Full Research

Crossref

Economic Analysis of Prices and Arrivals of Turmeric in Duggirala Market of Andhra Pradesh

G. Raghunadha Reddy[1], M. Chandrasekhar Reddy[1], K. S. Sneha[1], B. Meher Gita[1] and D. Ramesh[2]

[1]Division of Agricultural Economics, Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh (522 034), India
[2]Division of Statistics and Mathematics, Agricultural College, Bapatla, Andhra Pradesh (522 101), India

Corresponding Author

G. Raghunadha Reddy
e-mail: raghunadhareddy88@gmail.com

Abstract

Turmeric is an important spice grown in India since ancient times. It is also known for its medicinal value and used as an antiseptic since ancient times. India is apparently the largest consumer, producer and exporter of turmeric in the world. Turmeric is the third largest spice produced in India and largely concentrated in Telangana, Andhra Pradesh, Tamil Nadu, Karnataka etc. In this paper, an attempt has been made to study the arrivals and prices of turmeric in Duggirala market in Andhra Pradesh based on the secondary data during the period 2004-2019. The seasonal variations in the arrivals and prices were studied by seasonal indices with the help of ratio to moving average method. For the arrivals of turmeric in Duggirala market, seasonal indices were recorded maximum (206.44) during the month of May and minimum (50.32) in the month of October and prices were lowest (89.39) in the month of March and the highest (107 and 107.27) in November and December, respectively. The present study revealed that the power and cubic models were selected as the best fitted nonlinear models for prices and arrivals of turmeric in Duggirala market. Turmeric market price and arrivals in Duggirala Market for the year 2020 is estimated as INR 6827 quintal^{-1} and 82207 quintals^{-1}, respectively.

1. Introduction

Turmeric (*Curcuma longa* L.) is an ancient medicinal spice with a history of 5000 years. It belongs to family Zingiberaceae and is largely cultivated in parts of Southeast Asia. It is an important commercial spice crop grown in India and also known as "Indian saffron". India is the largest producer, consumer and exporter of turmeric in the world. Indian turmeric is considered to be the best quality due to its high curcumin content and thus it is increasingly used in medicinal and cosmetic applications. Other major turmeric producing countries include Bangladesh, Pakistan, Sri Lanka, Taiwan and China. Major turmeric exporting countries are India, Thailand, Taiwan and several other Southeast Asian, Central and Latin American countries. The major turmeric importing countries include Japan, Sri Lanka, Iran, UAE, US, UK and Ethiopia.

India accounts for about nearly 80-85% of the world's total turmeric and 60% of world exports. Major turmeric producing states in India are the southern states of Telangana, Andhra Pradesh, Tamil Nadu and Karnataka, the eastern states of Orissa and West Bengal, and the western states of Maharashtra. The major trading hubs of turmeric in India are mainly Nizamabad (Telangana), Duggirala (Andhra

Pradesh), Sangli (Maharashtra), Salem, Erode, Dharmapuri and Coimbatore (Tamil Nadu).

Andhra Pradesh is called the turmeric bowl of India. According to the advance estimate, the acreage under turmeric is 17800 ha with production of 80100 tonnes for the year 2019-20. In Andhra Pradesh, the turmeric arrivals are seen highest in Guntur (Duggirala market) with 54.25% and Cuddapah (Cuddapah market) with 45.75% of state arrivals. Agricultural marketing plays an important role in accelerating the pace of economic development. An efficient marketing system ensures higher levels of income to farmers and widens the market for the products by taking them to remote corners of the country and world-wide.

Analysis of price and market arrivals over time is important for formulating a sound agricultural price policy. Fluctuation in most arrivals largely contribute to the instability of the produce. In order to device appropriate ways and means for reducing price fluctuations of agricultural commodities, there is a need to have understanding of price behaviour over time and space. It gives information regarding the competitiveness of Indian turmeric in International market. Such analysis is helpful to the farmers in order to decide to the proper disposing of the produce to their best advantage.

2. Materials and Methods

The present study was based on the time series data collected from Duggirala market committee, Andhra Pradesh. In this study, Duggirala market was purposively selected because it is one of the biggest turmeric markets in the Andhra Pradesh. Data was collected for period of fifteen years (month wise) i.e. from 2004-2019 on prices and arrivals of turmeric for modelling purpose. The present study was conducted with an intention to study the behaviour of prices and arrivals of turmeric over a period of time in Andhra Pradesh.

