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GROUNDNUT PRICE FORECASTING AND SUPPLY RESPONSE MARKET INTEGRATION IN INDIA

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Abstract

The oilseed industry plays a significant role in India's agricultural economy, and the nation is the world's biggest producer of oilseeds. These crops are second only to food grains in terms of total acreage, total output, and total economic worth. The nine oilseeds—including the seven edible varieties of groundnut, rapeseed-mustard, sunflower, soybean, and sesame—can be successfully cultivated in India. Outside of Rajasthan, groundnut expansion patterns generally declined. The output of groundnuts in the states of Andhra Pradesh and Karnataka has been declining recently. The state of Tamil Nadu had the fastest increase in groundnut production. Groundnut output fluctuations were found to be greater in Gujarat and Andhra Pradesh, as measured by the instability index. Gujarat, Tamil Nadu, and Karnataka all had relatively stable groundnut crop areas. The market had the largest monthly rise in wholesale groundnut prices compared to other markets.

Keywords*: Groundnut Price, Forecasting, Market integration, India.*

1. Introduction

The oilseed industry is important to India's rural economy, since the nation is the world's biggest producer of oilseeds. In addition to cereals, oilseeds are one of our country's most valuable crop types. In terms of land used, output, and economic value, these crops come in second only to food cereals. The implementation of an oilseed technological mission resulted in excellent performance, but the rate could not be sustained because of the rainy nature of oilseed farming on a wide scale. Growth in the post-liberalization era was hindered in part because of oil imports on a large scale. This poor performance naturally raised concerns among agriculture specialists and policymakers.[1]

Boosting output, consumption, and economic growth all need a well-oiled marketing machine. When a bountiful crop is produced, farmers always see a drop in price for their goods. The challenge most farmers confront is getting their goods to market at the optimal time to maximize profits. Typically, they take their goods to market as soon as possible after harvesting the crop. There are a number of possible explanations for this, the most significant of which is probably a simple lack of understanding about when is the best time to sell their goods.[2]

1.1 Origin of groundnut

The edible seeds of the groundnut, or peanut, legume are a major reason for the plant's widespread cultivation. No one knows for sure where groundnut came from, although it was probably domesticated in South America somewhere between Peru and Brazil.[3]

Groundnuts were probably first farmed in Peru some 7,600 years ago, according to archaeological data. Argentina, Paraguay, and Uruguay were just a few of the places they arrived to after leaving Brazil.

The Portuguese merchants brought groundnuts to Africa in the 16th century. They then expanded across the rest of Africa, becoming a significant crop in nations as diverse as Nigeria, Senegal, Sudan, and Malawi.[4]

India, China, and the United States are just a few of the places where groundnuts are now commercially grown. China is first in the world in groundnut production, followed by India and the USA.

In addition to being eaten by humans, groundnuts serve a variety of additional purposes, including as animal feed and in the industrial manufacturing of edible oils and fats like margarine and shortening.[5]

1.2 Groundnut price forecasting in India

The weather, supply and demand, government regulations, and global market circumstances all have a role in the groundnut price in India, making accurate predictions difficult. However, the price of groundnuts in India may be predicted using a number of different approaches. Some common approaches are listed below.[6]

i. Time series analysis: By looking at past pricing data, we may see recurring patterns, such as those that occur at certain times of year or throughout specific economic cycles. Future price predictions may be made using this data.

ii. Regression analysis: Using factors like weather, planted area, and international market patterns, regression analysis uses past pricing data to create a statistical model that may foretell future price movements.

iii. Expert opinion: Market trends, supply and demand, and other variables may all affect the price of groundnuts, but experts in the field can shed light on these issues. Predictions based on these findings should be considered reliable.

iv. Machine learning models: Future prices may be predicted using machine learning models that have been trained using previous price data and other relevant information. The accuracy of these models often exceeds that of more conventional statistical techniques.[7]

v. Market intelligence reports: Groundnut market patterns and future price projections may be gleaned from market intelligence reports provided by institutions like the National Commodity and Derivatives Exchange (NCDEX) and the Agricultural and Processed Food Products Export Development Authority (APEDA).

