Research Article

Major Crops Forecasting Area, Production and Yield Evidence from Agriculture Sector of Pakistan

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Abstract | Food security is a burning issue of current era, provision of nutrition requisites for increasing population unfeasible without sustainable agriculture growth. Forecasting plays an imperative role in adjusting the vision and applicability regarding aspirations. The study attempted to forecast major crops area, production, yield and per capita food availability using Autoregressive Integrated Moving Average (ARIMA) model. Sixty-seven years annual time series data from 1947-48 to 2013-14 was obtained to forecast major crops and per capita food availability for 21years from 2014-15 to 2034-2035. Findings of the study pointed out increasing trends; major crops area, production, and yield except the sugarcane crop as mentioned decreasing trend in sugarcane yield. Decreasing of sugarcane yield in forecasted period is reported to lack of potential use of resources in sugarcane crop. Forecasted Per capita food availability will increase wheat 138.2kg to 185 kg, rice 36.2kg to 50.8kg and maize 26.8kg to 43.5kg for forecasted population 188 million to 258.4 million from 2014 to 2035. Food security and sustainable agriculture growth are conceivable through proper and feasible policy measures by policymakers to revamp their strategies accordingly.

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Introduction

According to United Nation (UN), millennium declaration of Millennium Development Goals (MDGs) "Eradicate Extreme Hunger and Poverty" and now food security has become a global concern in the current scenario of the world. It has anticipated world population will increase around 9.3 billion in 2050 and the immense increase in the population of Pakistan is expected in coming decades (UN, 2011). Pakistan population is currently 19.1 million 2015 and anticipated to increase 242.06 million in 2030 and 300 million in 2050 (PBS 2014-15). Increasing population requires more food, clothing, shelters and other necessities of life. Dynamics of population stresses economic resources and dependency of young on the economy of the country. Agriculture is a major source of providing food and employment to the population of the country. Major crops facilitate in the provision of food basket to the population. There is direct relation between population growth and food requirements, so it is necessary to focus on enhancing the agricultural productivity.

Agriculture is not only a major source direct employment, it also provides raw material to export oriented industries of Pakistan. Agriculture sector contributes 20.9% of GDP and employing a source of 43.5% of rural population. Official statistics reveals that growth rate of agriculture sector rose from 2.7 percent in

2013-14 to 2.9 percent in 2014-15, but the alarming fact is that the production of major food crops showed negative growth during the same period (PBS 2014-15).

Major crops of agriculture sector wheat, rice, cotton, maize, and sugarcane have reported 25.6% of value added in overall agriculture and 5.3% of GDP in Pakistan. Wheat crop is considered major crop in agriculture sector by cultivation area and it contributes 10% of value added in agriculture and 2.1% of GDP. A decrease in wheat cultivation area and production is observed. The wheat cultivation area reduced from 9199 thousand hectares in 2013-14 to 9180 thousand hectares in 2014-15. Wheat production decreased from 25979 thousand tonnes in 2013-14 to 25478 thousand tonnes in 2014-15. Rice crop is accounted for 0.7% of GDP and 3.2% agriculture value added. Increase in rice cropped area and production has recorded. Area rose from 2789 to 2892 thousand hectares and rice production from 6798 to 7005 thousand tonnes from during the fiscal year 2014-15. Maize is a prominent food crop, which accounts for 0.4% of GDP and 2.1% agriculture value added. Maize cropped area and production have decreased. Area shrank to 1130 from 1168 thousand hectares declined to 4695 from 4944 thousand tonnes (PBS, 2014-15).

Cotton crop performs a prominent role in foreign exchange earning exporting and provision of raw material to local textile industry. Cotton crop shares 1.5% of GDP and 7.1% of value added in agriculture. Cotton cropped area has increased to 2961 thousand hectares to 2806 thousand hectares increase and its production rose to 13.983 million bales from 12.769 million bales from 2013-14 to 2014-15 (PBS, 2014-15). Sugarcane is considered a cash crop and it contributes 0.6% of GDP and 3.1% of value added in agriculture. Decrease in sugarcane crop area and production has been reported from 2013-14 to 2014-15. The cropped area reduced to 1141 thousand hectares from 1173 thousand hectares decrease and its production decreased to 62.7 million tonnes from 67.5 million tonnes during the year (PBS, 2014-15).

Intensification in population is a critical issue to agrarian economies justifying nutrition requisite to masses of the country and raw material to the industrial sector. Low productivity in agriculture sector is a crucial one to developing economies. Developing agricultural countries have to import cereals to meet population nutrition requirements. Numerous factors are playing a role in such marginal rotations. Environmental changes are playing a pivot role in agricultural productivity. Environmental changes and policy matters are playing a key role in agro-based decisions in the current scenario. Forecasting plays a vital role in notifying future availability of resources and requirements of the country and vision to adjusting gaps and policy formulation to meet future requisites. Forecasting estimates of major crops will provide supportive measures to state, formulating policies relevant to trade, prices, and protective measures surplus and scarcity of food and raw material in future. In the agriculture sector, major crops are the main source of food staple to masses and provision of foreign exchange earnings and raw material to the industrial sector of the country. The study has focused on forecasting major crops (area, production, and yield) and per capita food availability for 21 years 2014-15 to 2034-35. Major crops are playing a vital role in the agriculture sector of Pakistan. This study has employed ARIMA model forecasting interlinked with previous sixty-seven years data of major crops from 1947-48 to 2014-15.