2.1. Analytical framework

In order to achieve the objectives of the study, statistical techniques used in the analysis is as under:

2.1.1. Seasonal fluctuations

To study the seasonal variation of prices and arrivals of turmeric - ratio to moving average method was selected as it is the most satisfactory, flexible and widely used method over other methods (Gupta and Kapoor, 2007).

The steps involved in the construction of seasonal index were as follows:

1. Firstly, data was arranged in months and years.

2. Then, Average $\overline{X}_i$, (i = 1, 2,……,12) for the ith month for all the years. [i^{th} month, i = 1, 2,……,12 represents January, February,….., December, respectively].

3. Average X of the monthly averages, i.e.,

$$\overline{X} = \frac{1}{12} \sum_{i=1}^{12} \overline{X}_i$$

4. Seasonal indices for different months are obtained by expressing monthly averages as %age of X_i.

Thus, Seasonal index for i^{th} month$=(\frac{\overline{X}_i}{\overline{X}})\times100$; i = 1, 2,….., 12.

2.1.2. Trend models

Growth rate analysis is widely employed to describe the long-term trends in variables over times. Nonlinear growth models have widely been used to measure agricultural growth in terms of growth rate (Joshi and Saxena, 2002). Keeping in the view the present study has been undertaken to find the growth trends on prices and arrivals with application of following nonlinear models (Ramesh et al., 2019):

Linear	:	$Y_t = a+bt + e_t$
Quadratic	:	$Y_t = a+bt + ct^2 + e_t$
Cubic	:	$Y_t = a+bt+ct^2+dt^3+ e_t$
Logarithmic	:	$Y_t = a+b \ln(t)+e_t$
Exponential	:	$Y_t = a\ e^{bt}+e_t$
Power	:	$Y_t = a\ t^b+e_t$
Compound	:	$Y_t = a\times bt+e_t$

Where,

Y_t – Prices and arrivals of turmeric (Prices in INR quintal^{-1} and arrivals in quintals)

a, b, c, d – Parameters

t – Time in number of years

Here, standard statistical package like SPSS containing in-built programs for fitting of these linear-nonlinear models were used to estimate parameters. In this study, the best model was selected by diagnostic criterion: Co-efficient of Determination (R^2), Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and Mean Absolute Percentage Error (MAPE).

3. Results and Discussion

Nearly every type of business activity is susceptible to seasonal influence on a greater or lesser degree and as such these variations are regarded as normal phenomenon recurring every year. The factors affecting market arrivals include climatic conditions, human and institutional factors, very low bargaining power of the cultivators, lack of storage facility, pressing demand for the product, ignorance of the market information which forces the cultivators to sell their produce immediately after harvest (Ali et al., 2018).

The average monthly arrivals and prices for the period for the 2004-05 to 2018-19 are shown in Table 1. From this, it is clear that the highest market arrivals of turmeric to Duggirala market were recorded during the months of April, May and June with an average of 19427, 26085 and 22690 (in quintals), respectively, while lowest was recorded in October with an average of 6358.50 (in quintals). The turmeric is a Kharif crop in India and its harvesting starts from December to March. Depending upon the variety, the crop becomes ready for harvest in 7-9 months after planting during January-March. Early varieties mature in 7-8 months, medium varieties in 8-9 months and late varieties after 9 months. The arrival of turmeric to markets generally starts from February and extends till May. Hence, the significant arrivals start from April and continue up to June in India.

Average highest market prices (INR Quintal^{-1}) of turmeric in Duggirala market were recorded during the months of November and December with an average of 5300 and 5313 (INR Quintal^{-1}), respectively, whereas lowest was recorded for March with an average of 4428 (INR Quintal^{-1}). To understand the variation (dispersion) of prices and arrivals of turmeric, Coefficient of Variation (CV) was calculated and also represented in Table 1. For prices, CV (%) was almost non-consistent with deviation over months which ranges from 51-64%; but the month January arrivals were highly dispersed (66.04%) than others, which indicated that the arrivals and prices are inconsistent and more volatile. Arrivals are depended on the production which in turn is related to sowing area, rainfall, productivity of the crop. With the above trend, we can conclude that planters are considering the price factor in deciding the sowing area which will influence the successive season production (Rudresh, 2019).

