ANALYZING THE IMPACT OF ECONOMIC AND CLIMATIC FACTORS ON CHICKPEA SUPPLY IN KHYBER PAKHTUNKHWA, PAKISTAN: AN EMPIRICAL INVESTIGATION AND POLICY IMPLICATIONS

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ABSTRACT

This study investigates the impact of economic and climatic factors on chickpea supply in the Southern zone of Khyber Pakhtunkhwa, Pakistan, using a comprehensive empirical analysis. Utilizing data spanning from 1980 to 2016, the study employs various econometric techniques, including Auto Regressive Distributed Lag (ARDL) modeling, to unravel the long-run and short-run elasticities of chickpea supply concerning key variables. The findings from the long run regression analysis reveal that the chickpea supply (production) exhibits a positive and statistically significant relationship with its own price, indicating price elasticity. Conversely, the price of the competitive crop, wheat, exerts a negative and significant influence on chickpea production. This underscores the importance of price support mechanisms and crop diversification policies. The study also underscores the significance of climatic factors, with minimum temperature positively impacting chickpea production and maximum temperature adversely affecting it. Precipitation demonstrates a positive relationship with chickpea production. In the short run, lagged production, chickpea price, and wheat price exhibit notable effects on chickpea supply, along with temperature fluctuations. In light of these findings, the study recommends for effective price stabilization mechanisms, crop diversification, climate-resilient farming practices, and risk mitigation strategies. These recommendations aim to enhance the sustainability and resilience of chickpea agriculture in the region.

Keywords: Chickpea Supply; Price Elasticity; Climate Impact; Time Series Analysis; ARDL Model; Khyber Pakhtunkhwa, Pakistan

Highlights:

- Chickpea production in Khyber Pakhtunkhwa varies a lot with changes in climate. This means farmers need to adapt to different conditions to grow chickpeas successfully.
- Market prices have a big influence on how much chickpea is grown, and this can affect the availability and price of chickpeas in the market.

INTRODUCTION

Agriculture remains one of the core segments across the globe, directly or indirectly involving a substantial portion of the world's population for their livelihoods (Ahmed, 2011). This sector holds an essential role, particularly in developing countries, as it not only serves as an economic cornerstone but also directly impacts food security and shelter for the world's population (Spash, 2007). With the global population projected to exceed 9 billion by 2050 (Merga and Haji, 2019), the demand for food is expected to rise exponentially, underlining the critical importance of agriculture in sustaining human existence.

Like many other developing nations, Pakistan's agriculture assumes a central role in the economy. It contributes significantly to both labor participation and Gross Domestic Production (GDP). In the year 2019-20, the agriculture sector contributed 19.3% to Pakistan's GDP, with a workforce participation rate of 38.5%, and approximately 70% of the population directly or indirectly dependent on it (Government of Pakistan, 2020). This sector not only feeds the nation but also provides raw materials for various industries, making it a prerequisite for economic stability and growth.

The performance of the agriculture sector can significantly impact the standard of living of rural communities, alleviating poverty and improving socio-economic conditions. Enhancing agricultural production to meet the rising demand is a key policy objective and central to achieving this goal is the concept of supply response, a crucial driver for production increase and price regulation (Nerlove and Bachmen, 1960). In less developed countries like Pakistan, achieving a robust supply response in the agriculture sector is essential for sustainable economic development (Anwarulhuq et al., 2013) and for addressing issues related to poverty and growth (Tripathi, 2008).

Pakistan's agricultural policies aim to ensure fair incomes for farmers, reasonable food prices for urban consumers, affordable raw materials for manufacturing, and increased exports (Mushtaq and Dawson, 2003). A huge empirical literature exists on agricultural supply response, with numerous studies focusing on Pakistan (Mushtaq and Dawson 2002; Mohammad et al., 2007; Nosheen et al., 2008; Sadiq et al., 2013; Riaz et al., 2014; Khan et al., 2018; Waqas et al., 2019), using time series data. This study also contributes to this field by investigating how price and climatic factors affect the producer response in the case of chickpea cultivation in Khyber Pakhtunkhwa.

