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A Empirical Study of Oil Palm Productivity in India using Time Series

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This is an overview of Oil Palm production and manufacturing in India. The facts from 1966-67 to 2022-23 have been analyzed the usage of time sequence method. Versions from 1966-67 to 2021-22 are used for generation and forecasting. Figures from 2019-20 to 2020-21 are used for version verification. Autocorrelation function (ACF) and partial autocorrelation characteristic (PACF) had been calculated for statistics. Fixed Patty Jenkins' Correct Autoregressive Integrated Moving Average. Version verification the usage of known statistical methods. The universal performance of the version is validated by an assessment criterion that includes the percentage deviation of the fee and the mean percentage absolute error (MAPE) of the prediction. To forecast the location, we forecast the key years the usage of autoregressive joint shifting common (0,1,1) and autoregressive joint transferring common (0,1,1), respectively. The effects also exhibit that the 12-month area forecast for 2022 is 8.3219 million hectares in the decrease bound state, 10.3718 million hectares in the top sure state, and the manufacturing forecast is about 6.4445 million hectares in the decrease certain state. Hectares, if the upper restriction is 8.6487 million hectares. Slope fashions are examined exponentially or linearly. The ultimate outcomes proven that integrated linear rebar loading is a fantastic and volumetric method for field and manufacturing applications.

Keywords: Oil Palm; Linear GR; Compound GR; Seasonal Auto Regression Integrated Moving Averages; AIC; BIC; MAPE.

1. Introduction

Oil Palm (Helianthus annuus L.) is one of the few crop species that originated in North America. It was first added to Europe via Spain, and unfold at some point of Europe as a curiosity till it reached Russia, where it was once as soon as surely adapted. After World War II, Russia's considerable oilseeds have been reintroduced to the United States, reviving hobby in the crop. Oil Palm production was later developed by means of entrepreneurs as an oilseed crop, birdseed crop, and human snack meals in the Great Plains of the United States. In India, Oil Palm used to be delivered as an oil seed crop in 1969 and before that it was once used as an ornamental plant. Among the main Oil Palm producers in the country, Karnataka is among

the pinnacle six states. Karnataka is the essential Oil Palm producing state in India with a production of 3.04 lakh tonnes from an vicinity of 7.94 lakh hectares found throughout Andhra Pradesh, Maharashtra, Bihar, Orissa and Tamil Nadu (Figure 1). As about eighty percentage of the region is rainfed, Oil Palm manufacturing follows systemic climatic conditions. In terms of productivity, Bihar leads with 1402 kg, followed via Tamil Nadu with 1328.7 ha, with each nation averaging less than 25000 ha of irrigated crops. The average productivity of the all India vary is 900 ha relying on climatic prerequisites and irrigation which are crucial factors for excessive yield.

2. Reviews Of Literature

Shukla and Jharkharia (2012) Investigated the applicability of autoregressive joint transferring averages in the wholesale vegetable market through exploiting sales of onion, a perishable vegetable. Data accumulated from Ahmedabad wholesale market, India. Validation of variations used to be carried out the usage of comparable market potato sales information. The (2, 0, 1) version of the autoregressive joint moving common is in right health, and the version parameters verify that revenue in the present day period are relatively inspired when using the previous period's earnings. [2].

Hassan S al. (2013) Attempted to predict name and transport in Punjab province of Pakistan the usage of the integrated shifting average model of autoregressive regression. Based on the ACF and PACF graphs, the autoregressive joint moving common (1, 1, 0) is healthy for location and production, and the autoregressive joint transferring average model (1, 1, 1) for onion consumption becomes healthful beauty. have. Onion consumption and manufacturing loss predicted in 2025. The projected location below onion cultivation may be 47,484 thousand hectares and the projected production in 2025 can also be 372,403 thousand tons.. [3].

