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Application of ARIMA Model for Forecasting Production of Jasmine Flower in Madurai District of Tamil Nadu, India

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Abstract: *Agriculture is known as the backbone of Indian economy, plays a very eulogistic role for the development of economy. Around 70 per cent of the population gets livelihood directly or indirectly from the Agriculture and allied sectors. Horticulture development had not been given priority in India until recent years; post 1993 the focused attention was given to horticulture development through an enhancement of plan allocation and knowledge-based technology. This decade is called a "Golden Revolution" in horticulture production. Jasmine is one of the important species in India, more than 80 Jasmine species are found here. Indian government has already declared flower based industry is a "SUNRISE INDUSTRY". The paper revealed that the production and forecasting of Jasmine flower in Madurai district of Tamil Nadu. Time Series data covering the period of 2000-01 to 2012-13 was used for the study. The study reveals that Autoregressive Integrated Moving Average (0, 1, 0) are the best fitted model for forecasting of Jasmine production in Madurai respectively. The results show the total Jasmine production can be increased in future, if land reclamation and conservation measures are adopted. The projection shows that Jasmine flower will play a vital role to improve economic conditions of the Jasmine cultivated farmers.*

Keywords: *ARIMA Model; Jasmine Flower; Production; Forecasting.*

I. Introduction

Flowers are inseparable from the social fabric of human life. Flowers being adorable Creation of God befits all occasions be it at birth, marriage or death. In the past, flowers were not of much economic importance. One would grow flowers to fulfill his or her aesthetic desire. At times, flowers were offered for sale to meet the special requirements of people. With the passage of time drastic changes have come about in the life style of people leading to commercialized cultivation of flowers. Today, flower plants are no longer meant for only window garden, but it plays an important role in the decoration of the living houses and office establishments. Floriculture is a fast emerging and highly competitive industry, with the continuous introduction of new cultivators and new crops, cultural techniques are changing and hence new products are developing. Ornamental crop culture technology is improving with the availability of equipment and there is a sea change in the trend of consumers. A new generation of growers is coming forward to employ modern technology for maximizing production and offer quality production for consumer acceptability, thus fetching a better price (Mathivanan B. 2013). Though the history of flower production started from 1950 but, during 1990s, floriculture began to emerge as a reliable economic option (Ananya Sahu 2011). Floriculture has become one of the important high value agricultural industries in many countries of the world (Singh B.K. 2010).

The science and art of commercial floriculture has been recognized as an economic activity with the potential for generating employment and earning valuable foreign exchange. In several countries of the world, floricultural products are amongst the main export items of agricultural origin. For any country to diversify its agricultural base geared towards export, the ornamental crop industry presents one of the most interesting and viable options. The aesthetic value of flowers and ornamental plants, their use in social events, overall satisfaction in working with them and high income generating power are attracting modern entrepreneurs to invest money in the floriculture industry. The demand for flowers and ornamental plants for different needs like religious, official ceremonies, parties, house decoration, weddings, funerals, etc, is on the rise. This demand for fresh flowers and plants is increasing world-wide over the coming years. The recent liberalization policy of the Government of India has given Phillip to commercialized agriculture particularly horticultural crops. Growing of flowers is in vogue in India since long time. Nevertheless, growing of cut-flowers has emerged as an important industry mainly to cater to the needs of the demand in the overseas market. It is being viewed as a high growth industry in our economy. There is a tremendous transformation in our floriculture sector mainly due to the entry of corporate who are producing cut-flowers to meet the emerging demand in the developed countries for floricultural products. The Government of India has also identified floriculture as a niche area with vast

potential for export. There are many incentives given by the Government for setting up of floricultural units as Export oriented units (EOUs) (Sudhagar.S 2013).

