Research Article

Maize Production Response to Climate Change in Pakistan: A Time Series Assessment

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Abstract | Increment in atmospheric CO_2, variations in temperature and precipitation are helping tools to forecast scenarios for the climate in an area. Changes in these tools from the past due to any unavoidable circumstances for today and in the future is refers to climate change (CC). Besides other living being, crops are either benefited or adversely affected by these changes in the climate of an area. Maize is one of the widely grown crops in the world and even in Pakistan has also influenced in either way. Current study employed vector auto regression models (VAR) along with times series data from 1980 to 2013 for Pakistan to estimate the potential effects of climate change on Maize production. Result professed that average temperature will affect Maize crop negatively bringing about 6% reduction in maize production till the year 2030. Average minimum temperature brought about 9% increases in maize production till 2021. Increase in overall rainfall will also benefits Maize crop production. Maize production will increase by 2% by the year 2030 from the base year *i.e.* 1980. Water availability in the crop growth periods and fertilizer application (today or in the future) will certainly increase production. This scenario demands devising adaptation strategies for farmers to be made available, this should be the key policy intervention of the government to cater with the climate change on agriculture and particularly on maize. Fertilizer management and crop variety choices according to the changing climate will address this serious concern expected in the future.

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Introduction

Statistically significant variation in either mean standing of the climate or in its variability, sticking over an elongated time period *i.e.* decades or longer is termed as climate change (CC) (Fellino and Salvacoin, 2007). CC is considered as most serious environmental threat globally (IPCC, 2007). Agriculture sector is responsive to the variation in climate. The liaison between climate changes and agriculture sector is holding a major importance, as the world's food production possessions are in stress from swiftly increase in global population (Matthews and Stephens, 2002). IPCC anticipated that overall earth mean temperatures will escalate by 2.8°C during current century while best guessed estimates of increase ranges between 1.8 to 4.0°C (IPCC, 2007a). Climate of Pakistan has also been changing in terms of shift in rainfall pattern from winter to summer and its intensity over the months of the year (Hanif and Ali, 2014). This has shown a change in the cropping pattern and productivity in Pakistan (Akmal et al., 2014). Despite the technological success in the previous half of the 20th century, the key role of weather

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climate towards agricultural production capacities of many economies is still highly susceptible to the predicted CC. The continuing CC is probable to affect drastically the growth, water cycle and output of the staple food crops in many regions of the world (Parry et al., 2004; IPCC, 2007) and in Pakistan in particular where population growth is very high.

Growth and development of crop is supposed to be effected in variety of ways which includes, changes in rainfalls (both spatially and temporally) and direct impacts on crop water cycle which introduce water stress in the crop development (Tao et al., 2003a, b; Hanif and Ali, 2014). Temperature deviation is key determinant of evaporation and transpiration demand (Roderick and Farquhar, 2002). Continuous temperature escalations during cropping season disturb the yield and reduce it (Roberts and Summerfield, 1987). On the other hand, short burst of increasing temperature at vital stages of crop development will enhance infertility and diminishes crop yields (McKeown et al., 2005).

Consequences of climate change on the agriculture sector of developing countries have remained blurred (Gbitibou and Hassan, 2005). Lowly developed countries are vulnerable to climate change as they lack latest technology, efficient resource and institutions (Kurukulasuriya and Rosenthal, 2003). In low-income countries, crop yields are hampered by the changing temperature and rainfall levels, due to low adoptive measures. This vulnerability has been due to the disturbing effects of recent floods and also due to the undefined and extended spells of droughts particularly in the twentieth century (Yesuf et al., 2008). Europe is also facing climate change impacts in its neighborhood. During the last decade, temperature has increased with increase in rainfall patterns in Northern Europe and decreased amount of precipitation in Southern and Eastern Europe (Olesen et al., 2011). Rainfall effects on South African agriculture were positive. Early summer and winter precipitation were useful in South Africa (Benhin, 2008). Bhutan's agriculture dependence on monsoon and temperature change pattern is vital to evaluate because the evidences of climatic change in Bhutan are mostly extreme. Marginal changes in weather extremes are anticipated to bring more losses to the sector in coming phases. The dangerous effects of these adverse factors are concentrated mostly and enormously on agriculture and on food security (Book, 2009). Agriculture sector of India also came across the hampering effects of the disastrous series of the climatic changes throughout the world. Many studies showed that increase in temperature could increase the rice yield but would reduce wheat yields (Guiteras, 2007). Bangladesh agriculture poses serious threats due to climate sensitivities showing negative impacts of climate change on agriculture activities affecting grain production in hundred tons. Sea level rise, increased floods and strong monsoon has affected agriculture production abilities tremendously (World Bank Report, 2006).