Suresh CH al. (2014) Growth in maize location, manufacturing and yield between 1970-71 and 2008-09 used to be evaluated. Various polynomial modes, such as linear, quadratic, cubic and various incremental modes, particularly logarithmic, inverse, exponential, compound and strength modes are used. To take a look at the mode. The dice function has become a well-equipped model for predicting room, vessel and corn yields because it has a most adjustment of R2. [4].

Murthy C al. (2014) Predict make bigger in domestic development, production, yield and export of Karnataka between 1987-88 and 2009-10. The linear shy away version is equipped one at a time for grenade location, processing and yield. There has been an explosion in pomegranate production, which is based entirely on the leaves of the variety. The website online below these trees grows drastically in Koppal and Bagalkot districts [5].

Debnathet al. (2015) Predict the area of cotton grown and produced in India the usage of an autoregressive built-in transferring common version. Overlapping time sequence from 1950 to 2010 had been modified for the study. Auto Regressive Integrated Moving Averages(0, 1,0) Auto Regressive Integrated Moving Averages(1, 1, 4) and Auto Regressive Integrated Moving Averages(0, 1, 1) are entirely featured variations for forecasting. It seems there is. Origin, production and yield of cotton in India. This estimate suggests that if the modern-day charge expand is sustained, manufacturing and yield for 12 months 2020 could be 10.92 million ha,

39.19 million bales at 170 kg and 527 kg per hectare. Indicates the presence [6]. Hina Al. (2017) Check out our strive to forecast manufacturing and yield of essential mills of Pakistan, specially sugarcane and cotton crops, the usage of Autoregressive Moving Average (ARMA) and Autoregressive Integrated Moving Average forecasting methods. Data from 1948 to 2012 were used to task production and yield for each plant for 18 years from 2013 to 2030. ARMA(1, 4), ARMA(1, 1) and ARMA(0, 1) are classified as appropriate for sugarcane production. , sugarcane yield, and cotton production, respectively, and autoregressive joint transferring averages (2, 1), 1) had been transformed to the proper version with the modified cotton yield forecast. Some diagnostic exams were additionally armed mode and nicely geared up [7].

B R Sreedhar (2022) in welcome find out about erect that the model grown for the nut district presented, individually, the joint autoregressive mobile average (0, 1, 1) and the joint autoregressive affecting common (0, 1, 1). According to the handy forecasts making use of the developed model, it is clear that the field cultivated accompanying peanuts suitable to know-how a beneficial fashion in result in the coming age. The genuineness of the concluded worth perhaps established when file is accessible for lead periods. Important for the domain, the result for the study ending suggests that capable measures are wanted to adjoin fee to nut in India.[8]

3. Methodology

This discussion is principally based on secondary records on Indian Oil Palm yield, estimation of charge increases, area forecasting and production. Production data accrued by using the Department of Economic Statistics, Ministry of Agriculture and Cooperation, India, for the period 1966-67 to 2022-23, Oil Palm crop location. Agricultural data from 1966-67 to 2022-23 have been converted to construct and forecast versions. Changed from 21/2019 to 23/2021 for use in version validation.

3.1.Estimation of Growth Rates

A appear at the facts, ie from 1966-67 to 2022-23. Keeping the targets, linear incremental cost (LGR) and compound incremental value (CGR) for crop traits were expected with the help of making Oil Palm crop in India, subsequent functions of Oil Palm crop in India. [9].

3.1.1.Linear increase characteristic

Linear increase characteristic is given by $\omega_t = f + d_t + e_t$with the aid of using

Where, t is the time in years, unbiased variable, Wt is the fashion price of the established variable c and d are constants or parameters and et is blunders term

The above equation is equipped with the aid of using the use of the least squares approach of estimation.