2. Literature review

Agashe, D. R., &Agashe, R. (2019) examined the annual percentage increase in land, harvest, and harvest yield for India's groundnut crop. She breaks down the whole research period into three parts: 1970–1971, phase II (1990–1991), and the total period of 1970–2010. She found that the total area planted with groundnuts rose by 0.45% every year during the course of the research. Production of groundnuts went up 1.55 percent during the first phase, 1.02 percent during the second, and 0.61 percent overall. It was discovered that the yield of groundnuts grew by 1.06 percent year after liberalisation, which was the time of her research. Over the course of the research period, variations in groundnut crop area, output, and yield were measured, and were determined to be 15.58 percent, 20.90 percent, and 20.03 percent, respectively.[8]

Gangwar, A., & Singh, V. (2018) India's key groundnut producing states (Gujarat, Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra, Rajasthan, Madhya Pradesh, Uttar Pradesh, and Orissa) were analysed for their respective area, output, and yield growth rates. The years 1990–91 through 2010–11 were used in Gujarat's case, whereas the years 2003–04 through 2009–10 were used for the rest of the states and for India as a whole. The rate of growth was determined using the CAGR method. They found that groundnut expansion in Rajasthan was greatest in area (7.89%), output (18.37%), and yield (9.33%). Tamil Nadu had the slowest expansion in land area (6.98%), while Uttar Pradesh had the slowest expansion in groundnut output (-4.52%) and yield (-3.45%).[9]

Burark, S. S., & Meena, G. L. (2017)analysed the expansion of Karnataka's key oilseeds in terms of land, output, and harvest size during 1982–1983. They employed a technique known as the compound annual growth rate methodology to determine the rate of increase. Using the compound growth function, we evaluated the increase in planted area, yield, and productivity for a number of distinct crop scenarios. They decided to look at ground nut, sesame, safflower, and sunflower fields. The groundnut area in the state of Karnataka grew by 0.06 percent, while the output and yield both decreased by 0.46 percent. They determined the cause to be a deficiency of high-yielding cultivars suited to the area. During the time frame of this research, the area planted with sesame had a negative growth rate of -2.36 percent every year. Sesame output grew at a rate of 0.41 percent annually, while yield grew at a rate of 2.83 percent annually, according to the data.[10]

Cuddy, J. D., & Valle, P. D. (2016) The area planted with sunflowers has increased by a healthy and noteworthy 4.04 percent annually. Farmers may have been encouraged to boost sunflower cultivation as a result of the high price that had previously prevailed for sunflowers and also because sunflowers are a crop that can thrive in arid regions. They counted 21.28 million hectares of oilseeds in the state of Karnataka. The findings suggested a minor annual variation of 20.53 percent in the area planted with oilseeds (0.93 percent). Total oilseed output and productivity both showed annual growth rates of 0.04 percent with a standard deviation of 12.15 percent and 0.06 percent with a standard deviation of 25.85 percent, respectively.[11]

Sharma, H. (2015) examined the development of oilseed cultivation, output, and efficiency in Andhra Pradesh from 1996–97 to 2011–12. The research focused on oilseed crops including peanut, sesame, and sunflower. The average annual growth rate of several oilseeds was computed using the Compound Annual Growth Rate (CAGR) technique. Area planted with peanuts (-2.17%), sesame (-4.89%), and sunflower (-0.53%) all declined over the research period. Groundnut and sesame output both had a negative growth rate of 2.15 and -2.56 percent, respectively. All three oilseed crops showed yield increases: 0.02 percent for groundnuts, 2.32 percent for sesame, and 1.71 percent for sunflower.[12]

3. Methodology

The appropriate research methods in order to draw useful results from the investigation. In reality, research technique is the backbone of each scientific study, and its explanation helps both readers and other researchers interpret the results.

3.1 Description of the study area

3.1.1 Description of Selected States

Many of India's states now cultivate groundnuts, the country's primary oil seed crop. The states were chosen based on their typical groundnut output between 2018–19 and 2019–20. Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh, and Karnataka are the chosen states.

Table 3.1: India's top five groundnut-producing states

Sr.No.	States	Trienniumaverageproduction(‘000tonnes)
1	Gujarat	3099.08
2	Rajasthan	1260.65
3	TamilNadu	835.79
4	AndhraPradesh	704.45
5	Karnataka	453.87

3.1.2 Selection of Markets

Agricultural marketplaces (mandies) were chosen once the primary groundnut producing states were identified. The Table 3.2 Arrivals Data was used to determine which markets to focus on. The top three-year arrival totals from 2018-2020 were used to determine which two states' mandies would be chosen. Mandies were chosen from the following cities in India: Gondal (Gujarat), Rajkot (Rajasthan), Avalurpet (Tamil Nadu), Bikaner (Rajasthan), Chomu (Rajasthan), Adoni (Andhra Pradesh), Kurnool (Andhra Pradesh), Yadgir (Karnataka), and Laxmeshwar (Karnataka)..