Pakistan has a long latitudinal extent that elongates from the Arabian Sea in the south to the Himalayan Mountains in North. It is placed in sub-tropics and partially in temperate region. Most parts of the country hold arid to semi-arid lands with significant spatial and temporal variation in climatic parameters. Country also receives 65% of the annual rainfall during monsoon season from June to August, which is chief water resource for Pakistan (Farooqi et al., 2005; Hanif and Ali, 2014). Pakistan's agriculture Sector comprises of Major crops like rice, cotton, wheat, sugarcane and maize and minor crops like masoor, mung, mash, potato, onion and chilies. Two central crop seasons of Pakistan are the Kharif and Rabi seasons. In Kharif season, sowing begins in April-June and harvesting is done from October to onwards. Rabi Season activates in October-December and harvesting is done in April-May. Kharif crops includes Rice, sugarcane, cotton, maize, mung, mash, bajra and jowar while wheat, gram, lentil (masoor), tobacco, rapeseed, barley and mustard are Rabi crops. Nine agro-climatic zones of Pakistan include the Rice/Wheat Punjab, Mixed Punjab, Cotton/Wheat Punjab, Low Intensity Punjab, Barani Punjab, Cotton/Wheat Sindh, Rice Other Sindh, Other N.W.F.P (now Khyber Pakhtunkhwa) and Other Balochistan. The districts in different provinces are then further distribution of the above mentioned zones (Amjad et al., 2008).

Climatic changes have placed a greater risk to the agriculture sector of Pakistan. It is under threat of climatic unevenness. Production abilities are supposed to be adversely affected at a greater extent in future. Number of studies have been conducted in the past regarding climate change effects on crop sector (Janjua et al., 2010). Ashfaq et al. (2011) reported that a slight increase in rain fall will effect wheat production positively. Increase in mean minimum temperature at sowing stage will increase the production capacities, while production loses were observed when mean maximum temperature increased at mature stages. Siddiqui et al. (2011) evaluated short and long run susceptibility for increase in temperature for wheat productivity. Temperature increase was found valuable for rice production initially but when temperature goes afar a certain optimal temperature the increase becomes harmful for rice production. Precipitation effects for rice crop were found negative. Increase in temperature also effected the sugarcane production negatively.

Maize is one of the important cereal crops of the cropping system in Pakistan. It is used mainly in three forms *i.e.* human food, feed for poultry and livestock. Maize crop is considered as a top yielding cereal crop in the world. Maize has also considerable importance for Pakistan. It is the third chief cereal after wheat and rice. The bulk of Maize production comes from two major provinces, Khyber Pakhtunkhwa (KP) and Punjab; whereas, a small fraction also contributed from Sindh and Baluchistan, therefore Focus of the current study is to quantify impact of climatic variables and evaluating variations in rainfall and temperature on Maize production in Pakistan and also to suggest some policy derivative to cope climatic changes effect both in long and short run.

Materials and Methods

Data Sources

Maize production data (00 t ha^{-1}) were obtained by consulting various publications sources e.g. Economic Survey of Pakistan (1980-2013). Temperature and precipitation variables (e.g. minimum, maximum, and avg. temperatures (^{0}C) and precipitation (mm)) were taken from the Metrological Department of Pakistan for the selected stations where the maize crop is sown and has a major contribution towards the overall production of maize in Pakistan.

Other Explanatory Variables

Non climatic explanatory variables are agricultural credit (Rs. Million), fertilizers used (000 N/tonnes), cultivated area under Maize crop (000 hectares) and water availability for Maize crop (MAF). The data of these non-climatic variables were also gathered from various editions of Economic Survey of Pakistan from the year 1980 to 2013.

Statistical Model

We have employed vector auto regression (VAR) model with the aim to trace maize crop response to climate change. The advantage of VAR method is its presentation of results in detail and also it decomposes the individual effect. This helps in tracing the individual impact of these variables on the Maize production in Pakistan. This method is simple to operate as it involves the OLS dynamics to each equation where the variables are operated as endogenous and are supposed to intermingle with each other.

Below is the general form of VAR model (Sims, 1980):

$$Y_{1t} = \sum_{i=1}^{n} \alpha_i Y_{1,t-i} + \sum_{j=1}^{n} \alpha_j Y_{2,t-j} + \varepsilon_{1t} \dots\dots\dots (1)$$

$$Y_{2t} = \sum_{i=1}^{n} \alpha_i Y_{1,t-i} + \sum_{j=1}^{n} \alpha_j Y_{2,t-j} + \varepsilon_{2t} \dots\dots\dots (2)$$

Akaike information criterion (AIC) and Schwarz information criterion (SIC) suggest taking in one lags in the model. So, VAR model becomes,

$$Y_{1t} = a_{11} Y_{1,t-i} + a_{22} Y_{2,t-j} + \varepsilon_{1t} \dots\dots\dots (3)$$

$$Y_{2t} = a_{21} Y_{1,t-i} + a_{22} Y_{2,t-j} + \varepsilon_{2t} \dots\dots\dots (4)$$

Simple production function advances as follows:

$$MZP = W(t) f(C, L)$$

Where, MZP is Maize production, and is a function of C (capital) and L (labor), While W grabs the impact of the climate change towards Maize production.