The linear increase price is calculated with the aid of using the formula: Linear increase price(LGR%) = $d/\bar{y}$ X 100

3.1.2.Compound increase characteristic

Compound increase characteristic is given with the aid of using

$\omega_\tau = \gamma\alpha^\tau$ (or) Log ω = log γ + τ log α

The compound increase price (CGR %) is calculated with the aid of using the use of the formula

CGR (%) = (antilog (D-1)) X 100

3.2.Auto Regressive Integrated Moving Model

Auto Regressive Integrated Moving Averages technique is also known as Box-Jenkins technique. The Box-Jenkins process is associated with becoming an autoregressive joint moving average version of a given set of statistics. The styles evolved through this technique are commonly known as SAIRMA styles because they use a mixture of auto regressive (AR), integration (I)-join change contrast technique and common transfer (MA) operations to provide forecasting. (Box, and G.M. Jenkin, 1976) . A version of SAIRMA is usually called Seasonal Auto Regressive Integrated Moving Averages(p, d, q).

Autoregressive correlative shifts are expressed in a general form:

If $\varphi_t=\nabla^b r_t = (1-B)^d r_t$ then

$$\varphi_t = \beta_1\varphi_{t-1} + \beta_2\varphi_{t-2} + \cdots + \beta_p\varphi_{p-1} + \delta_t - \beta_1\delta_{t-1} - \beta_2\delta_{t-2} - \cdots - \beta_p\delta_{t-p}$$

Where, is distinction operator, χ is the returned shift operator, that is $\chi\,(X_{t)} = X_{t-1}$

p is the variety of autoregressive terms, q the variety of transition common terms, d the variety of moments of stationery that results in a permutation. The primary goal of becoming this version of Auto Regressive Integrated Moving Averages is to discover the stochastic technique of the time sum and accurately anticipate destiny values. These strategies have additionally been useful in numerous state of affairs involving discrete-time addition and fashion construction for dynamical systems. But this technique does not work well for lead times or for seasonal aggregation with a large random component. A stochastic technique is neither a desk band nor a desk bond. The first aspect to note is that the time collection requirement is not desk bound and the regular version is more effective for desk bound time collection. Since the Auto Regressive Integrated Moving Averages fashion is most effective for a desk-bound period collection, the primary level of the Box-Jenkins version is to downgrade the non-desk collection to a desk-bound collection by taking first-order differences. The basic layers of building a Box-Jenkins predictive version are as follows. i) identification ii) parameter estimation iii) diagnostic testing and predictions.

3.3.Identification Stage

A cross-check with a chronology statistics table was conducted and it was found that Oil Palms were produced for India. A large and robust autoregressive joint moving average model was developed from statistics and used to forecast production in India, a potential growth location. His next five years. The autoregressive joint moving average mode was identified by finding the baseline values of the order of non-seasonal parameters 'p' and 'q'. They were obtained by searching for giant spikes in the autocorrelation and partial autocorrelation functions. At the identity level, one or more methods were tentatively selected that we believed provided a

statistically accurate representation of the available data. Exact estimates of the version parameters were then obtained by the method of least squares.

3.4.Estimation Stage

Auto Regressive Integrated Moving Averages fashions are outfitted and accuracy of the version turned into examined on the idea of diagnostics statistics.

3.5 Indicative Checking

The great healthy version turned into decided on primarily based totally on the subsequent diagnostics.

Low Akaike Information Criteria (AIC): - AIC is predicted through

AIC = (-2 log L + 2 w), in which w = p+ q and L is the probability function. Sometimes, SBC is likewise used and predicted through SBC =logσ2+ (v log s)/n.

3.6. Prognostication Accuracy Checking

An excellent version is used for forecasting mainly based on screening accuracy between autoregressive joint moving averages with excellent dressings and exponential smoothing method. In particular, accuracy is tested using the RMSE and MAPE measures. A major part of the statistics used to form the version is called the school set and a small part of the statistics (usually 10%) used to test the prediction accuracy is called the check out set.

3.7. Prognostication

The latter version is used to generate predictions that approximate fate values. R software was used for time-aggregation evaluation and growing autoregressive joint moving average trends and forecasts.

4. Output and Confab

4.1. Assessment of Growth Rates

The linear and composite boom expenditures had been 0.91 and 1.13 per cent per year respectively for the Oil Palm crop position searching at the duration for production 2.39 and 3.06 per cent per year respectively. Oil Palm crop in India. It displayed a high high-quality massive fashion for place and production beneath the Oil Palm crop in India. Table 1 suggests the linear and composite increase costs of Oil Palm area and manufacturing with 1 percentage magnitude degree.