3.1. Seasonal fluctuation in prices and arrivals of turmeric

Seasonal Indices of prices and arrivals of turmeric in Duggirala

Table 1: Average monthly prices and arrivals for turmeric in Duggirala market of Andhra Pradesh from 2004-2019

Months	Prices (INR quintal^{-1})		Arrivals (Quintals)	
	Average	Coefficient of variation (%)	Average	Coefficient of variation (%)
January	4995.92	64.91	7295.83	66.04
February	4646.15	56.78	8536.65	49.13
March	4428.01	60.27	7632.42	53.85
April	4838.67	54.90	19427.65	39.58
May	4937.51	56.56	26085.08	38.34
June	4812.13	56.45	22690.36	47.93
July	5015.94	56.36	16076.57	47.18
August	5074.10	54.11	10460.70	58.34
September	5038.51	51.09	8187.75	50.50
October	5041.28	55.55	6358.50	62.60
November	5300.35	59.12	10272.85	43.53
December	5313.64	63.99	8606.19	60.57

market in Andhra Pradesh (Table 2) revealed that the indices of arrivals of turmeric in Duggirala market were recorded maximum during the month of May (206.44 quintal) and minimum in the month of October (50.32 quintal). The arrivals started picking up from the month of April onwards to the end of July. Similar results were reported by Manjunath (2015) in analysis of price behaviour of turmeric in Andhra Pradesh.

The seasonal index for prices being lowest in the month of March (89.39) and the highest in November and December (107 and 107.27), respectively. The research findings stated

Table 2: Seasonal indices of prices and arrivals of turmeric in Duggirala market of Andhra Pradesh

Months	Seasonal Indices	
	Prices (INR quintal^{-1})	Arrivals (Quintals)
January	100.86	57.74
February	93.79	67.56
March	89.39	60.40
April	97.68	153.75
May	99.68	206.44
June	97.15	179.57
July	101.26	127.23
August	102.43	82.79
September	101.72	64.80
October	101.77	50.32
November	107.00	81.30
December	107.27	68.11

by Pallavi and Reshma (2018) were on par with study as it was revealed that maximum arrival index was in the month of April 240.43% followed by March and May and arrival index was minimum in the month November (25.46%).

The relationship between the seasonal indices in market arrivals and prices were shown in Figure 1. The highest seasonal price index was observed in the month of November and December which also indicate that the one of the lowest seasonal market arrivals were observed in the same month. The market arrivals were found higher in the month of May and June resulting lower prices in the month. Patil and Bhukre (2015) stated that as arrivals increased, prices decreased and vice versa. The lower the seasonal indices of market arrivals indicated that the prices were high and vice versa. Similar findings were received by Kanungo (2015) as there would be inverse relationship between the market arrivals and prices.
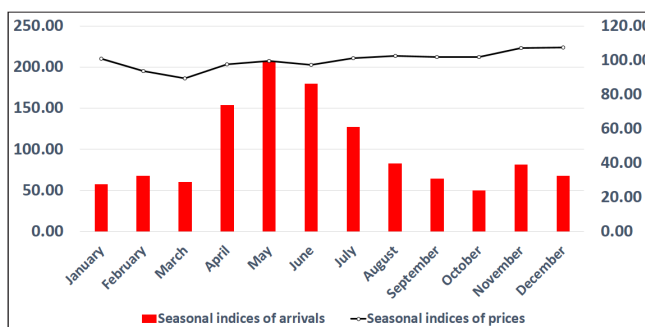

Figure 1: Seasonal Indices of Arrivals and Prices of turmeric in Duggirala market of Andhra Pradesh

3.2. Trend analysis

Trend is the basic tendency used to describe the basic pattern and behaviour of the series of data recorded in the past (Ali et al., 2018). To identify the trend in the arrivals and prices of turmeric in the Duggirala Market for the period 2004-2019, all the selected models were tried to fit, the estimated parameters and goodness of fit for the fitted models viz., R^2, RMSE, MAPE and MAE were depicted in Table 3 and Table 4, respectively.

From the Table 3, Cubic model was identified as the best model for market arrivals of turmeric due to highest value of R^2 and minimum values of another criterion. It could be observed from the table that the Co-efficient of Determination (R^2) was 0.259 which indicated that 25% of the variations in the arrivals of turmeric had been explained by the independent variable time (t). From the Table 3 the trend equation can be written as

Arrivals $(Y_t)=2.290-3.791+4.842t^2-183.49t^3+e^t$

Similar results were reported by Biswas et al. (2014), as it was reported that the cubic model was suitable for describing trends for production and productivity of wheat in Punjab.