Chickpea holds a significant place in the Khyber Pakhtunkhwa's agriculture, serving as a crucial component of both the financial and nutritional well-being of farming communities, particularly in the southern zone. Given its high demand and the fact that it is primarily grown in unirrigated regions, chickpea emerges as the optimal choice for utilizing such land. Surprisingly, there has been no prior research conducted on the supply response of chickpea cultivation in Khyber Pakhtunkhwa. This study seeks to bridge this gap by examining how farmers allocate their land to chickpea cultivation in response to price variations and environmental factors such as precipitation and temperature.

In the context of ongoing agricultural policy reforms and the need to boost agricultural growth and productivity, this research underscores the importance of supply response analysis and sheds light on the incentives and impacts of policies on agricultural production and offers insights into strategies that can be adopted to direct the changing agricultural scene effectively.

METHODOLOGY

Study Area

This study focuses on the southern zone of Khyber Pakhtunkhwa (KP), Pakistan, which is the primary region for chickpea production, accounting for 90-95% of the total output. This area includes several districts, such as D.I. Khan, Lakki Marwat, Tank, Bannu, Karak, and Kohat. Chickpeas are typically sown during October and November and harvested in the summer. In most of Khyber Pakhtunkhwa, chickpeas are cultivated on unirrigated land, except for D.I. Khan, where irrigation covers 5,402 hectares, yielding a production of 4,322 tonnes (Government of Khyber Pakhtunkhwa, 2018-19).

Data Sources

This research utilizes annual data spanning from 1980 to 2016, covering key variables such as chickpea production, chickpea cultivation area, chickpea and wheat prices, temperature, and precipitation. These data sources are obtained from various secondary sources, including the Food and Agriculture Organization (FAO) statistics for crops, Crop Reporting Services (CRS), Agricultural Statistics of Pakistan, and Development Statistics of Khyber Pakhtunkhwa, Pakistan Bureau of Statistics (Food, Agriculture & Livestock Division), Agricultural Policy Institute (API), and the Regional Meteorological Department (RMD) office in Peshawar.

Data Analysis

Conceptual Framework

Earlier studies on supply response of agricultural inputs and production used the Nerlovian model, proposed by Dale W. Jorgenson and Daniel S. Holland in 1971. It is a basic econometric framework that explores the short-run and long-run relationships between input use and output in agriculture. It is primarily used to analyze the response of agricultural production to changes in input prices and other factors. It assumes equilibrium conditions in the long run; however, it does not explicitly address the issues of stationarity or the dynamic nature of economic variables. Dynamic and lagged effects, which are often present in real-world economic systems. This is where the ARDL model comes into play.

The ARDL model is a dynamic econometric framework that is well-suited for modeling economic relationships over time, especially when dealing with non-stationary time series data. Stationarity is a fundamental concept in time series analysis. A stationary time series is one whose statistical properties (mean, variance, etc.) remain constant over time. In many economic time series, including those related to agriculture, stationarity is not always met. Non-stationary time series exhibit trends, seasonality, or other patterns that change over time. Variables like chickpea production, prices, and weather conditions often show non-stationary behavior.

In the ARDL model, you can explicitly model and test for the order of integration (I) of the variables, commonly referred to as I(0) for stationary and I(1) for non-stationary. This is crucial for selecting the appropriate lag structure and ensuring the model's statistical validity.

Chickpea supply, chickpea prices, weather variables (precipitation, temperature), and other economic indicators in KP may exhibit non-stationary behavior due to factors like seasonality, technological advancements, and market dynamics. Using the ARDL model allows you to work with non-stationary data by differencing the variables if necessary.

Chickpea production is likely influenced by past conditions, including weather patterns and prices. The ARDL model's ability to incorporate lagged values of variables is crucial for capturing these delayed effects and understanding how past conditions affect the current supply.

The ARDL model can distinguish between short-run and long-run relationships, which is vital when analyzing agricultural supply. It can reveal how immediate changes in variables impact chickpea supply while also identifying the equilibrium relationship in the long run.