Commercial floriculture in India comprises of both the modern and traditional group of flowers. In the recent past, export of the traditional group of flowers, particularly, Jasmine and tuberose has picked up because of their increasing demand from the Indian population settled in foreign countries (USA, UK, Singapore and Gulf countries). The flowers produced in the state are being exported to the neighboring countries viz., Singapore, Malaysia, Sri Lanka and the Middle East countries (Karuppusamy.R 2012).

Jasmine is an important fragrant flower that is cultivated predominantly in temperate climate. (1) The history of jasmine goes back to Egypt dynasties, Chinese emperors, Kings of Afghanistan, Nepal, Persia, and Spain. Its different varieties are recognized as the national flower for countries like Pakistan and Paraguay. It is grown for its aroma parts of the world of which Jasmine *Sambac* and Jasmine *Grandiflorum* can be seen extensively in India (2) Strings of Jasmine flowers are used by women to enhance their beauty and fragrance. The wearing of Jasmine flower strings on the hairs of lactating mothers of some parts of South India is associated with increased lactation and delayed ovulation. These flowers find place in floral decoration of marriages, to consecrate a sacred wedding ceremony, as a form of expressing love, affection, happiness and honouring the guests. The exchange of garlands made of Jasmine in marriage symbolizes the natural circle of protection and sacred bride to the spiritual life. Medicinal uses of Jasmine extracts include anti-inflammatory, mild analgesic (3) antioxidant (4) antiseptic, antiviral (5) and enhancement of immunity. It is used for treating skin diseases like ulcers (6) boils and vesicles. It produces a feeling of optimism, confidence, euphoria, strongly cooling and calming effects. It is most helpful to treat apathy, indifference and depression. A natural aphrodisiac, Jasmine's exquisite aroma has a powerful effect on frigidity and impotence. It can relax the mother and help relieve the pain of childbirth due to its antispasmodic effect (Aswini Dutt. R 2011).

The species used are Jasminum *Sambac* (Gundumalli or Madurai Malli), Jasminum *Auriculatum* (Mullai) and Jasminum *Grandiflorrum* (Jathimalli/Pitch). The first two species are mainly cultivated to sell as fresh flowers, whereas the third is cultivated for the perfumery industry's needs. Tamil Nadu is the leading producer of jasmine in the country with an annual production of 77,247 tons from a cultivated area of 9360 hectares. The flowers harvested in the state are exported to neighboring countries like Sri Lanka, Singapore, Malaysia and the Middle East. The major Jasmine producing districts of Tamil Nadu are Madurai, Dindigul, Salem, Tirunelveli, Virudhunagar and Trichy. Jasmine flowers are native to India, China and Iran (Ambika T. 2012).

With its heady fragrance, exclusive size and shape, the 'Madurai Malli's uniqueness has a district reputation universally. Farmers from Madurai, Theni, Dindigul, Sivaganga and Virudhunagar districts cultivating 'Madurai Malli' are jubilant as it has been given the Geographical Indication (GI) mark by the Geographical Indications Registry. Application for GI was made in June 2000 and approval came on January16 (Vandhana, 2013).

II. India's distinctive advantages for development of the floriculture sector

India has relatively better opportunities for development of the floriculture sector for the following reasons:

1. Diverse agro-climatic conditions and geographical locations suited for growing various types of flowers.
2. Skilled manpower to absorb the technology and implement the same at a relatively low cost.
3. Soil and water supply at most locations.
4. Good radiation/ sunlight leading to healthier plant growth and better quality flowers.
5. Light rains and salubrious climate during winter, the prime export season, leading to sustained high yields.
6. Good period of sunlight even during the heavy rains leading to continued plant growth and proper yield.
7. India is located centrally for catering to European and Far Eastern markets, as well as being close to the South East Asian and Middle East Asian markets that have high consumption requirement of flowers (Ev Murray 2006).

III. Review of Literature

The author has given some related studies to support the study which is as follows:

Nageshwar Rao and Behra (2001) reported that flower growers are earning more than Rs.40, 000 per acre annually by the way of raised cultivation. According to them, farmers are able to harvest up to 2 lakh flowers per acre per annum. They concluded that the flower growers do not consider marketing of flowers as a problem except price fluctuation.