Literature review

Agriculture has foremost worth the economic growth of developing countries. Major crops impact economic growth of developing countries it is notable to be aware of production and yield of crops for economic stability. Forecast food availability and population growth rate are consider as prerequisites for preventing alarming food insecurity in future and formulating policy measures for a viable solution. Most of studies have forecasted and detected curtailed in food crops and cash crops production in Pakistan. Hamid et al. (1987) and Muhammad (1989) reported forecast play vital role in growth in area and yield of major crops except some limits. Numerous studies have forecasted major crops and vegetables with a variety of econometric models, Exponential Smoothing Approach, Regression Analysis and ARIMA model. ARIMA model approach has remained the focus of massive studies for the forecasting object. Muhammad (1992) has applied ARIMA model approach to forecast rice production in Pakistan and suggest proper measures to increasing exports. Saeed et al. (2000) have forecasted wheat crop area and production employing ARIMA model. Karim et al. (2005) have forecasted wheat crop production through Regression Analysis of Bangladesh. Sabir and Tahir (2012) have forecasted wheat crop production with supply-demand

projection using Exponential Smoothing model for Pakistan. Badmus et al. (2011) study has forecasted maize cultivated area and production in Nigeria with the application of ARIMA model. Mehmood and Ahmad (2013) employed ARIMA model and investigated a forecasted area of mangoes in Pakistan while Iqbal et al. (2014) forecasted trading behaviour of food crop of four leading SAARC countries. Arivarasi et al (2015) study has forecasted vegetable trends and production of two vegetable growing zones in the Chennai state of India using ARIMA model. Badar et al. (2015) have used ARIMA model to forecast major food crops including wheat, rice, and maize, area, production and yield in Pakistan. Ali et al. (2015) have forecasted production and yield of cotton and sugarcane using ARIMA model.

In literature, a bulk of studies has focused, forecast of various crop wheat, rice, sugarcane, maize, cotton, and vegetables. Plenty of work has provided a fruitful contribution to literature while gap still prevails to the significant impact of forecasting crops. Numerous studies have fixated production and yield of crops while omitted cropped area forecasting except study of Badar et al. (2015). Cropped area plays a vital role in agriculture sector productivity and preliminary element in resource allocation. Studies in the literature have focused only limited major crops single crop, cash crops or food crops and not simultaneously forecasted all major crops. Studies have forecasted area, production, and yield while no justification of forecasted food availability per capita except study of Abbas et al. (2007) and Zulfiqar and Hussain (2014) forecasted wheat production gaps to approach state future food security in Pakistan. Research gap prevails to forecast major food crops and per capita food availability. In this study, five major crops are simultaneously forecasted area, production, and yield for 21 years 2014-2035. Per capita food availability of food crops forecasted to provide deep insight to bridge such research gap. Exponential Smoothing Approach or Regression Analysis has rarely used to forecast in studies. Plentiful studies in literature preferred ARIMA model as Azhar et al. (1972), Boken (2000), Saeed (2000), Muhammad (2001), Iqbal (2005), Karim (2005), Badmus (2011), Sabir and Tahir (2012), Ali et al. (2013), Mehmood and Ahmad (2013), Abid et al. (2014), Amin (2014), Zulfiqar and Hussain (2014), Ali (2015), Badar (2015) have applied ARIMA model to forecast based on valid estimation. ARIMA approach considers preferable for forecasting due to such feathers deal any type of data and estimation comparatively to other approaches.

Matrials and Methed

For the purpose of forecasting of production, area and yield of major crops, i.e. wheat, rice, maize, cotton and sugarcane, the study has used the long range of annual time series data. Our data set covers almost all history of Pakistan and it ranges from 1947-48 to 2013-14. The last few years are skipped due to unavailability of reliable statistic at the time of data analysis. The data for all three dimensions, including production, area and yield, of five major crops has been collected from various statistical supplements of Agriculture Statistics of Pakistan published by Pakistan Bureau of Statistics (PBS).

Keeping in view the aims of the study and nature of statistical information, various methods of forecasting have been considered at the time of data analysis. The Autoregressive Integrated Moving Average (ARIMA) model has chosen for analysis due to its suitability to our dataset and non-stationary nature of time series to be forcasted. ARIMA is univariate model which has several advantages over its multivariate alternates. This model suitable even for non-stationary time series, has great statistical power for reliable forcasting from small datasets and requires data for only time series being forcasted but not for its determinants (Brockwell and Davis, 2003; Hamilton, 1994; Tsay, 2005; Wei, 2005).

The major issue in the use of ARIMA is selection of appropriate ARIMA(p,d,q) models where 'p' refers to the number of autoregressive terms, 'd' represents order of integration and 'q' denotes the moving average terms to be selected for more precise forcast. For the purpose of model selection Box and Jenkins (1970) approach is used. This approach helps in ARIMA model identification, estimation, diagnostic checking and forecasting of both stationary and non-stationary time series. This approach differentiates ARIMA and ARMA model for stationary and non-stationary time series respectively.

In Box-Jenkins approach, stationarity or order of integration (d) of the data is checked through formal unit root tests like Augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) test etc. Graphs of Partial Autocorrelation Function (PACF) and

Table 1: *Augmented dickey fuller test (adf) unit root test results.*

Variables	Level		1st Difference		Order of integration
	DF t-stat	Selected Lags (AIC)	DF t-stat	Selected Lags (AIC)	
Wheat Area	-0.82951	2	-7.101306***	1	I(1)
Wheat Production	1.706653	2	-8.139106***	1	I(1)
Wheat Yield	1.339571	2	-8.593950***	1	I(1)
Rice Area	-0.78027	4	-6.912017***	3	I(1)
Rice Production	0.472830	3	-6.313575***	2	I(1)
Rice Yield	0.213872	2	-7.593533***	1	I(1)
Maize Area	-0.05509	4	-5.430871***	4	I(1)
Maize Production	4.193394	4	-6.656613***	0	I(1)
Maize Yield	2.075372	3	-6.933624***	0	I(1)
Cotton Area	-1.37459	2	-3.162753**	4	I(1)
Cotton Production	0.122871	3	-3.622326***	4	I(1)
Cotton Yield	0.075541	3	-6.867765***	2	I(1)
Sugarcane Area	-1.64598	3	-7.655642***	2	I(1)
Sugarcane Production	0.550530	3	-7.501035***	2	I(1)
Sugarcane Yield	-0.25776	3	-7.584749***	2	I(1)

*** at 1% level of significance ** at 5% level of significance

$$AR\ (p) = Xt\ = \lambda 0 + \lambda 1Xt - 1 + \lambda 2Xt - 2 + \cdots + \lambda pXt - p + Ut\ \ldots\ldots (1)$$

$$MA\ (q) = Xt\ =\ \beta + Ut + \psi 1Ut - 1 + \ \ldots \psi qUt - q + zt \ldots\ldots (2)$$

$$Xt\ = \lambda 0 + \lambda 1Xt - 1 + \lambda 2Xt - 2 + \ \ldots + \lambda pXt - p + Ut\ + \psi 1Ut - 1 + \cdots \psi qUt - q + zt (3)$$

Autocorrelation Function (ACF) are used to identify the length of autoregressive (p) and moving average (d) terms. Akaike Information Criterion (AIC) is used for selection of single appropriate model from various ARIMA (p,d,q) models for forecasting under consideration.