Table-1: Evolution rates for area, production of Oil Palm crop in India

India	LGR (%)	CGR (%)
Area	0.91**	1.13**
Production	2.39**	3.06**

** Significance at 1% level

Table-2: Values of Auto Correlation Function and Partial Correlation Function of Area and Production of Oil Palm Data.

Lag	Auto Correlation Function(ACF)-Area	Partial Correlation Function(PACF)-Area	Auto Correlation Function(ACF)-Production	Partial Correlation Function(PACF) – Production
0	1.000		1.000	
1	-0.622	-0.411	-0.469	-0.429
2	0.212	-0.322	0.154	-0.326
3	-0.119	-0.123	-0.271	-0.289
4	0.087	-0.221	0.193	-0.163
5	0.026	0.411	0.251	0.151
6	-0.243	-0.132	-0.243	-0.324
7	0.201	-0.213	0.047	-0.238
8	-0.217	-0.112	-0.293	-0.324
9	0.221	-0.212	0.129	-0.219
10	-0.210	-0.231	-0.219	-0.516
11	0.284	0.123	0.148	0.312
12	-0.145	-0.314	-0.542	-0.214
13	0.136	0.115	-0.215	0.231
14	-0.213	-0.124	0.321	-0.114
15	0.214	0.210	0.141	0.321
16	-0.223	-0.109	-0.213	-0.215
17	0.124	0.191	0.119	0.156

Table-3:AIC and BIC values for tentative Model

S.No	Oil Palm	ARIMA (p, d, q)	AIC	AICc	BIC	σ^2(Variance)
1	Area	1, 0, 1	91.37	95.17	101.4	0.2931
		1, 1, 1	91.64	90.12	94.61	0.2980
		0, 1, 1	89.13	89.20	93.04	0.2824
		0, 1, 2	90.69	91.17	96.66	0.2892
2	Production	1, 0, 1	61.49	62.29	69.52	0.1557
		1, 1, 1	56.15	56.63	62.11	0.1534
		0, 1, 1	52.17	52.41	54.15	0.1496
		0, 1, 2	56.14	56.62	62.11	0.1534

Table-4:Valuations of the fitted Auto Regressive Integrated Moving Averages model for AREA of Oil Palm

ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
0.1164	0.1353	0.3009	1.1632	4.1328	0.9048	-0.1382

Table-5:Evaluations of the fitted Auto Regressive Integrated Moving Averages model for PRODUCTION of Oil Palm

ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
0.0766	0.3209	0.2874	1.1747	4.3429	0.9141	-0.0102

ME- Mean Error, RMSE- Root Mean Square Error, MAE- Mean Absolute Error, MPA- Mean Percentage Error, MAPE- Mean Absolute Percentage Error, MASE- Mean absolute Scaled Error, ACF- Auto Correlation Function

Table-6: Prognostication -Area with Confidence Limits at 95%

Year	Point Forecast	Low 95%	High 95%
2019	7.1234	6.1325	9.1154
2020	7.3245	6.1458	9.0023
2021	7.2157	6.2135	9.1001
2022	7.4468	6.1457	9.2140
2023	7.108	6.2214	9.1145
2024	7.3651	6.1487	9.1234
2025	7.2301	6.2347	9.1156
2026	7.1911	6.1247	9.1212
2027	7.1241	6.0021	9.1145
2028	7.3254	6.1581	9.1231
2029	7.1234	6.1234	9.1123
2030	7.0147	6.1125	9.1231

Table-7 Prognostication --Production with Confidence Limits at 95%

Year	point Forecast	L 95%	H 95%
2019	5.5466	4.7860	7.3072
2020	5.5762	4.6575	7.4358
2021	5.5923	4.5453	7.5479
2022	5.6123	4.4445	7.6487
2023	5.6962	4.3522	7.7411
2024	5.7523	4.2665	7.8268
2025	5.8236	4.1862	7.9071
2026	6.0231	4.1104	7.9829
2027	6.1235	4.0383	8.0549
2028	6.5123	4.9696	8.1237
2029	7.0235	4.1325	8.9786
2030	7.7569	4.8675	9.0235