Nagagowda and Narayana Gowda (1990) in their study made an attempt on "Effect of Cycocel and Mallic Hydrazide of Yield in Gundumalli" They have analysed Jasmine flower and extraction of essential oil that the pattern freshly prepared Cycocel and Msaluic Hydroxide each at 1000 and 2000 PPM were sprayed and pre-purring. They results that Cycocel treated plants recorded higher flower yield in February and March. However, they revealed that, April, May and June are peak flowering months in jasmine (Gundumalli).

Raghava (1996) has observed that the floriculture is emerging as an important venture in the world. It has become a potential of money spinner for the third world countries commercial floriculture is becoming important from the export agricultural. The total area under flower crops was estimated to be around 3400 hectares. The area under flower crops increased to 38000 hectares in 1992-93. India's share in the world was only 0.6 per cent till 1990. Since as many as 134 collaborations attracting foreign investment of more than Rs.100 crores have been approved by India at an estimated total outlay of more than Rs.1000 crores.

Raghava and Dadlani (2000) have pointed out the growing domestic market of flower. A study of the Delhi market in 1995 estimated a trade of more than Rs.50 crores annually. This has increased many times during the last 4 to 5 years which has seen a major growth in business as evidenced by the florist shops in every locality in Delhi. A similar situation exists in all other major cities in the country. The green house produce has also led to appreciation of quality flowers for obtaining better prices. The range of products has vastly improved. Flowers like Authurium, Orchid, Illium, Callality, Bird of Paradise. Stanthus and Liatrice which one saw only in international stalls at flower shows or in magazines are being sold on street corners along with good quality rose, gladiolus, carnation, gerbera and Chrysanthemum.

Ashok Dhillion et.al. (2003) have selected three districts and one block from each district on the basis of the area of flower production from each selected district from each block the list of village was prepared to find where flower production is adopted from these village 120 growers were randomly and 13 large growers. This study revealed that flowers are grown in 1850 hectares during 1996-2000. According to their findings, in Haryana, flower production has emerged as one of the most lucrative businesses due to the higher potential of returns in comparison to other horticultural crops.

IV. Objectives of the Study

1. To suggest appropriate ARIMA model for the generation of forecasting production of Jasmine flower in Madurai District, Tamil Nadu, India and to make ten years forecast with appropriate prediction interval.
2. To generate forecasts of production of Jasmine flower in Madurai District, Tamil Nadu in India by using appropriate ARIMA models.

V. Materials and Methods

The Auto Regressive Integrated Moving Average (ARIMA) model is a generalization of an Autoregressive Moving Average (ARMA) model. These models are fitted to time series data either to better understanding the data or to predict future points in the series. The existing study applies Box-Jenkins (1970) forecasting model popularly known as ARIMA. The ARIMA is an extrapolation method, which requires historical time series data of underlying variable, generally this ARIMA model was used in macro level data analysis. This paper applies the model in micro level. The model in specific and general forms may be expressed as follows, let Y_t is a discrete time series variable which takes different values over a period of time. The corresponding AR (p) model of Y_t series, which is the generalizations of autoregressive model, can be expressed as:

$$AR(p): Y_t = \phi_0 + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + ... + \phi_p Y_{t-p} + \varepsilon t \quad (1)$$

Where, Y_t is the response variables at time t,

Y_{t-1}, Y_{t-2}……Y_{t-p} is the respective variables at different time with lags $\phi_0, \phi_1, ..., \phi_p$ are the coefficients and εt is the error factor. Similarly, the MA (q) model which is again the generalizations of moving average model may be specified as:

MA (q): $Y_t = \mu_t + \varepsilon_t + \delta_1 \varepsilon_{t-1} + \cdots + \delta_q \varepsilon_{t-q} + \nu t \quad (2)$