Statistical specification of the ARMA and ARIMA model is given below:
Autoregressive (AR) general form according to order (p) as mentioned in Equation (1).

Model AR (p) explained with "t" time
Xt : Value of response variable at time "t"; Xt-1, Xt-2…Xt-p: Symbolize different time lags of respective variable; λ0, λ1, λ2…..λp: Signify coefficients of the model; Ut: Mentions error term of time "t".

Moving Average MA (q) generalized form mentioned in Equation (2).

While βt as constant mean of series
ψ1+ …ψq: Mentioned coefficient of estimated error term; zt: error factor.

After combining Autoregressive and Moving Average models formed as ARMA model (Equation 3)

Use of differenced time series (ΔX_t) according to order of integration, like I (1) first-differenced stationary time series forms the ARIMA model.

Results and Discussion

This section operationalized the proposed ARIMA method used for forecasting in the study. As a first step of Box-Jenkins approach for ARIMA model selection, ADF unit root test is applied for checking the stationarity or non-stationarity of the time series being forecasted. Sixty-seven empirical annual observations for each series are used in this analysis and forecasting. Stationarity or non-stationarity check through unit root analysis will help us in choosing between ARMA and ARIMA for further processing and forecasting. The estimates of unit root test applied on the series of production, area and yield of wheat, cotton, sugarcane, rice and maize are reported in the Table 1.

Table 2: *Phillips perron unit root test.*

Variables	Level			1st Difference			Order of integration
	Intercept/Intercept and trend	PP t-stat	P-Value	Intercept/Intercept and trend	PP t-stat	P-Value	
Wheat Area	Intercept and trend	-3.001775	0.1396	Intercept and trend	-9.968882***	0.0000	I(1)
Wheat Production	Intercept and trend	-3.278213*	0.0789	Intercept and trend	-15.85875***	0.0000	I(0)
Wheat Yield	Intercept and trend	-4.061621**	0.0112	Intercept and trend	-16.28165***	0.0000	I(0)
Rice Area	Intercept and trend	-5.11609***	0.0004	Intercept and trend	-22.13442***	0.0001	I(0)
Rice Production	Intercept and trend	-4.51513***	0.0030	Intercept and trend	-15.73239***	0.0000	I(0)
Rice Yield	Intercept and trend	-3.252173*	0.0835	Intercept and trend	-11.26238***	0.0000	I(0)
Maize Area	Intercept and trend	-4.072488**	0.0109	Intercept and trend	-8.996700***	0.0000	I(0)
Maize Production	Intercept and trend	2.414227	1.0000	Intercept and trend	-6.991907***	0.0000	I(1)
Maize Yield	Intercept and trend	1.469491	1.0000	Intercept and trend	-7.241810***	0.0000	I(1)
Cotton Area	Intercept and trend	-2.639000	0.2651	Intercept and trend	-12.54490***	0.0000	I(1)
Cotton Production	Intercept and trend	-3.668377**	0.0316	Intercept and trend	-19.61910***	0.0000	I(0)
Cotton Yield	Intercept and trend	-4.21679***	0.0072	Intercept and trend	-20.71304***	0.0000	I(0)
Sugarcane Area	Intercept and trend	-3.924406**	0.0163	Intercept and trend	-11.32320***	0.0000	I(0)
Sugarcane Production	Intercept and trend	-4.32297***	0.0053	Intercept and trend	-12.22841***	0.0000	I(0)
Sugarcane Yield	Intercept and trend	-6.36319***	0.0000	Intercept and trend	-23.99439***	0.0001	I(0)

*** at 1% level of significance ** at 5% level of significance * at 10% level of significance

Table 3: *Estimation of wheat area, production and yield.*

Estimates of wheat area, parameters ARIMA Model(2,1,4)				
Type	**Coefficient**	**Standard Error**	**T ratio**	**P- Value**
AR(2)	-0.521379	0.194989	-2.673889	0.0097
MA(4)	-0.531779	186.2633	-0.002855	0.9977
Estimates of wheat production parameters ARIMA Model (1,1,2)				
AR(1)	-0.782083	0.146588	-5.335252	0.0000
MA(2)	-0.522841	862.4576	-0.000606	0.9995
Estimates of wheat yield parameters ARIMA Model(1,1,2)				
AR(1)	0.907917	0.056707	16.01078	0.0000
MA(2)	0.857217	0.093622	9.156119	0.0000

Table 4: *Estimation of rice area, production and yield.*

Estimates of rice area parameters ARIMA Model(3,1,4)				
Type	**Coefficient**	**Standard Error**	**T ratio**	**P- Value**
AR(3)	-0.403459	0.276510	-1.459109	0.1500
MA(4)	-0.899765	509.6772	-0.001765	0.9986
Estimates of rice production parameters ARIMA Model (0,1,1)				
MA(1)	-0.396584	0.110215	-3.598285	0.0006
Estimates of rice yield parameters ARIMA Model(0,1,1)				
MA(1)	-0.350600	0.095920	-3.655136	0.0005

Estimates of unit root test in Table 1 indicate that all fifteen variables consisting of wheat crop area, production, yield, rice crop area, production, yield, maize crop area, production, yield, cotton crop area, production, yield and sugarcane crop area, production and yield are non-stationary at level based on ADF test statistics and level of significance. This indication suggests that ARMA model is not suitable for forecasting of these variables and we will have to move for ARIMA models for reliable forecasting. The results of the last three columns reveal that all the variables became stationary when they are used in first differenced form. It suggests that ARIMA (p, 1, q) model should be used for forecasting as all the variables have order of integration I (1).