Similarly, in Table 4, Power model was identified as the best model for turmeric market prices due to highest value of R^2. The coefficient of determination was obtained as 0.519 which

Table 3: Goodness of fit and estimation of parameters for arrivals in Duggirala market in AP

Model	Parameter estimates				Goodness of Fit			
	a	b_1	b_2	b_3	RMSE	MAE	MAPE	R^2
Linear	1.674	-2.360			33324.14	26292.26	19.818	.096
Logarithmic	1.783	-1.615			24561.44	22451.77	16.922	.124
Quadratic	1.757	-5.122	162.489		24056.61	21504.85	16.224	.104
Cubic	2.290	-3.791	4.842	-183.499	27741.56	24951.11	19.311	.259
Compound	1.662	.0982			27765.91	25160.65	18.957	.106
Power	1.791	-.118			28460.94	26356.71	19.813	.128
Exponential	1.662	-.018			27765.91	25160.65	18.957	.106

Table 4: Goodness of Fit and Estimation of Parameters for Prices in Duggirala market in AP

Model	Parameter estimates				Goodness of Fit			
	a	b_1	b_2	b_3	RMSE	MAE	MAPE	R^2
Linear	2.87	2.43			2256.088	1608.379	37.01	.199
Logarithmic	1.53	1.78			3180.79	2942.28	63.54	.292
Quadratic	-45.58	1.21	-57.35		3271.44	2994.883	63.12	.384
Cubic	-5.58	1.53	-1.02	1.76	3274.135	3024.981	64.58	.387
Compound	2.35	1.07			2937.144	2516.311	52.15	.408
Power	1.69	0.49			2930.289	2596.374	53.39	.519
Exponential	2.35	0.07			2937.144	2516.311	52.15	.408

tells that 51% of the turmeric price variations explained by the trend variable. From the Table 4 the trend equation can be written as

Prices $(Y_t) = 1.69\ t^{0.49} + e_t$

In order to know the relationship between the observed and estimated arrivals of turmeric at Duggirala market along with deviation (%) are presented in the Table 5. During the years 2005-2007, 2011-2012, 2015, 2017 and 2019 showed positive deviation (%) of arrivals with tells that the observed values were of increasing nature over the years. The highest increase

in the deviation (%) of arrivals as compared to observed and estimated are found in the year 2017 with increase by 28 % and highest decrease in the deviation (%) of arrivals was found in the year 2018 with 59%. The relationship between the observed and estimated prices of turmeric at Duggirala market along with deviation (%) are presented in the Table 5. The years 2005-2008, 2012-2014 and 2017-19 showed negative deviation (%) of prices with tells that the observed values were of decreasing nature over the years. The highest increase in the deviation (%) of prices as compared to observed and

Table 5: Trend for annual arrival and prices of turmeric to Duggirala market of Andhra Pradesh

Years	Observed Arrivals	Estimated Arrivals	Deviation (%) of Arrivals	Observed Prices	Estimated Prices	Deviation (%) of Prices
2004	168556.00	195750.97	-16.13	2078.84	1693.02	18.56
2005	203933.50	171078.45	16.11	2179.12	2381.36	-9.28
2006	163586.75	153887.37	5.93	1934.95	2907.34	-50.25
2007	163586.75	143076.74	12.54	1934.95	3349.57	-73.11
2008	111610.00	137545.57	-23.24	3118.33	3738.41	-19.89
2009	114305.00	136192.86	-19.15	6014.19	4089.40	32.00
2010	102214.00	137917.63	-34.93	12082.29	4411.74	63.49
2011	192083.00	141618.87	26.27	6729.78	4711.44	29.99
2012	169282.00	146195.59	13.64	3881.89	4992.64	-28.61

Table 5: Continue...

Years	Observed Arrivals	Estimated Arrivals	Deviation (%) of Arrivals	Observed Prices	Estimated Prices	Deviation (%) of Prices
2013	128278.00	150546.80	-17.36	4581.01	5258.37	-14.79
2014	137313.00	153571.50	-11.84	5075.46	5510.93	-8.58
2015	158757.75	154168.70	2.89	7014.31	5752.06	18.00
2016	139783.00	151237.40	-8.19	6648.43	5983.20	10.01
2017	201419.74	143676.62	28.67	5648.88	6205.46	-9.85
2018	81722.88	130385.35	-59.55	5035.39	6419.81	-27.49
2019	120679.87	110262.60	8.63	5298.44	6627.01	-25.07
2020		82207.12			6827.73	
2021		45118.37			7022.54	

estimated are found in the year 2010 with increase by 63% and highest decrease in the deviation (%) of prices was found in the year 2007 with 73%.