Where, μ_t is the constant mean of the series, $\delta_1 \ldots \delta_q$ is the coefficients of the estimated error term, εt is the error term. Combining both the model is called as ARIMA models, which has general form as:

$$Y_t = \phi_0 + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \cdots + \phi_p Y_{t-p} + \varepsilon_t + \delta_1 \varepsilon_{t-1} + \cdots + \delta_q \varepsilon_{t-q} + \nu t$$

If Y_t is stationary at level or I (0) or at first difference I (1) determines the order of integration, which is called as ARIMA model. To identify the order of *p* and *q* the ACF and PACF is applied.

A. Data

Jasmine is one of the important species in India, more than 80 Jasmine species are found here. Tamil Nadu is the leading producer of Jasmine in the country with the annual production of 1.021 million from a cultivated area of 0.183 million hectares.

The data collected and analyzed to draw a meaningful interpretations and to assess the situation in the Jasmine flower economy in India. The secondary data have been used for the study purpose. In order to analyze the growth rate, the time series data of production, of Jasmine flower were collected from various publications, official records and web sources such as Hand Book of Statistics on the Indian Economy, Office of the Assistant Director of Statistics, Madurai, Directorate of Horticulture and Plantation Crop, Chennai etc., have been referred

for the collection of data from 2000-01 to 2012-13. For the present study, the statistical tools were employed to assess the growth performance of jasmine flower in Madurai. Since large numbers of data are required for ARIMA models.

VI. The following models based on relevant study

Chengappa (1980) applied the Box Jenkins model to forecast poor sale and export auction prices of coffee. Monthly data were used and due to the distinct seasonal variation in prices, the ARIMA seasonal model was applied. The poor sale price forecasts were found to be accurate when compared to forecast of export prices. This was attributed to a possible lack of stationary of the data. Hence adoption of differencing procedure or a transformation to make the data stationary was found necessary for a better estimate of export prices.

Lanciotti (1990) presented a paper that analysis of time series data of monthly prices for a group of dairy products with the aim of obtaining reliable forecasts. The method of analysis employed is ARIMA as put forward by Box-Jenkins. The time series data covers both wholesale and retail prices for butter, Gorgonzola, Provolone, Grana Padano and Pasmigiano Reggiano. To estimate the reliability of the forecast obtained, a comparison is made with those resulting from naïve models do not require any estimates. Indicators on the accuracy of the forecasts show that except for Grana Padana, Le ARIMA forecasts are better.

Mastny (2001) used ARIMA models, also called Box and Jenkins models after their developers, is a group of models allowing the analysis of the time series with various features. The article demonstrates the possible usage of the Box-Jenkins methodology for the analysis of time series for agricultural commodities. The paper contains a basic mathematical explanation of ARIMA models together with a practical illustration of a price development forecast for a selected agricultural commodity.

Yin-Runsheng and Mins-Rs (1999) conducted timber price forecasts were univariate Auto Regression Integrated Moving Average (ARIMA) models employing the standard Box Jenkins modeling strategy by using quarterly price series Timber Mart South. The results showed that most of the selected pipe pulpwood and saw timber markets in six southern US states can be evaluated using ARIMA models, and that short-term forecasts, especially those of one lead forecast, are fairly accurate. It is suggested that forecasting future prices could aid timber producers and consumers alike in timing harvests reducing uncertainty and enhancing efficiency.