Wheat crop area, production and yield estimation are mentioned with appropriate models in Table 2. According to Akaike Information Criteria(AIC), ARIMA(2,1,4) model for wheat area, ARIMA(1,1,2) model for wheat production and ARIMA(1,1,2) model for wheat yield are considered appropriate models for forecasting of these three variables.

Estimation of rice crop area, production, and yield are presented in Table 3 with selected models. In this table, ARIMA (3, 1, 4) model for rice area, ARIMA (0,1,1) model for rice production and ARIMA(0,1,1) model for rice yield are selected as appropriate models for forecasting of these variables.

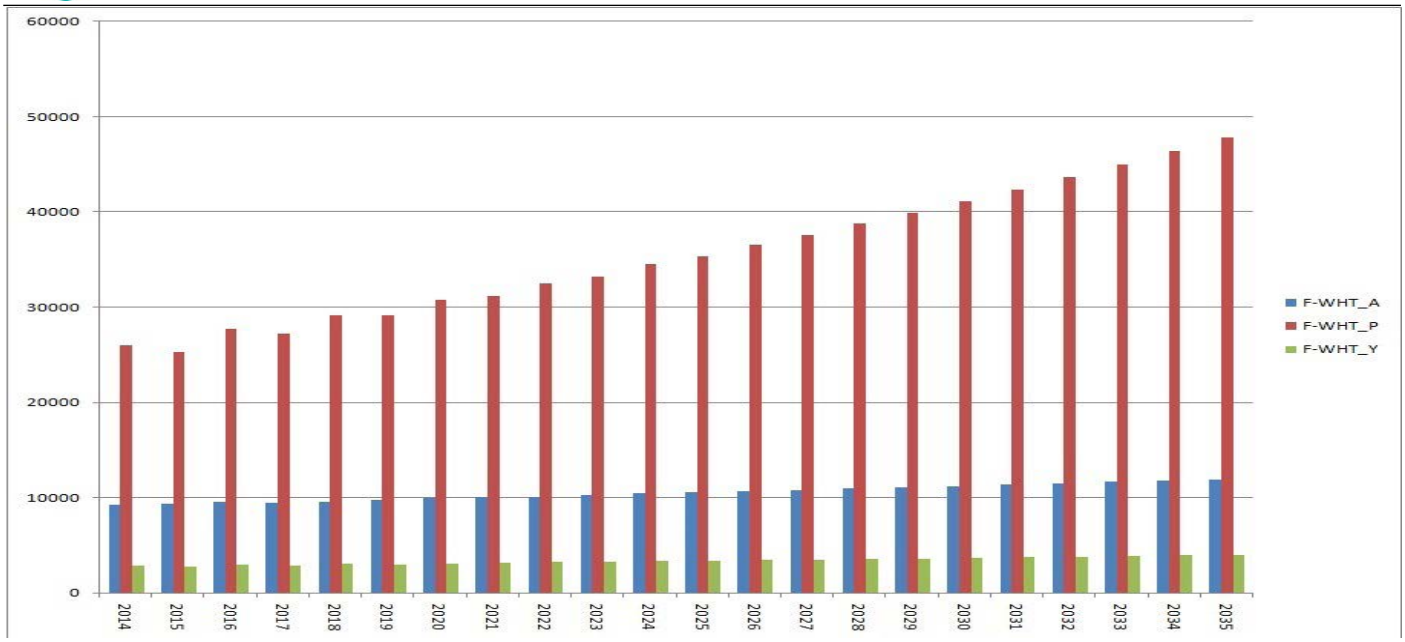

Figure 1: *Forecasted wheat area, production and yield.*

Table 5: *Estimation of maize area, production and yield.*

Estimates of maize area parameters ARIMA Model (0,1,4)				
Type	**Coefficient**	**Standard Error**	**T ratio**	**P- Value**
MA(4)	-0.406397	269.0026	-0.001511	0.9988
Estimates of maize production parameters ARIMA Model (0,1,1)				
MA(1)	-0.219086	0.098713	-2.219429	0.0301
Estimates of maize yield parameters ARIMA Model(2,1,4)				
AR(2)	-0.730347	0.192099	-3.801927	0.0004
MA(4)	0.356243	81.38603	0.004377	0.9965

Table 6: *Estimation of cotton area, production and yield.*

Estimates of cotton area parameters ARIMA Model(4,1,2)				
Type	**Coefficient**	**Standard Error**	**T ratio**	**P- Value**
AR(4)	-0.426121	0.129898	-3.280424	0.0018
MA(2)	0.808630	0.170757	4.735565	0.0000
Estimates of cotton production parameters ARIMA Model (4,1,1)				
AR(4)	-0.371179	0.104703	-3.545055	0.0008
MA(1)	0.766906	0.243989	3.143199	0.0026
Estimates of cotton yield parameters ARIMA Model(0,1,2)				
MA(2)	0.499716	15.71141	0.031806	0.9747

Findings of appropriate ARIMA models of maize crop area, production and yield are reported in Table 4. ARIMA(0,1,4) model for maize area, ARIMA(0,1,1) model for maize production and ARIMA(2,1,4) model for maize yield are selected as appropriate models for forecasting of these series.

Table 5 reported appropriate ARIMA models and their estimates for cotton crop area, production and yield. ARIMA(4,1,2) model for cotton area, ARIMA(4,1,1) model for cotton production and ARIMA(0,1,2) model for cotton yield are chosen as suitable forecasting models for cotton related variables.

ARIMA models for sugarcane area, production, yield and their estimates are given in Table 6. ARIMA (2,1,1) model for sugarcane area, ARIMA(3,1,1) model for sugarcane production and ARIMA(0,1,3) model for the sugarcane yield are considered appropriate models for forecasting sugarcane area, production and yield respectively.

Diagnostic checking of fitted models is considered next step in pursuit of models fitted and estimated through Box-Jenkins (1976) approach. Autocorrelation function (ACF) and Partial Autocorrelation function (PACF) of plotted residual pointed out fitted model. For major crops area production and yield ACF and PACF of plotted residual are found within limits and proves fitness of models (see Appendix-A). Forecasting of major crops area, production, and yield is made through above estimated ARIMA Models. Major crops forecasted values of wheat, rice, maize, cotton, sugarcane, area, production and yield for the year 2014-15 to 2034-35 presented in Table 7.