Table-8:ACF and PACF values of Residuals at AUTO REGRESSION INTEGRATED MOVING AVERAGES(0,1,1) Area and Production of Oil Palm

Lag	ACF-Area	PACF-Area	ACF-Production	PACF-Production
0	1.000		1.000	
1	0.007	0.008	0.008	0.008
2	-0.003	-0.013	-0.013	-0.003
3	-0.139	-0.119	-0.129	-0.129
4	0.113	0.117	0.113	0.107
5	0.125	0.126	0.135	0.136
6	-0.130	-0.148	-0.140	-0.168
7	-0.124	-0.179	-0.114	-0.079
8	-0.157	-0.135	-0.117	-0.165
9	0.110	0.024	0.100	0.034
10	-0.052	-0.095	-0.032	-0.085
11	0.026	0.013	0.016	0.033
12	-0.166	-0.029	-0.126	-0.079
13	-0.174	-0.238	-0.124	-0.248
14	0.039	0.011	0.069	0.121
15	0.025	0.025	0.045	0.045
16	-0.002	-0.117	-0.022	-0.137
17	-0.016	0.017	-0.026	0.077

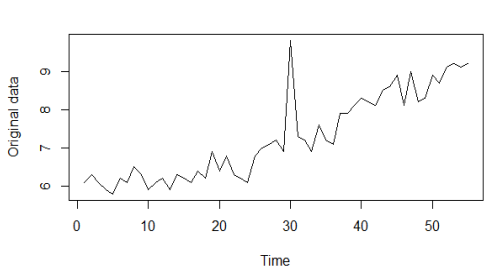

Fig-1(a): Base data-Area

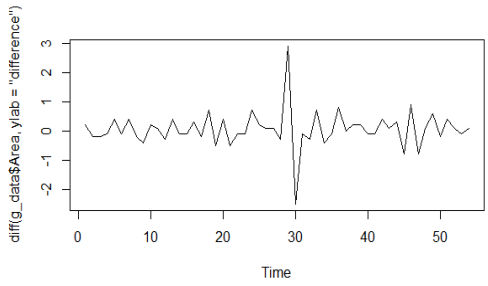

Fig1(b): I st Differences –Area

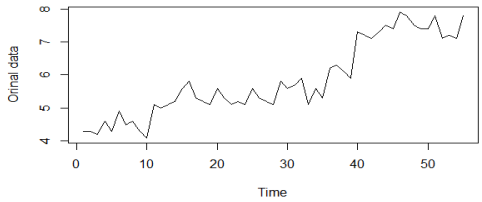

Fig-2(a): Base data-Production

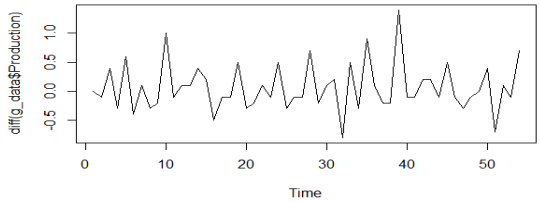

Fig-2(b): I st Differences –Production

4.2.Build Auto Regressive Integrated Moving Averages model for Area and Production of Oil Palm Crop