ARDL allows you to test for cointegration, a phenomenon where non-stationary variables have a long-run relationship. Cointegration analysis is relevant when examining the equilibrium relationships between chickpea supply and its determinants over time.

Understanding the dynamic relationships between chickpea supply, prices, and weather conditions in KP can have significant policy implications for farmers and policymakers. The ARDL model's ability to capture these dynamics can inform more effective agricultural policies.

Econometric Analysis

The ARDL model for chickpea supply response is given below:

$$\Delta lnqucht = \propto o + \delta 1 lnaucht - i + \delta 2 lnprcht - i + \delta 3 lnprwt - i + \delta 4 lnprect - i + \delta 5 lnMaxtt - i + \delta 6 lnMintt - i + \delta 7 lnauncht - i + \sum_{i=1}^{n} \beta_1 \Delta\, lnqucht - I + \sum_{i=1}^{n} \beta_2 \Delta\, lnprcht - i + \sum_{i=1}^{n} \beta_3\, \Delta lnprwt - i + \sum_{i=1}^{n} \beta_4\, \Delta lnprect - i + \sum_{i=1}^{n} \beta_5 \Delta\, lnMaxtt - i + \sum_{i=1}^{n} \beta_6 \Delta\, lnMintt - i + \sum_{i=1}^{n} \beta_7 \Delta\, lnauncht - i$$

$where$;

- $'quch(t)' is\ supply\ (production\ of\ chickpea\ in\ year\ t;$
- $'aunch'\ area\ under\ chickpea\ cultivation$
- $'prch'\ is\ its\ per\ unit\ price;$
- $prw\ is\ wheat\ price\ per\ unit; pre\ in\ precipitation$
- *Maxt is maximum temperature and*
- *Mint is minimum temperature*
- *ln stands for natural-log, Δ is the difference operator,*
- *t-i is used for the lags*

Short-run dynamics are shown by coefficients $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ and β_7. Long-run relationship is shown by δ_1-δ_7. After the estimation of bound test; with the null hypothesis of no cointegration, F-statistics is used to check the long run relation among variables.

$H_o = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$

$H_1 = \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq 0$

Upper and lower are two critical bounds in order to accept or reject the null hypothesis. The null hypothesis is rejected when the F-statistics value is larger than the upper bound at 5% level of significance. If the F-statistics value is below the lower bound then the null hypothesis is failed to reject rather we accept it. Moreover, if the value of F-statistics falls in between the upper and lower bound the test is then inconclusive; no decision can be made for the LR association among the variables. This study is oriented about LR which is why SR and LR elasticities were estimated.

Long and short run elasticities

The below equation was used to estimate the long-run elasticities among variables:

$$lnquch_t = \propto_o + \sum_{k=1}^{m} \delta_1 lnprch_{t-i} + \sum_{k=1}^{m} \delta_2 lnprw_{t-i} + \sum_{k=1}^{m} \delta_3 lnprec_{t-i} + \sum_{k=1}^{m} \delta_4 lnmaxt_{t-i} + \sum_{i=1}^{n} \delta_5 lnmint_{t-i} + \sum_{k=1}^{m} \delta_6 lnaunch_{t-i} + U_{it} \quad (9)$$

In equation (3.10) δ_i shows the long run elasticities. For the lag selection AIC, HQ information Criterion were followed. For short-run elasticities the following equation was used:

$$\Delta lnquch_t = \propto_o + \sum_{k=1}^{m} \beta_1 \Delta lnquch_{t-i} + \sum_{k=1}^{m} \beta_2 \Delta lnprch_{t-i} + \sum_{k=1}^{m} \beta_3 \Delta lnprw_{t-i} + \sum_{k=1}^{m} \beta_4 \Delta lnprec_{t-i} + \sum_{k=1}^{m} \beta_5 \Delta lnmaxt_{t-i} + \sum_{k=1}^{m} \beta_6 \Delta lnmint_{t-i} + \sum_{k=1}^{m} \beta_7 \Delta lnaunch_{t-i} + \lambda ECT_{t-i} + e_t \quad (10)$$

Where βs are the short-run elasticities, ECT. The speed of adjustment towards long-run is shown by λ and it range from 0 to 1.