From the Figure 2 the highest market arrival was found to be in year 2005 and 2017 whereas the lowest was observed in the year 2018. The estimated arrival for turmeric in Duggirala market for the year 2020 was 82207.12 Quintals. Similarly from the Figure 3, the highest peak for market price was observed in the year 2010 of 12082 (INR Quintal^{-1}) while the lowest was seen in the year 2006-07 of 1934 (INR Quintal^{-1}). The estimated price for turmeric in Duggirala market for the year 2020 was 6827 (INR quintal^{-1}).
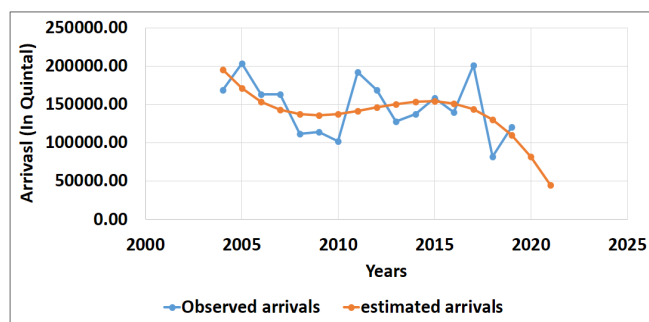

Figure 2: Observed and estimated trends in market arrivals of turmeric Duggirala market
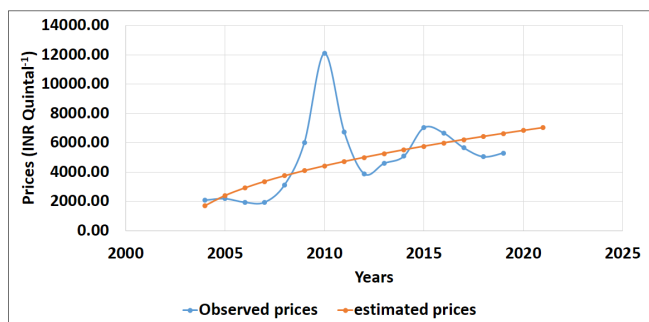

Figure 3: Observed and estimated trends in market prices of turmeric Duggirala market

4. Conclusion

The arrivals of turmeric in Duggirala market and seasonal indices are recorded maximum during the month of May (206.44 quintals) and minimum in the month of October (50.32 quintals). Prices were observed to be the lowest in the month of March (INR 89.39 kg^{-1}) and the highest in November and December (INR 107 kg^{-1} and INR 107.27 kg^{-1}), respectively. A significant inverse relationship between the seasonal indices of market arrivals and prices of turmeric was recorded. It was observed that cubic and power model were found to appropriate for describing the trend in turmeric market arrivals and prices in Duggirala market in Andhra Pradesh.

5. References

Ali, J., Kachroo, J., Bhat, D.J., Bhat, A., 2018. Analysis of Prices and Arrivals of Apple Fruit in Narwal Market of Jammu. Economic Affairs 63(1), 107–111.

Biswas, B., Dhaliwal, L.K., Singh, S.P., Sandhu, S.K., 2014. Forecasting wheat production using ARIMA model in Punjab. International Journal of Agricultural Sciences 10(1), 158–161.

Gupta, S.C., Kapoor, V.K., 2007. Fundamentals of applied statistics. Pp: 2.2-2.9. Sutanchand& sons, New Delhi.

Joshi, P.K., Saxena, R., 2002. A profile of pulses production in India, facts, trends and opportunities. Indian Journal of Agricultural Economics 57, 326–339.

Kanungo, 2015. Influence of market arrival on price information on turmeric in Kandhamahal district of Odisha. Journal of Business and Management 17(1), 1–5.

Manjunath, U., 2015. An analysis of price behaviour of turmeric in Guntur district of Andhra Pradesh. Ph. D. Thesis. Acharya N G Ranga University, Guntur Andhra Pradesh.

Pallavi, L.K., Reshma, S., 2018. Price behaviour of turmeric in Sangli APMC. Research Square 1, 1-7.

Patil, R., Bhruke, V., 2015. Economic analysis of arrivals and prices of pulses in Maharashtra state in India. Research Journal of Economics and Business studies 3, 20–24.

Ramesh, D., Srinivasa, R.V., Nafeez, S.K.U., Venkata, V.K., 2019. Application of nonlinear regression models on production of egg and milk in Andhra Pradesh. The Andhra Agricultural Journal 66(spl), 175–179.

Rudresh, H.R., 2019. Turmeric marketing: Arrivals and price trend analysis- Chamarajnagar district of Karnataka. Journal of Emerging Technologies and Innovative Research 6(6), 235–241.