4.2.1.Identification

The first step in the analysis used to be to plot the given data. Figure 1 suggests the location and production of Indian Oil Palm from 1966-67 to 2017-18. Inspection of Figure 1 revealed a tremendous vogue over time, indicating nonstationarity of the series. This used to be tested via autocorrelation function (ACF) partial autocorrelation characteristic (PACF). To stabilize the series, it was originally divergent however then the facts reached a stationary region and Oil Palm yields, as shown in Figure 2 The subsequent step is to identify the p and q values. For this purpose, more than a few orders of autocorrelation coefficients and partial autocorrelation coefficients of X are calculated (Table 2). Figures three and 4 show the location and product data, autocorrelation characteristic (ACF) and partial autocorrelation function (PACF). We reviewed eight primary autoregressive joint shifting average models and selected the one that comfy the smallest AIC (Akaike Information Criterion) and SBC (Schwartz Bayesian Criterion). For AIC and BIC, select the terrific model: autoregressive joint moving common (0, 1, 1) for the Oil Palm region. Autoregressive built-in transferring average (0,1,1) for Oil Palm production has the lowest values for AIC and SBC. shown in Table three

4.3.Model Estimation and Verification

Indian Oil Palm range, manufacturing model parameters were estimated using R software program document estimation results. Predicted values the use of autoregressive joint shifting averages the usage of model fitting information such as RMSE and MAPE values

are proven in Tables four and 5. Model validation entails inspecting the model residuals to see if there are still systematic patterns that can be eliminated to improve the chosen autoregressive integration. Moving average.

4.4.Diagnostic Checking

Examining the auto correlations and partial auto correlations of the residuals of various orders. Fig. 5 shown the ACF and PACF of the residual and Box L-Jung statistic non-significant result also indicate "good fit" of the model.

4.5 Prognostication

Using autoregressive joint transferring average (0,1,1) Oil Palm area model and autoregressive joint transferring average (0,1,1) Oil Palm production mannequin to predict place and yield of Indian Oil Palm crop over a 6-year period. to do The envisioned values are proven in Table 6. Hence, the nice overall performance is observed with autoregressive embedded shifting common (0,1,1) with R2 cost of 98.00% each Oil Palm vary mannequin and product model. The accuracy of both earlier than and after predictions was tested the usage of the following checks such as mean squared error (MSE) and suggest absolute proportion error (MAPE). An autoregressive joint moving average mannequin is principally designed to predict the variable in question. To assess the predictive ability of the geared up autoregressive joint transferring common model, a key measure of forecast accuracy used to be calculated for the sample period. Mean absolute percentage error (MAPE) for the Oil Palm region, production is 4.612, with measurements of 4.942, indicating low forecast uncertainty.