Diagnostic tests

DW test was conducted for Auto correlation, Bruesch-Godfrey LM for serial-correlation, Jarque-Bera test of normality, White test for heteroskedasticity and for structural break CUSUM and CUSUMSQ were used.

RESULTS DISCUSSION

Summary Statistics

Table 1 provides an essential overview of the variables utilized in supply response analysis for chickpea growers. The mean production of chickpea is approximately 30,870 tons, with a considerable standard deviation of 18,870 tons, indicating substantial variability in production. Chickpea prices range from 458.53 to 14,293.75 Pakistani rupees (PKR)/100kg, displaying a wide price fluctuation. Similar variability can be seen in the area under chickpea cultivation, with a mean of 69,440 hectares and a standard deviation of 29,980 hectares. Temperature and precipitation data show less variation but remain important factors for the analysis.

Table 1 Descriptive statistics of the variables

Variable	Units	Mean	Std. Dev.	Min	Max
production of chickpea (quch)	'000' tons	30.87	18.87	0.6	81.8
price of chickpea (prch)	Rs/100kg	3904.39	2684.71	458.53	14293.75
price of wheat (prw)	Rs/100kg	1189.79	1150.76	141.17	3997.38
area under chickpea (aunch)	'000' ha	69.44	29.98	27.1	123.7
minimum temperature (mint)	°C	11.69	0.677	10.07	12.70
maximum temperature (maxt)	°C	26.60	0.752	24.91	27.87
precipitation (prec)	Mm	24.93	7.127	7.791	37.75

Source: Authors' estimates from data, 1980-2016.

Unit Root Tests (ADF and PP Tests)

The Augmented Dickey-Fuller (ADF) unit root test was employed to determine stationarity in the time series data. The results are detailed in Tables 2. At the level, ADF test results indicate that variables such as lnquch, lnaunch, lnprch, and lnprw are non-stationary as their ADF statistics are higher than the critical values. Conversely, lnmint and lnmaxt are stationary at this level since their ADF statistics are below the critical values. After taking the first difference, all variables become stationary, confirming their integration order of I(1). The stationarity test suggests using the integrated order I(1) variables in the time series analysis.

Table 2. ADF test Output

At Level				
Series	**ADF statistics**	**Mackinnon critical value**	**Prob.**	**Conclusion**
lnquch	-1.390	-2.972	0.5872	Non stationary
lnaunch	-0.002	-2.972	0.9583	Non stationary
lnprch	-0.402	-2.972	0.9097	Non stationary
lnprw	-0.432	-2.972	0.9045	Non stationary
lnmint	-3.268	-2.972	0.0164	Stationary
lnmaxt	-3.866	-2.972	0.0023	Stationary
lnprec	-1.698	-2.972	0.4322	Non stationary
At First Difference				
lnquch	-4.943	-2.975	0.000	Stationary
lnaunch	-5.041	-2.975	0.000	Stationary
lnprch	-4.867	-2.975	0.000	Stationary
lnprw	-4.450	-2.975	0.0002	Stationary

Source: Authors' estimates from data, 1980-2016.

Lag Order Selection (VAR)

Table 3 displays the lag order selection results obtained through Vector Auto Regression (VAR). Lag order selection is crucial for determining the number of lags to be included in the model.

Various criteria, including the Final Prediction Error (FPE), Akaike Information Criteria (AIC), Hannan-Quinn (HQ), sequential modified LR test statistics, and Schwarz Criteria (SC), were considered. These criteria consistently suggest that including three lags in model is appropriate for estimating both short-run elasticities.

Selecting the optimal lag order is essential to ensure the accuracy of analysis. The chosen three lags strike a balance between capturing relevant information in the data and preventing over fitting, ensuring that the model is well-suited for supply response analysis.