Table 3.2: Arrivals of groundnuts in some marketplaces

Sr.No.	States	Markets	Trienniumaverage(tonnes)
1		Gondal	157411.40

2	Gujarat	Rajkot	54146.97
3	Rajasthan	Bikaner	150360.63
4		Chomu	40543.67
5	TamilNadu	Avalurpet	3756.47
6		Tindivanam	2880.57
7	AndhraPradesh	Adoni	16466.40
8		Kurnool	10012.77
9	Karnataka	Yadgir	52899.00
10		Laxmeshwar	6829.67

3.2Nature and sources of data

Secondary data from 2018-20 were used for analysis. Area, output, productivity, irrigated land, and the cost of a groundnut crop were gathered from the Central Statistics Office of India, the Government of India's Department of Agriculture and Farmers' Affairs, and Indiastat.com, among other sources. Commission for Agricultural Cost and Prices (CACP) statistics on MSP and Indian Meteorological Department data on rainfall were used to compile this study. For the purposes of market integration and price forecasting, data from 2002-2019 was examined for study period. This is because model price is regarded as preferable as monthly average price since it represents the biggest proportion of the groundnut commodity sold during the month in a certain market. For the sake of cost forecasting, the whole dataset was divided into training and testing set of 80:20. The remaining 20% of the data was utilized to validate the model once it was built using the other 80%.

3.3 Analytical tools and techniques

The following is a list of the many analytic methods that were used in the study:

- Analysis of Compound Annual Growth Rate
- Index of Uncertainty

- Linear pattern

4. Results

4.1Extent of market integration in selected major groundnut market

In this era of globalization, market integration has become more robust and open. Market integration describes the extent to which vertically or geographically interconnected marketplaces share prices with one another. How closely prices in different marketplaces in different locations move together are one indicator of how integrated such markets are. In an integrated market, all vendors sell the same goods and services at the same price, according to the "law of one price" (LOOP). When dealing with similar products, one pricing dominates. Johansen co-integration and Granger's causality test were used to determine the direction of causation in the groundnut markets' price movements. From 2019 to 2021, we looked at wholesale prices every month. The Augmented Dickey Fuller test was used to check for stationarity in the time series data that was under scrutiny. Tables 4.1 display the outcomes of the study. Prior to conducting the cointegration and causality analysis, a unit root test was conducted on the groundnut commodity using the enhanced approach.

Table 4.1: Analytical DF unit root test for groundnut pricing

Groundnutmarkets	AugmentedDickeyFullerTest	
	Level	Firstdifference
Rajkot	-1.688 (0.435)	-14.246** (0.000)
Gondal	-2.037 (0.270)	-10.771** (0.000)
Bikaner	-1.774 (0.392)	-12.616** (0.000)
Chomu	-1.813 (0.392)	-15.636** (0.000)
Adoni	-1.757 (0.401)	-12.248** (0.000)
Kurnool	-1.865 (0.348)	-12.893** (0.000)
Yadgir	-4.081 (0.001)	-
Laxmeshwar	-1.448 (0.557)	-14.170** (0.000)
Tindivanam	-1.854 (0.353)	-13.393** (0.000)
Avalurpet	-1.551 (0.401)	-14.187** (0.000)

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Table 4.2: The Lag Selection Criteria

Lag	LogL	LR	FPE	SIC	HQ
0	-15552.44	NA	5.48e+51	147.670	147.575
1	-14560.35	1880.738	1.17e+48	**140.802***	**139.761***
2	-14430.04	234.684	8.80e+47	142.104	140.116

Minimum Schwarz information criterion (SIC) and Hannan-Quinn (HQ) information criterion values were used as the lag selection criteria. For the 10 chosen groundnut markets in India (Gondal, Rajkot, Bikaner, Chomu, Kurnool, Adoni, Laxmeshwar, Avalurpet, Tindivanam, and Yadgir), the lowest SIC and HQ values were found at the very top of the system. As a result of the above, it was believed that there was just one lag in the Johansen cointegration approach.

The E-views 11 software was used to conduct the Johansen cointegration analysis on a subset of the Indian groundnut market. Table 4.3 contains the gathered data on the trace statistic and Eigen value. The existence of co-integrated series was inferred when the trace statistic was larger than the 0.05 threshold value. Eigen values represent the degree to which the initial difference and the error correction term are correlated. Trace statistics value for groundnut pricing was found to be more than the threshold value of 5%. From the data in the table, it is clear that eleven groundnut markets are cointegrated.