Wheat crop forecast values indicate that wheat cropped area will reach to 11927 thousand hectares, wheat production will rise to 47797 thousand tonnes and wheat yield will be increased to 4007 kg/ hectare till the year 2035. These forecast estimates are represented in Figure 1. These forecast findings are consistent with the studies of Iqbal et al. (2005), Sher and Ahmad (2008), Amin et al. (2014) and Badar et al. (2015).

Table 7: *Estimation of sugarcane area, production and yield.*

Estimates of sugarcane area parameters ARIMA Model(2,1,1)				
Type	**Coefficient**	**Standard Error**	**T ratio**	**P- Value**
AR(2)	-0.620881	0.110919	-5.597605	0.0000
MA(1)	-0.357184	0.203053	-1.759069	0.0836
Estimates of sugarcane production parameters ARIMA Model (3,1,1)				
AR(3)	0.316863	0.145980	2.170584	0.0339
MA(1)	-0.999987	1184.555	-0.000844	0.9993
Estimates of sugarcane yield parameters ARIMA Model(0,1,3)				
MA(3)	0.037476	72.95671	0.000514	0.9996

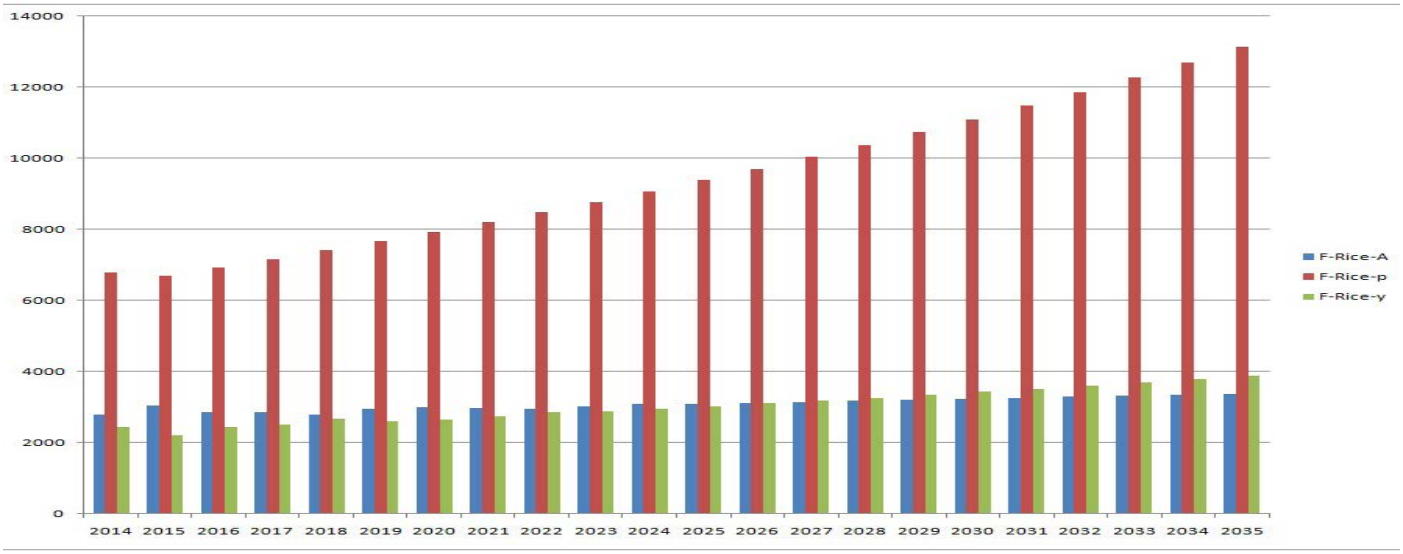

Figure 2: *Forecasted Rice area, production and yield.*

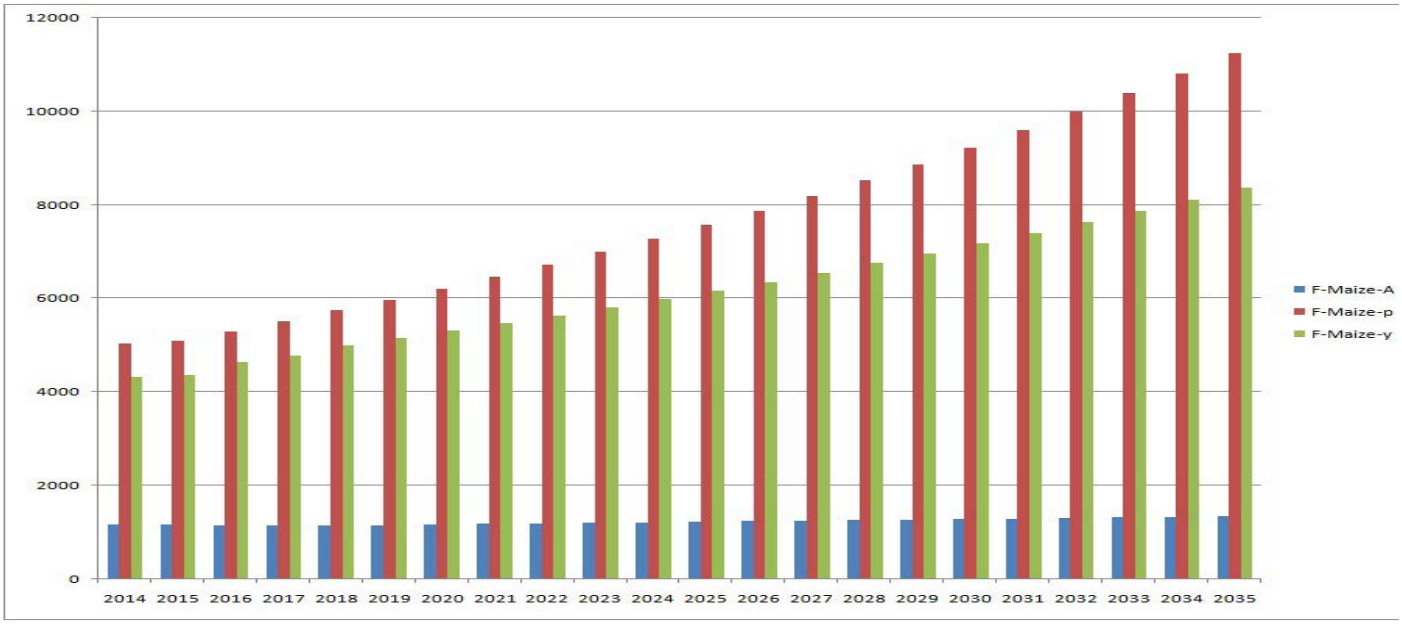

Figure 3: *Forecasted Maize area, production and yield.*

Rice crop forecasted values are shown in Figure 2. The forecasted rice area will reach to 3383 thousand hectares, rice production will rise to 13103 thousand tonnes and rice yield will increase to 3881kg/ hectare by the year 2035. These findings are accounted parallel to the study of Badar et al. (2015).

Figure 3 shows the maize crop forecasted values. Maize area will be 1343 thousand hectares, maize production will increase to 11251 thousand tonnes

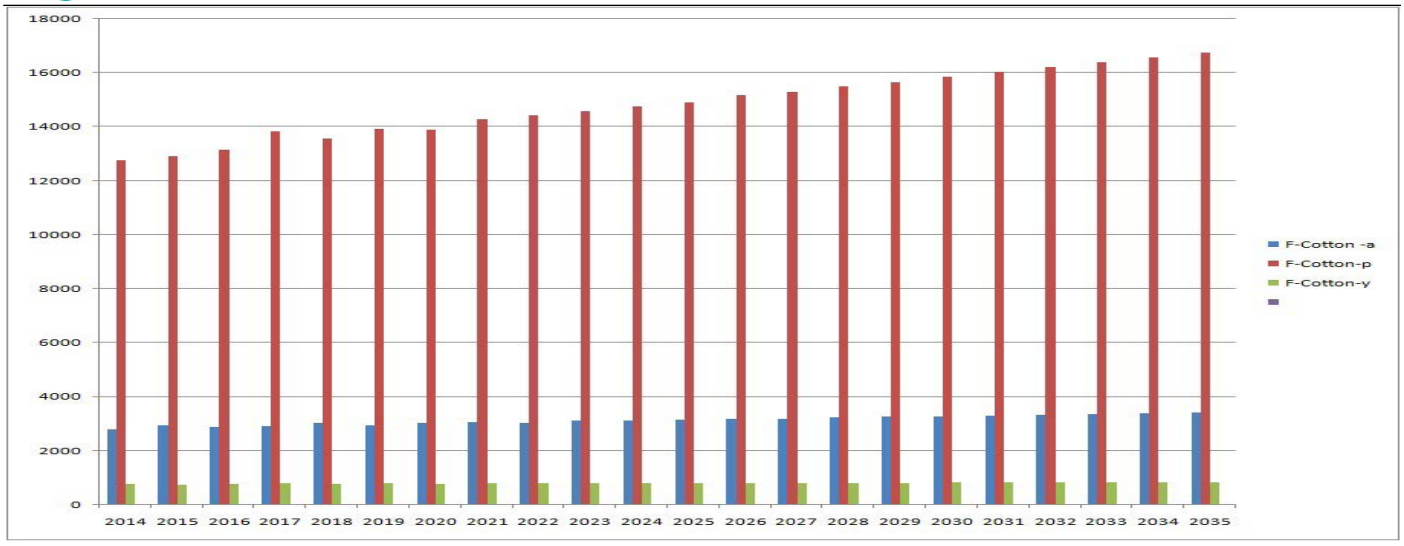

Figure 4: *Forecasted Cotton area, production and yield.*

Table 8: *Major crops forecasted area, production and yield from 2014 to 2035.*

	Wheat			Rice			Maize			Cotton			Sugarcane		
Year	Area (000 ha)	Product (000 t)	Yield (Kg ha)	Area (000 ha)	Product (000 t)	Yield (Kg ha)	Area (000 ha)	Product (000 t)	Yield (Kg ha)	Area (000 ha)	Product (000 Bales)	Yield (Kg ha)	Area (000 ha)	Product (000 t)	Yield (Kg ha)