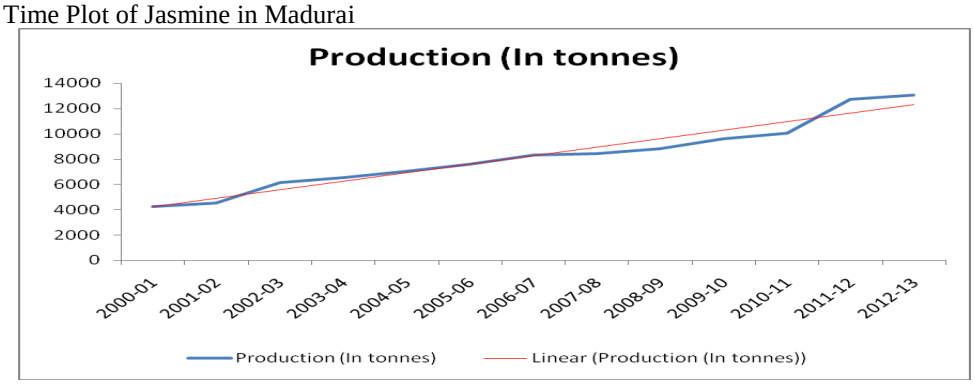
VII. Results and Discussion

The result of the study deals with jasmine flower forecasting value of the study area.

A. Model Identification

The ARIMA model was formulated after assessing the transforming of the variable under forecasting was a stationary series. The stationary series was the set of values that varied over time around a constant mean and constant variance. This model was a common method to check the stationary and explain in the following figure. Figure 1 reveals in this data used were non-stationary. Again, non-stationary in mean was corrected through first differencing of the data. The production and time variable (Y_t) could now be examined for stationary. The both blue and red lines shows increasing trend of production of Jasmine in Madurai district.

Figure: 1 Time Plot of Jasmine in Madurai

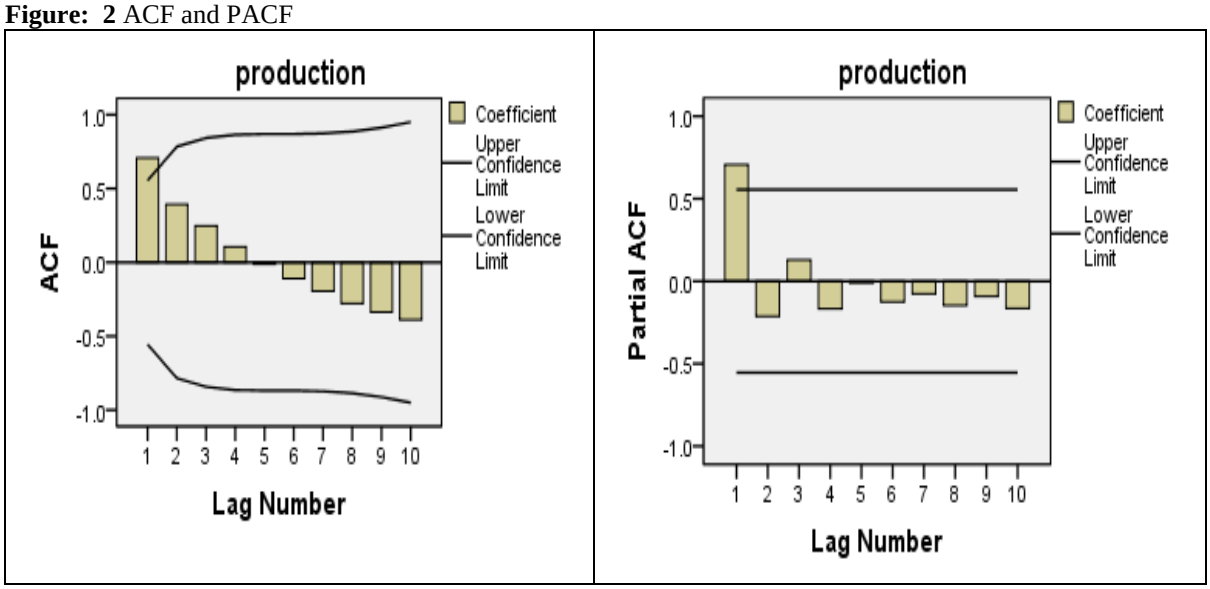


Since, Y_t was stationary in mean, the next step was to identify the values of p and q. For this, the autocorrelation and partial autocorrelation coefficients (ACF and PACF) of various orders of Y_t were computed and presented in Table 1 and Figure 2.