Table 3 Lag order selection (VAR)

Lags	LogL	LR	FPE	AIC	SC	HQ
0	131.144	NA	1.59e-12	-7.302	-6.988	-7.195
1	251.678	184.345*	2.52e-14	-11.510	-8.996*	-10.653
2	302.190	56.4548	3.41e-14	-11.599	-6.885	-9.991
3	385.149	58.5491	1.65e-14*	-13.596*	-6.682	-11.238*

Source: Authors' estimates from data.

Bound Test

The results from the Bound Test, presented in Table 4, verifying the existence of a long-run relationship between the dependent and explanatory variables. At all significance levels (10%, 5%, and 1%), the F-statistic value exceeds the critical values, indicating a strong long-run association among the variables. This finding is crucial for supply response analysis, as it justifies the use of the Auto Regressive Distributed Lag (ARDL) model to estimate both short-run and long-run elasticities.

Table 4. Bound Test

Test Statistic	Value	K
F-statistic	16.625	6
	Critical Value Bounds	
Significance	I0 Bound	I1 Bound
10%	2.12	3.23
5%	2.45	3.61

1%	3.15	4.43

Source: Author's estimates from data, 1980-2016.

Long-Run Elasticities

Table 5 presents the long-run elasticity results derived from the ARDL model, shedding light on the relationships between various factors and chickpea production in the long term.

- Price of Chickpea (lnprc): The long-run analysis reveals a positive and statistically significant relationship between the price of chickpea and chickpea supply (production). The coefficient value of 4.704 indicates that a 1% increase in chickpea price results in a 4.704% increase in chickpea production. Such elasticity signifies that chickpea production is responsive to changes in its price, implying that higher prices can incentivize farmers to produce more chickpea. These findings align with previous research by Fahimifard et al. (2011), Khan et al. (2018), and Waqas et al. (2019).

- Wheat Price (lnprw): In contrast, the wheat price shows a negative and statistically significant impact on chickpea production, with a coefficient of -5.644. This suggests that a 1% increase in wheat price leads to a 5.644% decrease in chickpea production. Wheat is considered a competitive crop to chickpea in unirrigated areas of Khyber Pakhtunkhwa, and this elasticity indicates that it has an elastic effect on chickpea production. These results support the findings of previous studies, including Fahimifard et al. (2011), Khan et al. (2018), and Waqas et al. (2019).

- Area under Chickpea (lnaunch): The area under chickpea cultivation exhibits a positive and statistically significant impact on chickpea production, with a coefficient of 1.13. This implies that a 1% increase in the area under chickpea leads to a 1.13% increase in chickpea production. This finding is in line with the results of Shahzad et al. (2018) and Waqas et al. (2019). It suggests that expanding the cultivation area dedicated to chickpea can boost its production.

- Minimum Temperature (lnmint): Minimum temperature positively and significantly affects chickpea production, with a coefficient of 34.89. A 1% increase in minimum temperature results in a substantial 34.89% increase in chickpea production. These results are consistent with studies by Covell et al. (1985) and Singh and Diwakar (1995), which found that chickpea production benefits from minimum temperatures in the range of 10-15°C.

- Maximum Temperature (lnmaxt): Maximum temperature has a negative but statistically significant effect on chickpea production, with a coefficient of -27.409. This indicates that a 1% increase in maximum temperature could decrease chickpea production by 27.40%. These findings are consistent with research by Karla et al. (2008), Basu et al. (2009), Gaur et al. (2013), and Chandio et al. (2021), which highlighted the detrimental impact of high temperatures on chickpea production.

- Precipitation (lnprec): Precipitation positively and significantly influences chickpea production, with a coefficient of 2.017. A 1% increase in precipitation leads to a 2.01% increase in chickpea production. These results align with the findings of Muchapondawa (2009), Fahimifard et al. (2011), and Zhang et al. (2017), suggesting that adequate rainfall is beneficial for chickpea production.

In summary, the long-run elasticity results highlight the complex interplay of various factors on chickpea production. While price, area under cultivation, and climate variables like temperature and precipitation play significant roles, they can have both positive and negative effects on production. These findings are valuable for policymakers and farmers seeking to enhance chickpea production and profitability.