The particular structure of the model employed for current study is, Maize Production = f (area under maize crop, Fertilizers used, Agriculture credit, Water availability, Average temperature, Avg. minimum temperature, Avg. maximum temperature, Average rainfall).

The econometric equation will be:

$$MZP = \beta_1 + \beta_2 AU + \beta_3 FR + \beta_4 CD + \beta_5 WA + \beta_6 AT + \beta_7 ATX + \beta_8 ATM + \beta_8 ARN + U_i$$

Where, MZP is production of maize crop, AU is area under maize crop, FR is fertilizer used, CD is agriculture credit, WA is water availability, AT is average temperature in Celsius, ATX is average maximum temperature in Celsius, ATM is average minimum temperature in Celsius, ARN is average rainfall in millimeter.

Results

VAR Model Result

Lag selection criteria and stationarity of variables: Vector Auto-regression (VAR) requires checking of unit roots of all variables. For that reason, stationarity of the variables are checked by using Augmented Dickey-Fuller (ADF). The results from Table 1 showed that some variables are stationary at level though some are at first difference. Avg. temperature, avg. minimum temperature, avg. maximum temperature, average rainfall and area under maize crop are stationary at levels however fertilizer used, Wheat production, credit disbursed and fertilizer used are stationary at 1st difference. AIC and SIC suggested us to use lag one model rather than any other lag model as values of both the criterion was less than any other lag model. AIC and SIC value for our model is -1.91 and -1.459 as shown in Table 1. We, therefore, use one lag VAR model to estimate the long run dynamics of Maize crop production in Pakistan. Results of the VAR in Table 2 showed that though the t-statistics values of all the included variables are not statistically significant ($P<0.05$) at conventional level of significant. However, the F statistic value of the model is very high and also statistically significant so the model is said to a best fit. Also the coefficient of determination ($R^2 > 0.98$) is high enough and adjusted coefficient of determination R^2 is 0.972. Both values strongly support the hypothesis of goodness of fit for the model.

Dynamics: Impulse Response Functions

Cholesky impulse response function verifies the effect of single time shock to one of the innovations on current and future values of the endogenous variables. The outcomes of the impulse response function are presented in Table 3 (Figure 1). From the impulse

Table 1: *Unit root test results*

Variable	At level		At difference		Order of co-integration
	t-Statistics	MacKinnon P-value	t-Statistics	MacKinnon P-value	
MZP	-0.448266	0.9810	-5.353675	0.0008	I(1)
AU	-5.152453	0.0013	--	--	I(0)
FR	-1.551388	0.4952	-3.751353	0.0084	I(1)
CD	-1.951246	0.3050	-3.136010	0.0357	I(1)
WA	-2.611428	0.1015	-7.981737	0.0000	I(1)
AT	-4.488903	0.0059	--	--	I(0)
ATX	-2.895670	0.0570	--	--	I(0)
ATM	-5.113613	0.0012	--	--	I(0)
ARN	-3.017101	0.0439	--	--	I(0)

Table 2: *Result of VAR model*

	PR	AU	FR	CD	WA	AT	ATX	ATM	ARN
PR(-1)	0.815561	-0.014461	-0.155412	0.427343	-0.186023	0.033316	0.105080	-0.021607	0.410611
AU(-1)	-1.161449	0.166310	-0.112616	-0.895502	0.354180	0.005050	-0.127860	0.310401	-1.929312
FR(-1)	0.136825	0.059538	0.349670	0.849321	0.181271	0.140064	0.165397	0.071762	-0.791553
CD(-1)	0.099060	0.019503	0.194896	0.665378	0.034575	-0.030614	-0.051591	-0.018577	0.101071
WA(-1)	0.265116	0.264241	1.094395	-0.884768	0.340067	-0.204506	-0.173320	-0.181092	2.083655
AT(-1)	1.378581	0.592217	-5.317011	-4.539368	-0.466182	0.664740	0.564469	-0.669054	2.539682
ATX(-1)	-0.815705	-0.863347	2.879822	0.599120	0.004626	-0.506208	-0.267875	0.301939	-0.475393
ATM(-1)	-0.335051	0.154419	1.305390	3.885749	0.233255	-0.186935	-0.218208	0.201915	-2.356074
ARN(-1)	0.022978	-0.03431	-0.057496	-0.340565	0.049091	-0.079740	-0.053906	-0.100620	0.390407
C	5.233447	4.677101	3.202989	7.267202	0.985253	3.572010	2.884596	2.919652	7.868363
R^2	0.980767	0.934978	0.970225	0.987520	0.971630	0.671299	0.601637	0.615756	0.393323
Adj. R^2	0.972898	0.908378	0.958045	0.982415	0.960024	0.536830	0.438671	0.458565	0.145138
F-Statistics	124.6488	35.14950	79.65367	193.4275	83.71899	4.992226	3.691781	3.917248	1.584794
SWC	-1.918037	-3.925990	-1.963207	-0.530461	-4.575938	-4.793912	-4.101285	-4.568475	-0.549072
AIC	-1.459995	-3.467948	-1.505164	-0.072418	-4.117895	-4.335870	-3.643243	-4.110432	-0.091029