Table: 1 ACF and PACF of Jasmine Production

LAG	Auto Correlation		Box-Ljung Statistics			PARTIAL AUTOCORRELATION	
	VALUE	DF	SIG	VALUE	DF	VALUE	DF
1	0.707	0.277	8.12	1	0.004	0.707	0.277
2	0.393	0.392	10.858	2	0.004	-0.213	0.277
3	0.248	0.421	12.058	3	0.007	0.129	0.277
4	0.105	0.432	12.296	4	0.015	-0.168	0.277

Figure: 2 ACF and PACF



The order of an ARIMA model is usually denoted by the notation ARIMA (p,d,q), where p is the order of the autoregressive part d is the order of the differencing q is the order of the moving-average process.
The ARIMA model were discussed with values differenced once (d=1) and the model which had the minimum normalized Bayesian Information Criterion (BIC) was chosen. The BIC value is to determine the autoregressive order used to estimate the error series. The estimation of parameters for Jasmine flower, production was estimated in Best Fitted Model. The various ARIMA models and the corresponding normalized BIC values are given in Table 2. The value of normalized BIC of the chosen ARIMA was 13.602.

Table: 2 BIC value of ARIMA (p,d,q)

0,1,0	**13.602**
0,1,1	13.774
0,1,2	13.956
1,1,0	13.778
1,1,1	13.952
1,1,2	14.260
2,1,0	14.101
2,1,1	14.288
2,1,2	14.663

B. Model Estimation

The second step was the estimation of model parameters were estimated using SPSS.20 version was used to estimate the results and the results were presented in Table 3 and 4. R^2 value was 0.92. Hence, the most suitable model for Jasmine production was ARIMA (0,1,0), as this model had the lowest normalized BIC value, good R^2 and better model fit statics (RMASE and MAPE). In this justified that the selection of ARIMA (0,1,0) is the best model to represent the data generating process very precisely.

Table: 3 Model Estimation ARIMA Model Parameters

	Estimate	**SE**	**T**	**Sig.**
Constant	452.632	504.354	.897	.391

Table: 4 Estimated ARIMA Model Fit Statistics

Stationary R-quared	**R-squared**	**RMSE**	**MAPE**	**Normalized BIC**
.036	.924	730.496	5.293	13.602

C. Diagnostic checking

This model proves that the verification was concerned with checking the residuals of the model to see if they contained any systematic pattern which still could be removed to improve the chosen ARIMA, which has been done through examining the autocorrelations and partial autocorrelations of the residuals of various orders. For this purpose, Table 5 shows various autocorrelations up to 10 lags were computed and the same along with their significance tested by Box-Ljung statistic. The results indicate none of these autocorrelations was significantly different from zero at any reasonable level. The selected ARIMA model was suitable model for forecasting Jasmine production in Madurai district.

Table: 5 Residual of ACF and PACF of Jasmine Flower Production

Lag	ACF		PACF	
	Mean	SE	Mean	SE
1	-.342	.289	-.342	.289
2	.050	.321	-.076	.289
3	-.056	.321	-.073	.289
4	-.133	.322	-.199	.289

