non-significant impact on summer acreage allocation. In case of Rajkot district, almost the same acreage response as observed in Junagadh district was found towards price and non-price factors, Thus, in both the districts, summer sesamum growers considers the factors like area and price of competing crop, lagged yield and total rainfall while allocating the area under summer sesamum.

Area adjustment and price elasticities

Area adjustment coefficients, short-run and long-run elasticities are given in [Table -5]. The coefficient of adjustment, in the present context, indicate 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. In the *kharif* sesamum the coefficient of adjustment was positive for both of the districts. The higher values of coefficient of adjustment were found in Junagadh district as compared to Rajkot district in all models indicated the higher speed of adjustment in acreage allocation of *kharif* sesamum in Junagadh district. For most of models in Junagadh district, values of adjustment coefficient were more than 0.5 indicating a general lack of rigidities in Nerlovian parlance which indicating attainment of equilibrium output, which was obvious because this era is of extensive agriculture which added flexibility in resource allocation plan. The price elasticities show the influence of unit change in price on acreage allocation of the crop. In the present study, price elasticity was estimated for short run as well as for long run period. The variation in the magnitude of short run and long run price elasticity factors between two districts of Junagadh and Rajkot were evident from the [Table-5].

Table-5 *Price elasticities and coefficient of adjustment for sesamum*

	Junagadh			Rajkot		
	Kharif (1995-96 to 2018-19)					
	Y	SR	LR	Y	SR	LR
M1	0.6662	-0.3343	-0.5018	0.0047	-0.1024	-21.6347
M2	0.6797	-0.1873	-0.2755	0.2574	-0.1289	-0.5011
M3	0.6778	0.1501	0.2215	0.2788	0.2944	1.0559
M4	0.6739	-0.0579	-0.0859	0.2852	0.1689	0.5921
	Summer (2009-10 to 2018-19)					
M1	0.9682	-0.6597	-0.6813	1.1423	0.8095	0.7086
M2	0.9223	-5.3327	-5.7814	1.3468	-0.6406	-0.4756
M3	0.5579	-0.0986	-0.1767	0.5571	-0.1097	-0.1969

The coefficient of both the elasticities of *kharif* sesamum found positive and negative in different model indicated in consistence response to price. The higher value of long run elasticity (LR) indicated that the farmers were relatively market oriented in their decision in the long run than in short run in respect to the sesamum in Junagadh and Rajkot districts. In the summer sesamum the coefficient of adjustment was higher than 0.50 for both of the districts indicated general lack of rigidity in summer sesamum acreage adjustment. The highest value of coefficient was found for the Rajkot 1.3468 in M2 and 1.1423 in M1. The value of coefficient of adjustment was found closer to one in Junagadh district. Based on the value it can be inferred that farmers are quicker in adjustment towards price change. They require the time less than one year to adjust the price change. In the Rajkot district, value of coefficient of adjustment was found greater than unity indicating the over adjustment toward price change. The coefficients of both the elasticities were negative in all the models of Junagadh. This indicated the negativity of summer sesamum growers towards the price stimuli. In case of Rajkot district, the coefficients of both the elasticities were found positive in model-1 and negative in model-2 and model-3. Thus, response to price is not consistence.

Factors considered by farmers for acreage allocation of *kharif* and summer sesamum crop

Factors considered by farmers while acreage allocations under *kharif* sesamum of Junagadh district are ranked using Garret ranking analysis. The factors associated with acreage allocation under *kharif* sesamum are presented in [Table-6]. The results revealed that among the ten different factors considered by the *kharif* sesamum respondents, the rainfall of season was the most important factor expressed with a Garrett's score of 72.9 (Rank- I) followed by low cost of cultivation of sesamum (64.63), price of sesamum during last year (61.93), price of groundnut during last year (59.9), low plant protection cost of sesamum (57.76), less labour requirement of sesamum (53.3), yield per ha of sesamum (51.33), easy harvesting of sesamum (44.56), less irrigation requirement of sesamum (32.3) and easy to store of sesamum (29.83). Factors considered by farmers while acreage allocations under *kharif* sesamum of Rajkot district are ranked using Garret ranking analysis. The factors associated with acreage allocation under *kharif* sesamum are presented in [Table-7].

Table-6 *Factors considered by farmers while acreage allocation under kharif sesamum of Junagadh district*

S	Attributes	Total score	Garrett's score	Rank
1	Price of sesamum during last year	1858	61.93	3
2	Price of groundnut during last year	1797	59.9	4
3	Low cost of cultivation of sesamum	1939	64.63	2
4	Low plant protection cost of sesamum	1733	57.76	5
5	Less labour requirement of sesamum	1599	53.3	6
6	Yield per ha of sesamum	1540	51.33	7
7	Less irrigation requirement of sesamum	969	32.3	9
8	Rainfall of season	2187	72.9	1
9	Easy harvesting of sesamum	1337	44.56	8
10	Easy to store of sesamum	895	29.83	10

Table-7 *Factors considered by farmers while acreage allocation under kharif sesamum of Rajkot district*

S	Attributes	Total score	Garrett's score	Rank
1	Price of sesamum during last year	1867	62.23	1
2	Price of groundnut during last year	1592	53.6	4
3	Low cost of cultivation of sesamum	1830	61	2
4	Low plant protection cost of sesamum	1566	52.2	5
5	Less labour requirement of sesamum	1635	54.5	3
6	Yield per ha of sesamum	1336	44.53	7
7	Less irrigation requirement of sesamum	1461	48.7	6
8	Rainfall of season	1330	44.33	8
9	Easy harvesting of sesamum	1105	36.83	10
10	Easy to store of sesamum	1117	37.23	9

The results showed that among the ten different factors considered by the sesamum respondents, the price of sesamum during last year was the most important factor expressed with a Garrett's score of 62.23 (Rank-I) followed by low cost of cultivation of sesamum (61.0), less labour requirement of sesamum (54.5), price of groundnut during last year (53.6), low plant protection cost of sesamum (52.2), less irrigation requirement of sesamum (48.7), yield per ha of sesamum (44.53), rainfall of season (44.33), easy to store of sesamum (37.23) and easy harvesting of sesamum (36.83).Factors considered by farmers while acreage allocations under summer sesamum of Junagadh district are ranked using Garret ranking analysis. The factors associated with acreage allocation under summer sesamum are presented in [Table-8].