Table 4.3: The results of Johansen's cointegration tests for the Indian groundnut market

Hypothesized No.ofCE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob**
None *	0.478	588.535	239.235	0.000
Atmost1*	0.375	449.174	197.370	0.000
Atmost2*	0.338	348.417	159.529	0.000
Atmost3*	0.310	259.969	125.615	0.000
Atmost4*	0.262	180.275	95.753	0.000
Atmost5*	0.189	115.214	69.818	0.000

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Atmost6*	0.139	70.230	47.856	0.000
Atmost7*	0.099	38.004	29.797	0.004
Atmost8*	0.062	15.529	15.494	0.049
Atmost9	0.007	1.667	3.841	0.196

4.2 Evaluate the various price forecast methods for groundnut in selected markets

Table 4.4: market groundnut prices subjected to an ADF (augmented Dickey-Fuller) analysis

	t-value	Probability
ADFteststatistic	0.465	0.893

Table 4.5: market groundnut prices undergo an ADF test for differenced time series.

	t-value	Probability
ADFteststatistic	10.128	0.000

To determine whether the series was stationary, the Augmented Dickey-Fuller (ADF) unit root test was used. Table 4.4 displays the outcomes of the ADF evaluation. The findings showed that our series was not stationary, since the p value (0.893) was not statistically significant at the 5% level of significance. Differentiating the series is the next step after discovering that the time series under examination is nonstationary in order to make it stationary. The series was then differentiated at the first order to produce a stationary series.

The ADF test outcomes after first-order differentiation are shown in Table 4.5. Since the p-value was less than 5%, we reject the null hypothesis and conclude that there is a significant difference. The series has now stopped progressing. Table 4.6 displays the results of many models established via trial and error procedures, including the Akaike Information Criterion (AIC), the Schwarz Bayesian Information Criterion (SBC), the Root Mean Square Error (RMSE), and the Mean Absolute Percentage Error (MAPE). A model's predictive accuracy is quantified by its Mean Absolute Percentage Error (MAPE). Therefore, a requirement for selecting the optimal model was a MAPE value that was relatively low. The ARIMA (3,1,2) model proved to be the most effective in predicting groundnut prices in the indian market.

Table 4.6: Preliminary estimates of the market price for groundnuts

Model(p,d,q)	AIC	SBC	RMSE	MAPE
(1,1,1)	2323.38	2332.80	211.45	4.87
(1,1,2)	2325.38	2337.94	211.46	4.88
(1,1,4)	2329.31	2348.16	211.40	4.86
(2,1,3)	2329.07	2347.92	211.25	4.89
(3,1,1)	2327.10	2342.81	211.26	4.89
(3,1,2)	2318.24	2337.09	201.78	4.81
(3,1,3)	2320.24	2342.23	201.79	4.82
(3,1,4)	2325.84	2350.97	204.35	4.88

The best model was determined to be ARIMA with parameters set to (3,1,2). Table 4.7 displays the parameter co-efficient values together with their standard errors, z-values, and p-values. The z-scores indicated the degrees of significance for the parameter estimations. At the 1% level of significance, all of the parameters were judged to be significant.

Table 4.7: Parameter estimates for fitted ARIMA model for groundnut prices for market

Parameter	Estimates	Std.Error	zvalue	Probability
AR1	0.281	0.081	3.458	0.000
AR2	-0.984	0.020	-47.604	0.000
AR3	0.246	0.079	3.084	0.002
MA1	-0.100	0.021	-4.670	0.000
MA2	0.999	0.026	37.940	0.000

In single exponential smoothing, each observation has the same importance. Table 4.8 demonstrates that at the 1% level of significance, the alpha value was 1.000 with a standard error of 0.082. Table 4.9 displays the results of the SES model fit statistics. During the model fitting process, the following values were determined: R2 = 0.961, RMSE = 215.432, MAPE = 4.891, and BIC = 10.755.

Table 4.8: SES model parameters for predicting market groundnut prices

Smoothingparameter	Estimate	S.E	t-value	Sig.
Alpha(Level)	1.000	0.082	12.187	0.000

Table 4.9: Statistics from the SES model for predicting market groundnut prices

Modelfitstatistics				
Model_1	R-squared	RMSE	MAPE	NormalizedBIC
	0.961	215.432	4.891	10.755

5. Conclusion

The research indicated that although groundnut planting declined over time in Gujarat, both output and yield increased. Groundnut output and yield have shown a high incidence of volatility. The harvest season's unfavourable weather had a significant effect in the fluctuation in yield and productivity. Groundnut plantings, harvests, and yields have all been on the rise in Rajasthan. Only in the state of Rajasthan were seen discernible increases in both output and yield over time. The state of Tamil Nadu had the fastest increase in groundnut production. The Avalurpet market had the largest monthly rise in wholesale groundnut prices among all marketplaces.

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