Figure: 3 ACF and PACF Plot of Residuals

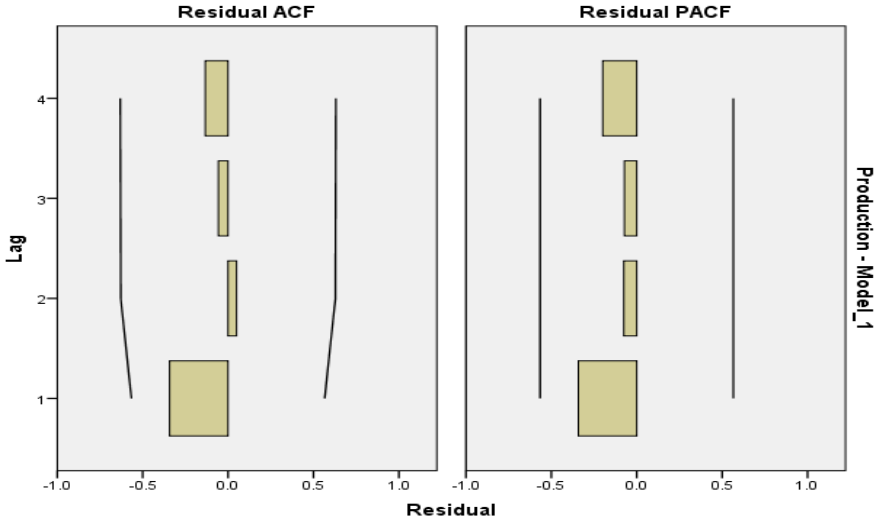
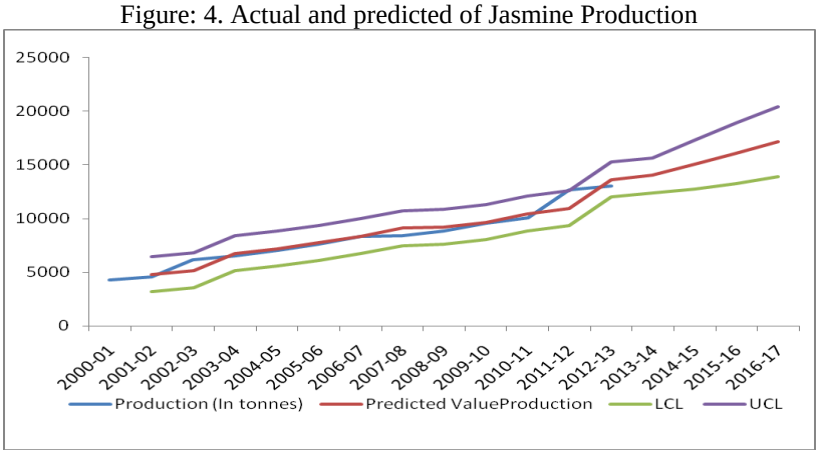


Table: 6 Forecast for the Production of Jasmine flower in Madurai District

SI. No	Year	Predicated	LCL	UCL
1	2013-14	14020.03	12392.38	15647.68
2	2014-15	15030.23	12728.39	17332.07
3	2015-16	16077.6	13258.44	18896.77
4	2016-17	17162.15	13906.86	20417.44

Note: (upper control limit UCL and lower control limit LCL)

Figure: 4. Actual and predicted of Jasmine Production



D. Forecasts of Jasmine

The four year forecast of Jasmine production was estimated by using the best model of ARIMA is presented in the Table 6. It shows that Jasmine production was increased 14020.03 tons in the year 2013-14, further the predicted production increased to 15030.23, 16077.60 and 17162.15 tonnes for 2015, 2016 and 2017 respectively. The present analyses concluded that the production of Jasmine will increased in the study predicted years.

VIII. Conclusion

It can be concluded from the study that the production of Jasmine is highly profitable. As far as floriculture is concerned, the steady increase in flowers floriculture has become one of the important commercial trades in feature agriculture which is attracting profits and new ideas to breed new variety of flowers with the concepts of cross hybridization. The results show that the total cropped production can be increased in future, if land reclamation and conservation measures are adopted. The projection shows that Jasmine flower will play a vital role to improve economic conditions of the Jasmine cultivated farmers.

Hence, commercial floriculture industry is attracting hi-tech activity to have a better growth and quality of the flowers. Various steps are taken up to improve the quality of the flowers. India has a long floriculture history and flower growing is an age old enterprise. Paying attention to the input needs, forming the association, better resource management, and financial assistance and making various policies as entrepreneur friendly and favorable export policy would lead to a balanced growth of the industry.

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