Table-8 *Factors considered by farmers while acreage allocation under summer sesamum of Junagadh district*

S	Attributes	Total score	Garrett's score	Rank
1	Price of sesamum during last year	1752	58.2	2
2	Price of groundnut during last year	1748	58.26	3
3	Low cost of cultivation of sesamum	1823	60.76	1
4	Low plant protection cost of sesamum	1604	53.46	4
5	Less labour requirement of sesamum	1599	53.3	5
6	Yield per ha of sesamum	1521	50.7	7
7	Less irrigation requirement of sesamum	1582	52.73	6
8	Rainfall of season	1268	42.26	8
9	Easy harvesting of sesamum	1117	37.23	9
10	Easy to store of sesamum	917	30.56	10

The results revealed that among the ten different factors considered by the summer sesamum respondents, the low cost of cultivation of sesamum was the most important factors expressed with a Garrett's score of 60.76 (Rank-I) followed by price of sesamum during last year (58.2), price of groundnut during last year (58.26), low plant protection cost of sesamum (53.46), less labour requirement of sesamum (53.3), less irrigation requirement of sesamum (52.73), yield per ha of sesamum (50.07), rainfall of season (42.26), easy harvesting of sesamum (37.23) and easy to store of sesamum (30.56).Factors considered by farmers while acreage allocations under summer sesamum of Rajkot district are ranked using Garret ranking analysis. The factors associated with acreage allocation under summer sesamum are presented in [Table-9]. The analysis revealed that among the ten different factors considered by the sesamum respondents, the low cost of cultivation of sesamum was the major factor expressed with Garrett's score of 57.53 (Rank-I) followed by less labour requirement of sesamum (53.26), less irrigation requirement of sesamum (52.46), yield per ha of sesamum (50.7),

Table-9 Factors considered by farmers while acreage allocation under summer sesamum of Rajkot

S	Attributes	Total score	Garrett's score	Rank
1	Price of sesamum during last year	1415	47.16	7
2	Price of groundnut during last year	1309	43.63	9
3	Low cost of cultivation of sesamum	1726	57.53	1
4	Low plant protection cost of sesamum	1483	49.43	6
5	Less labour requirement of sesamum	1598	53.26	2
6	Yield per ha of sesamum	1521	50.7	4
7	Less irrigation requirement of sesamum	1574	52.46	3
8	Rainfall of season	1372	45.73	8
9	Easy harvesting of sesamum	1506	50.2	5
10	Easy to store of sesamum	1261	42.03	10

easy harvesting of sesamum (50.2), low plant protection cost of sesamum (49.43), price of sesamum during last year (47.16), rainfall of season (45.73), price of groundnut during last year (43.63) and easy to store of sesamum (42.03).On the whole, in Junagadh district, the most important factors considered by farmers while acreage allocation under *kharif* sesamum were; the rainfall of current year, low cost of cultivation of sesamum and price of sesamum during last year. In case of Rajkot district, the most important factors considered by farmers while acreage allocation under *kharif* sesamum were; the price of sesamum during last year, low cost of cultivation of sesamum and less labour requirement of sesamum. For *kharif* sesamum, the low cost of cultivation of sesamum and price of sesamum during last year were the common factors considered by farmers while acreage allocation in both of the districts. In Junagadh district, the most important factors considered by farmers while acreage allocation under summer sesamum were; low cost of cultivation of sesamum, price of sesamum during last year and price of groundnut during last year. In case of Rajkot district, the most important factors considered by farmers while acreage allocation under summer sesamum were; low cost of cultivation of sesamum, less labour requirement of sesamum and less irrigation requirement of sesamum. In the summer sesamum the low cost of cultivation of sesamum was found common factor considered by farmers while acreage allocation in both of the districts.

Conclusion

In nut shell, area and production under *kharif* and summer sesamum declined in both the districts, while yield has increased in summer sesamum only. Instability in area and production found higher than in yield. Sesamum growers of Junagadh district has not responded to price factors. Whereas sesamum growers of Rajkot district considers, area under 97competing crops and its one-year legged piece and total rainfall (in summer) in acreage allocation under sesamum. The most important factors considered by farmers while acreage allocation under *kharif* and summer sesamum are the low cost of cultivation of sesamum and price of sesamum during last year.

Application of research: Sesamum being an important foreign exchange earning crop of the country, it is necessary to increase area under cultivation of the crop to produce more to sustain the present level of export. This can be achieved through increasing the assured irrigation facility in summer sesamum growing area and providing hectare-based subsidy like in cumin crop. Efforts are needed to educate the farmers regarding the use of pest and disease resistant varieties so as to reduce the major cost component incurred towards plant protection chemicals.

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Cultivar / Variety / Breed name: Sesamum (*Sesamum indicum* L.)

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