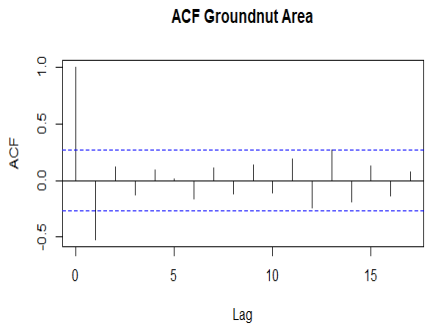

Fig-3(a): ACF- Area

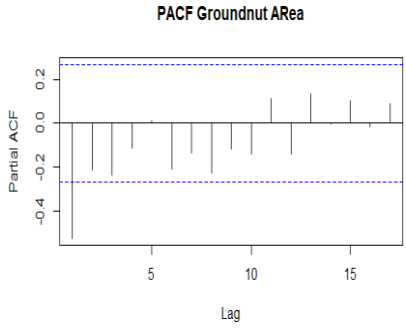

Fig-3(b):PACF- Area

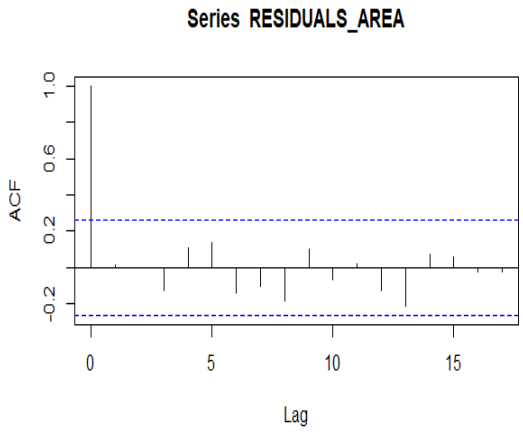

Fig-5(a): Residuals ACF –Area

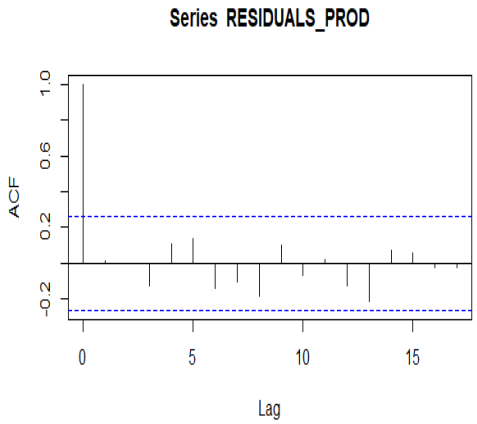

Fig-5(b): Residuals PACF -area

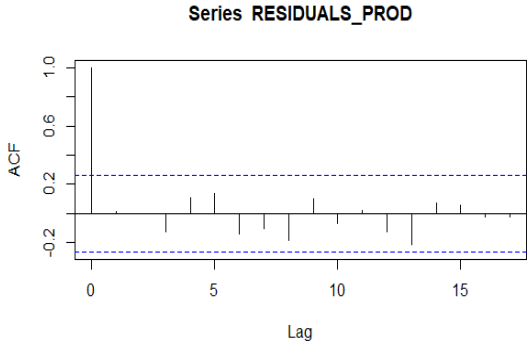

Fig-6(a): Residuals ACF – Production

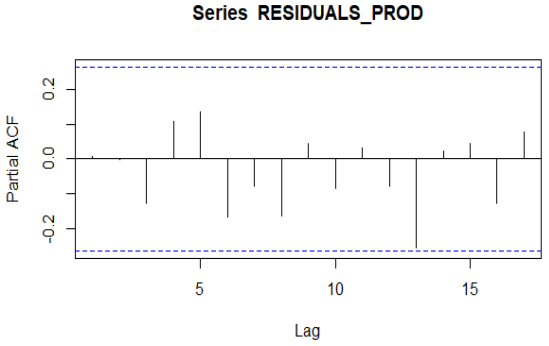

Fig-6(b): Residuals PACF - Production

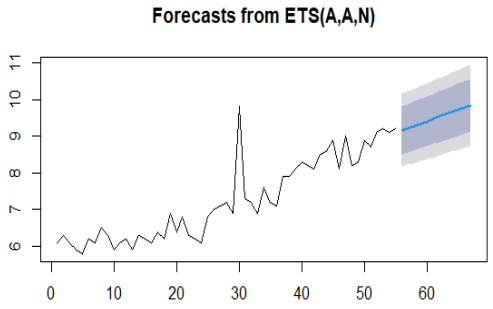

Fig-7: Forecast of Oil Palm area

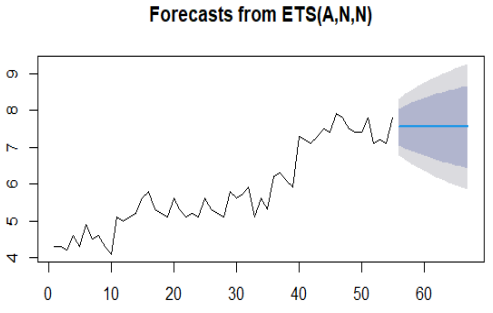

Fig-8: Forecast of Oil Palm production

5. Conclusion

In this study, the developed models for Oil Palm place have been decided as autoregressive joint transferring common (0, 1, 1) and autoregressive joint moving

average (0, 1, 1), respectively. The projections reachable the use of the developed models exhibit that the projected Oil Palm acreage and manufacturing will exhibit a superb fashion in the coming years. Validity of the expected price can be validated if data is reachable for the lead period. The linear and compound growth prices of Oil Palm at some point of the study duration proved to be wonderful and good sized for regional production, suggesting that terrific measures ought to be taken for Oil Palm enchantment in India.

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