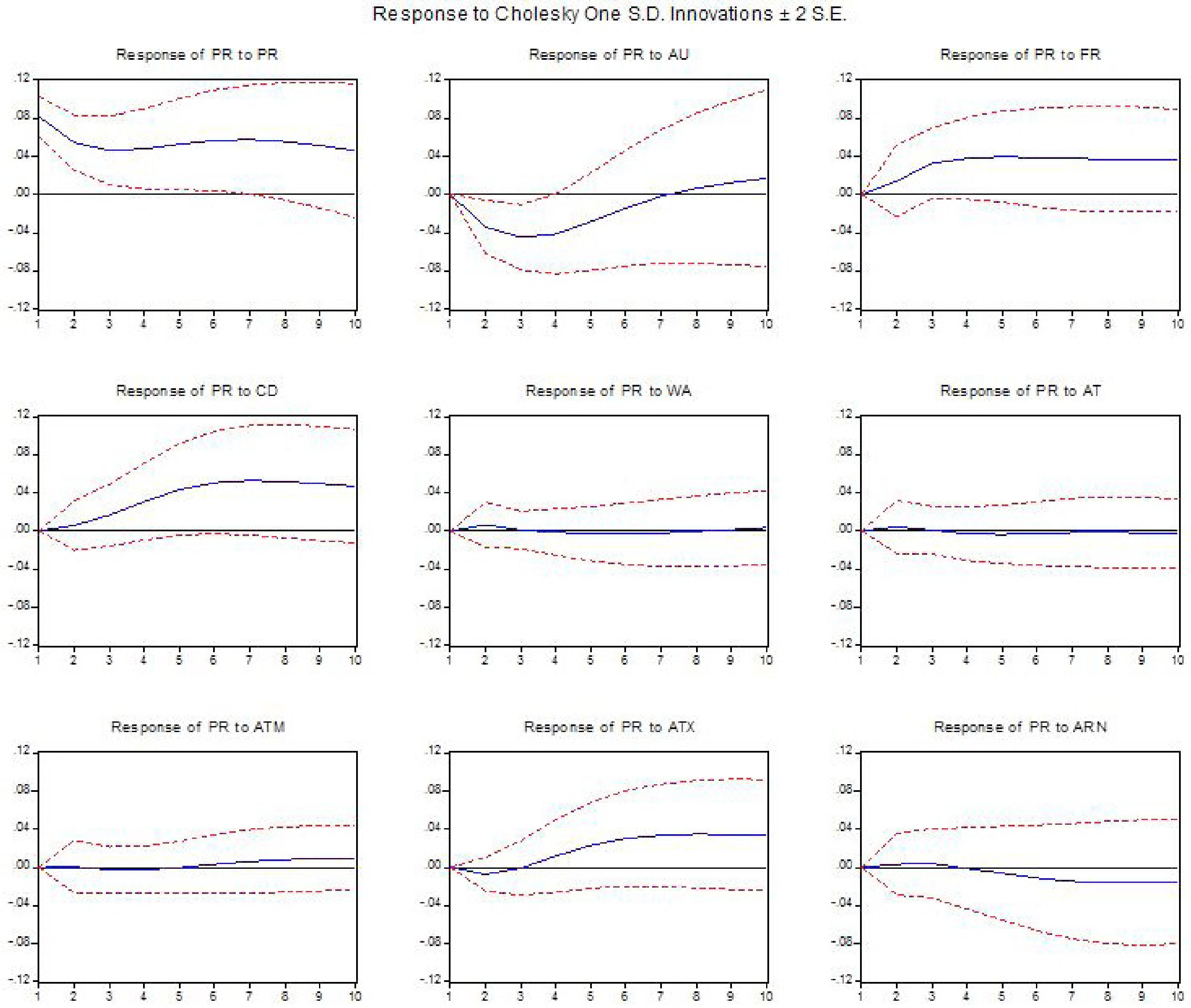

Figure 1: *Graph of impulse response function*

Table 3: *Impulse response function*

Period	PR	AU	FR	CD	WA	AT	ATX	ATM	ARN
1	0.081830	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.054407	-0.033950	0.014273	0.005633	0.006435	0.004136	0.000398	-0.007285	0.003255
3	0.046077	-0.044889	0.032754	0.016411	0.000828	0.000821	-0.002502	-0.000777	0.004134
4	0.047928	-0.041481	0.037816	0.030830	-0.001333	-0.003013	-0.002720	0.011839	-0.001241
5	0.052759	-0.028377	0.039510	0.043563	-0.003104	-0.003593	-0.000176	0.023157	-0.006052
6	0.056698	-0.014002	0.038567	0.050775	-0.003094	-0.002807	0.003298	0.030297	-0.011313
7	0.057623	-0.002023	0.037730	0.052953	-0.002170	-0.001849	0.006257	0.033623	-0.014661
8	0.055562	0.006493	0.037050	0.051919	-0.000506	-0.001605	0.008177	0.034603	-0.016115
9	0.051360	0.012413	0.036568	0.049547	0.001415	-0.002050	0.009229	0.034528	-0.015931
10	0.046006	0.016847	0.035983	0.046901	0.003347	-0.002889	0.009788	0.034108	-0.014867

response function of average temperature and Maize production it is notable that single unit shock in average temperature will die down in period four *i.e.* any increase or decrease in the temperature will affect the Maize production and this effect will die down in period four. The impulse response function of average minimum temperature and Maize production will die out in period three and again becomes positive in period six and never dies down till tenth period. Impulse response of average maximum temperature and Maize production showed that a unit shock in average maximum temperature will die down in period two and becomes positive in period four. After period four it never dies down and remains positive till the last period. Unit shock in Average rainfall for Maize crop will die down in period four and remains till the tenth period. A unit shock in water available for Maize production will die down in period four and becomes positive in period nine. From the impulse response of credit disbursed and fertilizer off take it is understandable that single one standard deviation shock in both fertilizers used and credit disbursed will never dies down throughout the ten periods and has positive effect on Maize production.

Variance Decomposition

The purpose of variance decomposition is to break up the variation on endogenous variables into the component shocks to the VAR. Table 4 expresses comparable results as produced by impulse response function. It is undoubtedly apparent from Table 4 and Figure 2, that most of the variation in Maize production is due to the Avg. maximum temperature which is approximately 9 percent in tenth period. This specifies that in the long run the increase in average maximum temperature will have a significant increase Maize production. The variation in Maize production due to variation in average minimum temperature and average temperature is 0.4 and 0.09% in tenth period. Average precipitation will have a variation of approximately 1.6% in Maize production in period ten.

The non-climatic variables that are the core variables of the study also showed substantial deviation in maize