2014	9199	25979	2824	2789	6798	2437	1169	5044	4315	2806	12769	775	1173	67460	57511
2015	9375	25291	2698	3044	6708	2204	1167	5100	4370	2955	12914	744	1136	62820	55286
2016	9530	27742	2911	2851	6937	2433	1141	5306	4649	2882	13145	776	1119	59689	53361
2017	9489	27231	2870	2849	7174	2518	1157	5520	4772	2924	13828	805	1156	61979	53614
2018	9548	29149	3053	2780	7419	2668	1148	5742	5002	3020	13571	765	1196	64416	53851
2019	9781	29163	2981	2958	7673	2594	1160	5974	5152	2956	13914	801	1203	64236	53402
2020	9939	30755	3094	2989	7935	2655	1171	6215	5308	3031	13887	780	1199	63912	53304
2021	10003	31129	3112	2979	8206	2755	1182	6466	5468	3062	14273	793	1213	65077	53643
2022	10099	32533	3222	2964	8486	2863	1194	6727	5634	3049	14421	805	1239	66510	53698
2023	10265	33162	3230	3032	8775	2894	1205	6999	5806	3122	14565	794	1256	67200	53510
2024	10414	34468	3310	3084	9075	2943	1217	7281	5983	3119	14770	806	1264	67702	53565
2025	10524	35285	3353	3101	9385	3027	1228	7575	6167	3143	14891	806	1275	68597	53817
2026	10642	36551	3435	3108	9705	3123	1240	7880	6356	3195	15161	808	1292	69635	53906
2027	10789	37516	3477	3144	10037	3192	1251	8198	6552	3193	15278	814	1309	70479	53844
2028	10935	38784	3547	3187	10380	3257	1263	8529	6754	3233	15501	816	1322	71232	53875
2029	11066	39870	3603	3216	10734	3338	1274	8873	6964	3263	15646	816	1334	72082	54022
2030	11198	41166	3676	3235	11101	3431	1286	9232	7180	3274	15846	824	1349	72990	54122
2031	11344	42360	3734	3264	11480	3517	1297	9604	7404	3316	16029	823	1364	73852	54137
2032	11491	43705	3803	3299	11872	3599	1309	9992	7635	3334	16201	827	1379	74679	54166
2033	11634	44999	3868	3330	12277	3687	1320	10395	7874	3358	16394	831	1392	75527	54251
2034	11777	46406	3940	3356	12696	3783	1332	10814	8121	3393	16559	831	1406	76397	54335
2035	11927	47797	4007	3383	13130	3881	1343	11251	8377	3410	16755	836	1421	77257	54368

and maize yield will rise to 8377 kg/ hectare till 2035. These forecasted findings are similar to the studies of Badar et al. (2015).