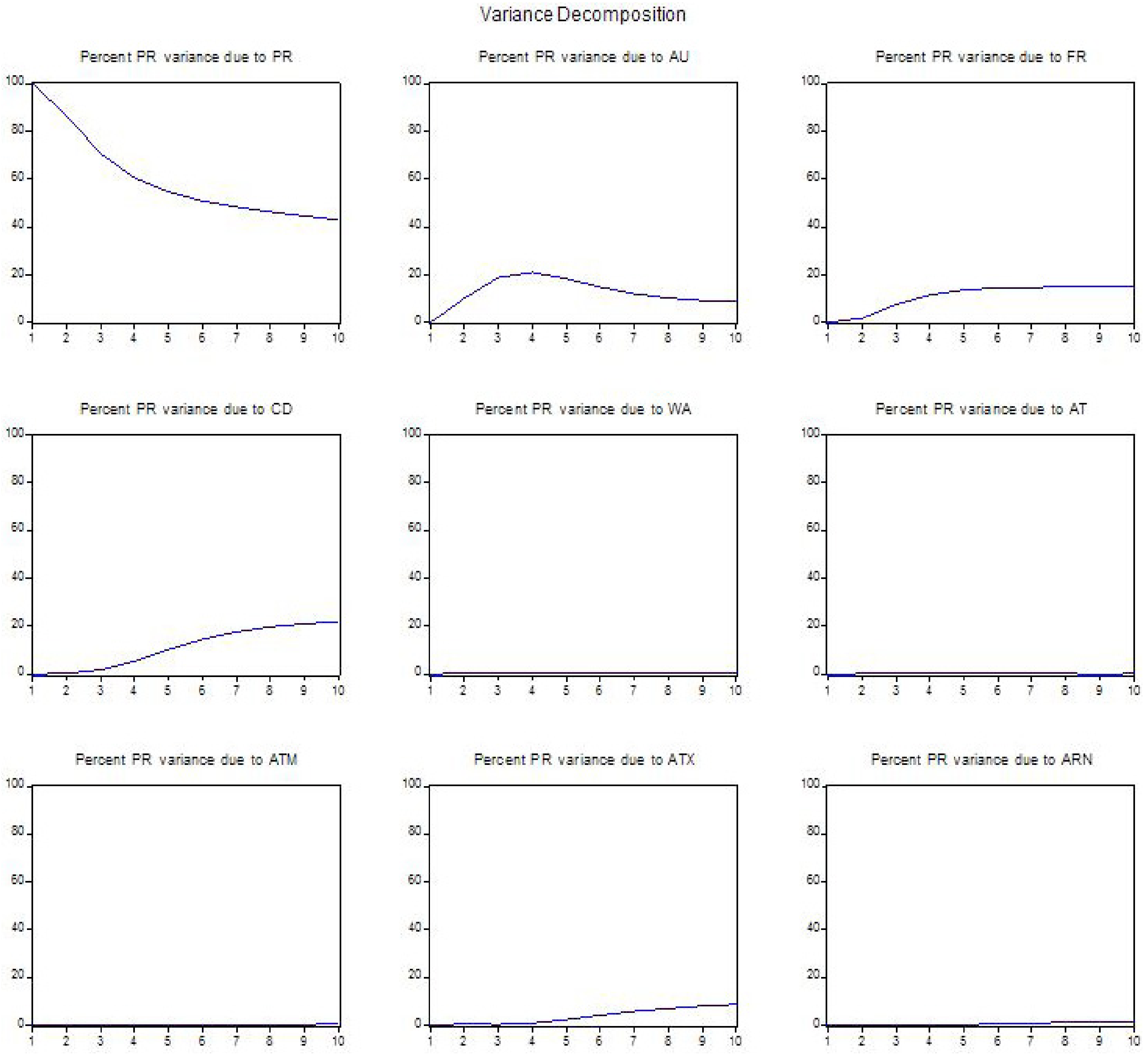

Figure 2: *Graph of variance decomposition*

Table 4: *Variance decomposition.*

Period	S.E.	PR	AU	FR	CD	WA	AT	ATX	ATM	ARN
1	0.081830	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.105673	86.47423	10.32170	1.824215	0.284149	0.370839	0.153223	0.001416	0.475325	0.094903
3	0.129121	70.65281	18.99934	7.656461	1.805660	0.252489	0.106669	0.038502	0.321985	0.166084
4	0.152416	60.59502	21.04241	11.65083	5.387542	0.188859	0.115639	0.059469	0.834409	0.125830
5	0.175709	54.61007	18.44152	13.82281	10.20052	0.173310	0.128824	0.044847	2.364770	0.213329
6	0.198555	50.92015	14.93913	14.59766	14.52754	0.160003	0.120868	0.062715	4.180252	0.491679
7	0.219929	48.36821	12.18491	14.84129	17.63818	0.140147	0.105582	0.132064	5.744452	0.845162
8	0.238942	46.38436	10.39679	14.97772	19.66432	0.119179	0.093960	0.228997	6.963821	1.170850
9	0.255371	44.65284	9.338295	15.16294	20.97986	0.107407	0.088700	0.331092	7.924637	1.414221
10	0.269461	43.02033	8.778154	15.40196	21.87272	0.111897	0.091162	0.429325	8.719830	1.574621

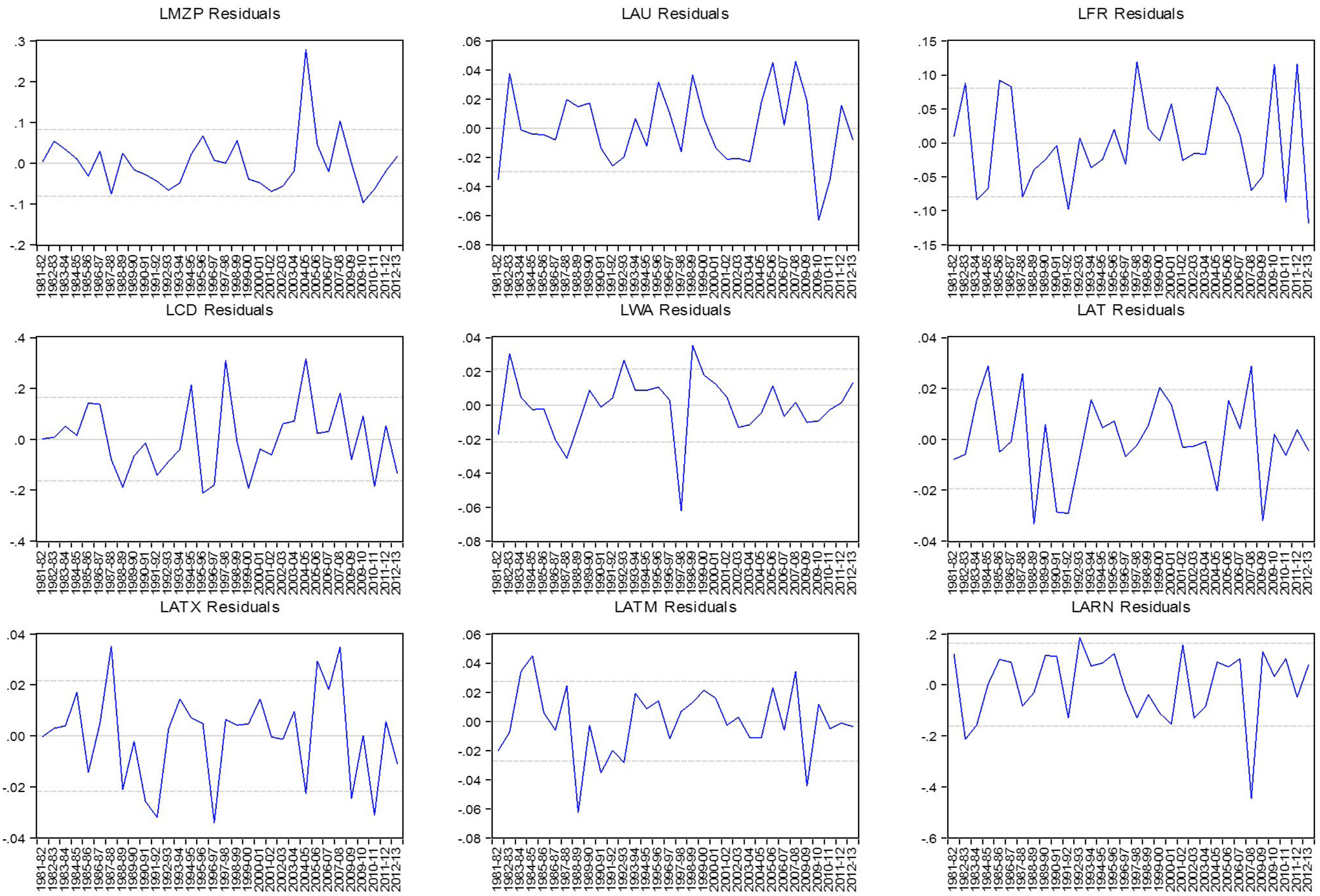

Figure 3: *Plot of AR root test*

Table 5: *Simulation scenarios*

Scenarios	% Increase in production	% Decrease in production
Average temperature increases from 2^0C to 4^0C	-	5.8 %
Average temperature increases from 4^0C to 5^0C	-	10.4%
Average rainfall increases from 5 percent to 10 percent	0.3%	-
Average rainfall increases from 10 percent to 15 percent	1.9%	-

production due to variation in water availability (0.37%) in third year when evaluated from the base year. Maize cultivated area may cause 21 percent variation in period four while fertilizer take off and credit disbursed will bring about 15% and approximately 22% in period ten.

Simulation Scenarios for Year 2030

Different simulation scenarios for the year 2030 have been considered. In first scenario it was assumed that temperature would increase from 2-4^{0}C while in second scenario temperature increase from 4-5^{0}C was

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considered. Scenario three explains a rainfall increase from 5-10% increase, while in scenario four rainfall increases from 10-15% was taken. It was evident from Table 5 that when temperature increased from 2-4^{0}C up to year 2030, Maize production decreased by 5.8%, while in scenario two temperature increased from 4-5^{0}C till 2030, Maize production decreased by 10.4%. In rainfall scenarios when rainfall increased from 5-10%, Maize production increased by 0.3% and when rainfall increased from 10-15% increase was about 2%.

Residual Diagnostics

Residuals correlation matrix and Residuals Graph: Table 6 gave us the residuals correlation matrix between the variables of the estimated model. From the results it is clear that there is no high correlation found between any of the variables. Similarly, Figure 3 (residual graph) showed that all the residuals plots are within acceptable band *i.e.* are random which confirms that the VAR model used is good fit.

AR roots test: Figure 4 (residual graph) Reports the inverse roots of the characteristic AR polynomial; Lütkepohl (1991). The estimated VAR is stable (stationary) if all roots have modulus less than one and lie inside the unit circle. From Figure 4, we can see that all the roots lie within the unit circle which confirms the stability of the estimated VAR model.

Discussion

From the above empirical investigation, it is evident that expected changes in climatic parameters are going to have considerable effects on Maize crop production in Pakistan. From results of impulse response function and variance decomposition and also the climate change scenarios for the year 2030, it can be gather that average temperature is going to affect Maize crop negatively in short run explained by impulse response and variance decomposition and also in the long runs till year 2030. Simulation scenarios showed that temperature increase from 2 to 4^{0}C will reduce Maize production by 6 percent from the base year. Oseni and Masarirambi (2011) evaluated that increasing mean temperature will decrease Maize production at their set of climatic conditions in Swaziland. Makadho (1996) found that increase in temperature along with decreasing rainfall will also threat Maize production in Zimbabwe. Average rainfall will have positive effect towards Maize production in long run, while in short run Average Rainfall showed negative effect but the variation brought in Maize production by variation in rainfall was maximum 1.5 percent in short run, which was not highly significant.