Cotton crop forecasted area, production, and yield are reported in Figure 4. Forecasted values of cotton crop area will be 3410 thousand hectares, cotton production will rise to 16755 thousand bales and cotton yield will increase to 836 kg/ hectare by 2035. All these estimates are consistent with Ali et al. (2015).

As the Figure 5 above have reported the Sugarcane forecasted area, production, and yield. Sugarcane forecasted area will rise to 1421 thousand hectares, sugarcane production will increase to 77257 thousand tonnes and sugarcane yield will be 54368 kg/ hectare by the year 2035. These reported estimates are similar to the studies of Masood and Javid (2004), Yaseen et al. (2005) and Ali et al. (2015) (Table 9).

Forecasted values of the population for the year 2014 to 2035 are shown in Figure 6, which indicate that forecasted population would be 258.4 million in 2035.

Per capita forecasted estimates of food crops like wheat, rice and maize are given in Figure 7. Availability of per capita wheat will be 185 kg, rice 50.8 kg and maize 43.5 kg for the year 2035 such findings are aligned with study of Zulfiqar and Hussain (2014).

Figure 5: *Forecasted Sugarcane area, production and yield.*

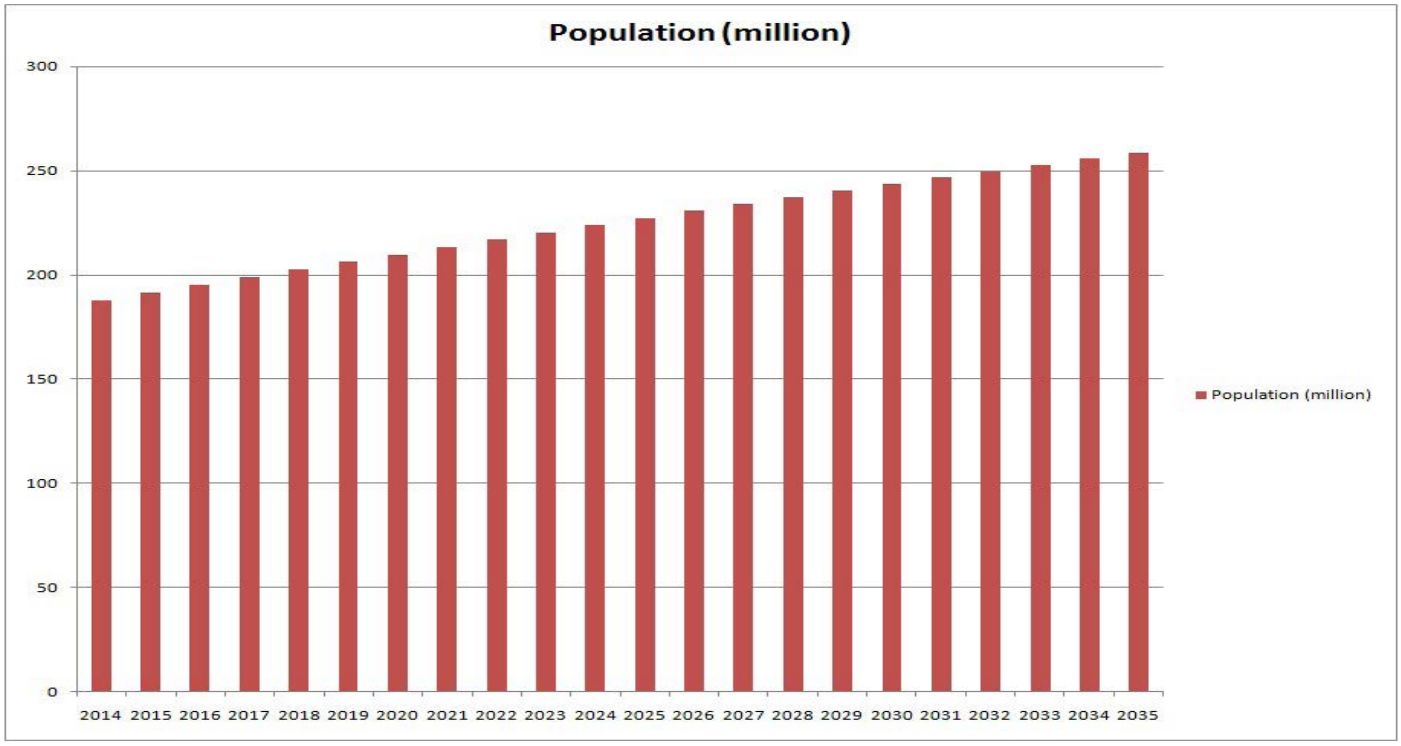

Figure 6: *Forecasted Population (millions).*

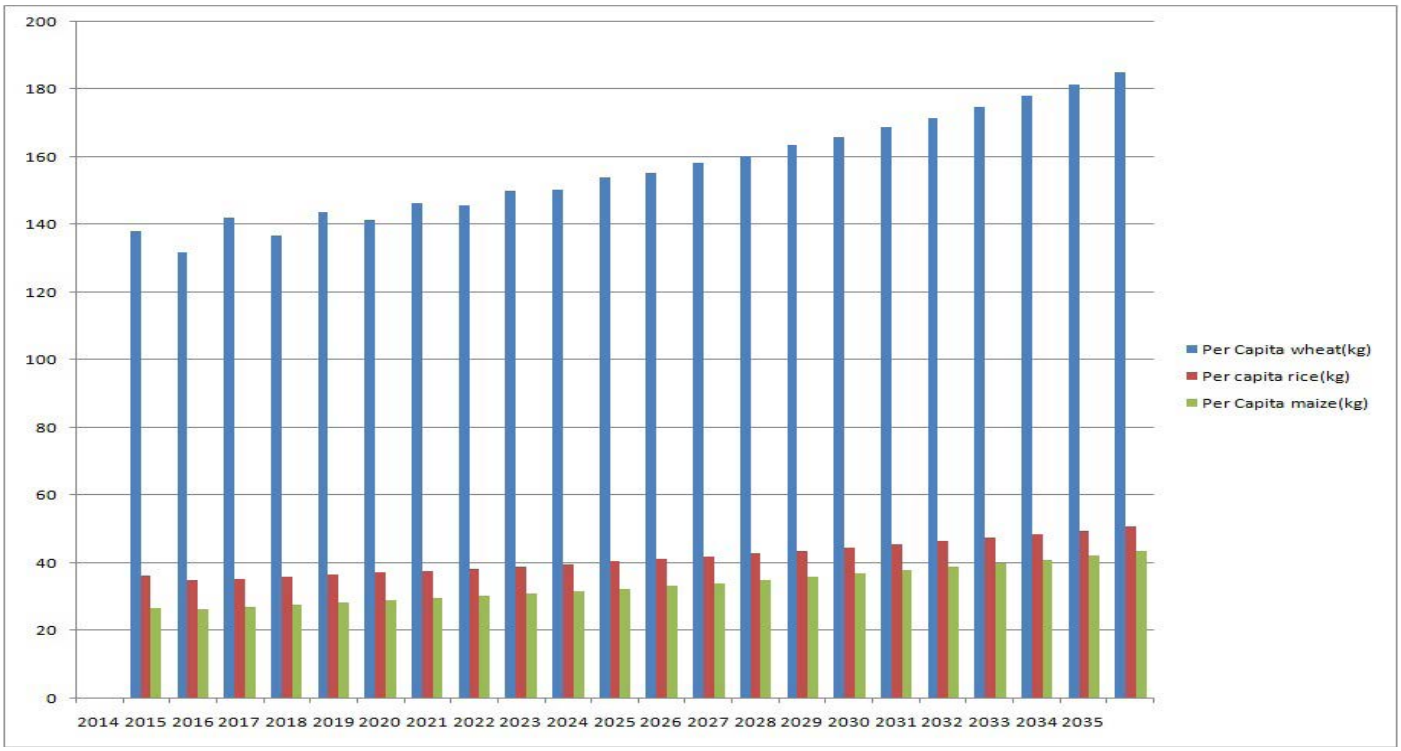

Figure 7: *Forecasted major food crops per capita (kg).*

Table 9: *Forecasted estimation of per capita food of major food crops from 2014-2035.*

Year	Population (million)	Wheat production (000) tonnes	Per Capita wheat(kg)	Rice production (000)tonnes	Per capita rice(kg)	Maize production (000)tonnes	Per Capita maize(kg)
2014	188	25979	138.2	6798	36.2	5044	26.8
2015	191.7	25291	131.9	6708	35	5100	26.6
2016	195.3	27742	142	6937	35.5	5306	27.2
2017	199	27231	136.9	7174	36.1	5520	27.7
2018	202.6	29149	143.9	7419	36.6	5742	28.3
2019	206.2	29163	141.4	7673	37.2	5974	29
2020	209.8	30755	146.6	7935	37.8	6215	29.6
2021	213.3	31129	145.9	8206	38.5	6466	30.3
2022	216.9	32533	150	8486	39.1	6727	31
2023	220.4	33162	150.5	8775	39.8	6999	31.8
2024	223.8	34468	154	9075	40.5	7281	32.5
2025	227.2	35285	155.3	9385	41.3	7575	33.3
2026	230.6	36551	158.5	9705	42.1	7880	34.2
2027	233.9	37516	160.4	10037	42.9	8198	35
2028	237.2	38784	163.5	10380	43.8	8529	36
2029	240.4	39870	165.8	10734	44.6	8873	36.9
2030	243.6	41166	169	11101	45.6	9232	37.9
2031	246.7	42360	171.7	11480	46.5	9604	38.9