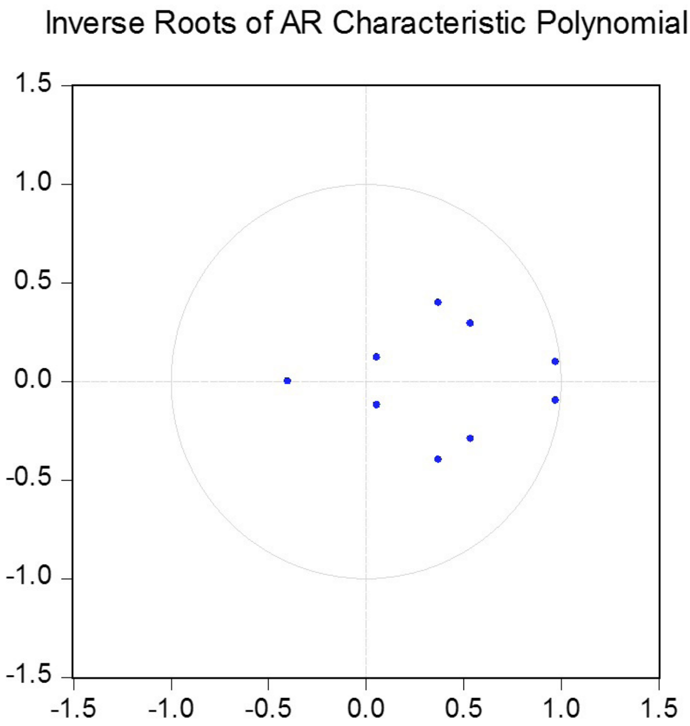

Figure 4: *Plot of residuals of VAR model*

Table 6: *Residuals correlation matrix*

LMZP	LAU	LFR	LCD	LWA	LAT	LATX	LATM	LARN
1	0.55	0.159	0.42	0.09	-0.07	-0.03	0.02	-0.12
0.55	1	0.00	-0.03	0.31	0.24	0.30	0.17	-0.26
0.15	0.00	1	0.51	-0.12	-0.04	0.11	-0.001	0.069
0.42	-0.03	0.51	1	-0.38	0.11	0.28	0.24	-0.18
0.09	0.31	-0.12	-0.38	1	0.11	-0.02	0.08	0.04
-0.07	0.24	-0.04	0.11	0.11	1	0.82	0.91	-0.34
-0.03	0.30	0.11	0.28	-0.02	0.82	1	0.67	-0.32
0.02	0.17	-0.00	0.24	0.08	0.91	0.67	1	-0.37
-0.12	-0.26	0.06	-0.18	0.04	-0.34	-0.32	-0.37	1

In long run when rainfall increased from 10 to 15 percent, Maize production increased up to 2 percent from the base year. Sowunmi and Kintola (2010) evaluated that increase in rainfall will lead to grow more Maize in Nigeria in the long run. Average maximum temperature showed highest of the variation in Maize production from all the climatic variables introduced, which was about approximately 9 percent. Average minimum temperature was found to be beneficial for Maize production. Increasing minimum temperature showed positive effects. The variation brought in Maize production due to the variation in average maximum temperature was only 0.5 percent. It was also evident from results reported above that time availability of water will definitely enhance Maize production. Fertilizer used and credit availability will also significantly add towards Maize production which brought about 15 percent and 22 percent variations in Maize productions. The scenario requires efficient employment of farming practices that suits best to the current farming structure of Pakistan land tenure.

Conclusions

From model calculations, it is concluded that newly up-and-coming risk of CC may pressure the intensity of Maize production in Pakistan. Most importantly, the temperature component will produce alarming effects on Maize production for coming 15 years. average temperature was found to be effecting Maize crop negatively bringing about 10% reduction in maize production till the year 2030. Average minimum temperature brought about 9% increases in maize production till 2021 clearly indication the advantageous effects of average minimum temperature. Increase in overall rainfall also benefited Maize crop production. Maize production will increase by 2% by the year 2030 from the base year *i.e.* 1980. Water availability in the crop growth periods and fertilizer application (today or in the future) will certainly increase its production. Coping emerging hazard of CC towards the maize crop production in Pakistan requires adaptation policies. Some strategic measures are necessary to safeguard climate change impacts. Fertilizer management and appropriate variety selection for the agro-ecological zones are the factors that help to alleviate Maize yield losses. Maize crop sowing time has to be adjusted accordingly for the region in Pakistan. Water conservation management should enhance to conserve water controlling expected floods in the country which may adversely affects other crops in addition to maize.

Limitations and Future Implications

The current study evaluated the climate change effects on maize crop production by using average seasonal monthly data. It is recommended that, in order to get more sensitize climate change impacts, daily data should be used in further studies. The climate change studies could also be extended to minor crops as they also contribute significantly towards the agriculture share of GDP.

Authors' Contributions

US identified the research idea, research gap, developed a research plan and organized the study. AS provided with the sound theoretical and empirical frame work. NK did literature review. MR helped in empirical analysis. ZH helped us in reviewing and incorporating the reviewer's comments and AR contributed in writing of the manuscript.

Conflict of Interests

Authors have declared no conflict of interest.

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