2032	249.7	43705	175	11872	47.5	9992	40
2033	252.7	44999	178.1	12277	48.6	10395	41.1
2034	255.6	46406	181.6	12696	49.7	10814	42.3
2035	258.4	47797	185	13130	50.8	11251	43.5

Conclusion and Suggestions

Focus of the study was forecast of major crops area, production, yield and per capita food availability in future. ARIMA model was employed for estimation of historical data from 1947-48 to 2013-14. Findings of study have shown increasing trend of forecasted values of major crops area, production and yield except sugarcane. It provides a good vision of food security with extremely increasing population and scares available resources. Forecasted per capita food pointed out increasing trend, which is promising through favorable environmental conditions and good policy measures. Policy measures play a key role in economic growth and such forecasted values could helpful in formulating policies regarding agriculture especially about major crops. Refined sugar necessary dietary component for the masses of the country. Lower sugarcane yield per hacter is concerning issue for future and may result in shortage of refined sugar in the future. The government needs to ensure availability of high yield varieties and offer reasonable support price in order to meet future demand of refined sugar in the country. Higher production and yield of major crops is applicable only the proper required based use of fertilizer, pest control measures, improving cultural practices, maximum scale utilization of mechanization and adequate flow of irrigation to crops and other crop-related input measures. State-based policy measures need to familiarize for smooth increasing productivity of crops and overcome required increasing population needs.

Authors Contribution

The concept and design of research were developed by Dilshad Ahmad with the help and guidance of Muhammad Irfan Chani and Asad Afzal Humayon. Dilshad Ahmad conducted the trails collected and analyzed the primary and secondary data and prepared the first draft of the manuscript. The draft manuscript was studied and amended according to by all the authors before submission for publications. All authors read and approved the final manuscript.

Supplementary Material

There is supplementary material associated with this article. Access the material online at: http://dx.doi.org/10.17582/journal.sja/2017/33.3.385.396

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