Table 5. Long-run Chickpea Supply Elasticities

Variables	Coefficient	Std. Errors	t-ratios	Prob.
lnaunch	1.130	0.376	3.00	0.015
lnprc	4.704	1.826	2.58	0.030
lnprw	-5.644	2.111	-2.67	0.026
lnmaxt	-27.409	11.371	-2.41	0.039
lnmint	34.890	12.024	2.90	0.018
lnprec	2.017	0.708	2.85	0.019
Constant	-3.331	11.176	-0.30	0.772

Source: Authors' estimates from data, 1980-2016.

Short-Run Elasticities

Table 6 presents the results of short-run elasticities in relation to chickpea production using the ARDL model. These findings provide understandings into the immediate effects of various factors on chickpea production in the short term. Results revel that in short-run, the lagged value of chickpea production, chickpea prices, both minimum and maximum temperatures and precipitations have negative significant effects on chickpea supply. While, the lagged value of area under chickpea cultivation and wheat prices demonstrates a positive and significant relationship with chickpea supply in the short term.

The Error Correction Term (ECT) value of -0.48 suggests that chickpea supply will adjust to equilibrium level by 48% after changes in explanatory variables. The high R-squared value of 0.97 signifies that 97% of the variation in chickpea production can be explained by the given independent variables. Furthermore, tests for normality, autocorrelation, and heteroskedasticity indicate that the model assumptions are generally met. The Jarque-Bera test suggests that residuals follow a normal distribution, the Durbin-Watson statistic indicates no autocorrelation, and the Breusch-Godfrey LM test and White test for heteroskedasticity support the validity of the model.

In summary, the short-run elasticities reveal the immediate effects of various factors on chickpea production. Price sensitivity, temperature fluctuations, and lagged production are some of the key drivers of short-term changes in chickpea production.

Table 7 Short-run elasticities

Variables	Coefficients	Std. Errors	t-ratio	Prob.
D(lnquch)	-0.325	0.127	-2.55	0.031
D(lnprc)	-1.751	0.230	-7.58	0.000
D(lnprc (-1))	-1.879	0.282	-6.66	0.000
D(lnprc (-2))	-1.054	0.174	-6.06	0.000
D(lnprw)	1.076	0.222	4.85	0.001
D(lnprw (-1))	1.459	0.283	5.14	0.001
D(lnprw (-2))	0.889	0.231	3.85	0.004
D(lnaunch)	0.244	0.216	1.13	0.287
D(lnaunch (-1))	0.437	0.178	2.45	0.037
D(lnaunch (-2))	-0.233	0.165	-1.41	0.193
D(lnmaxt)	-4.960	2.188	-2.27	0.050
D(lnmaxt (-1))	2.189	2.852	0.77	0.462
D(lnmint)	-4.727	1.307	-3.38	0.008
D(lnmint (-1))	-12.320	1.788	-6.89	0.000
D(lnmint (-2))	-2.635	0.641	-4.11	0.003
D(lnprec)	-0.298	0.259	-1.15	0.279
D(lnprec (-1))	-0.898	0.302	-2.97	0.016
Cointeq(-1)	-0.480	0.151	-3.18	0.011
R squared = 0.97 ; Adjusted R squared = 0.91				
Jarque-Bera statistics p-value = 0.74				
DW statistics = 0.60				
Breusch-Godfrey serial correlation LM test p-value = 0.13				
White Heteroscadasity test p-value = 0.36				

Source: Authors' estimates from data, 1980-2016.

CONCLUSIONS AND POLICY RECOMMENDATIONS

The empirical analysis conducted in this study has yielded valuable insights into the impact of economic and climatic factors on chickpea supply. In the long run, chickpea supply is positively associated with changes in its own price. A 1% increase in chickpea price led to a 4.704% increase in chickpea production. This indicates that chickpea supply is price elastic in the long run. The price of wheat has a negative and significant impact on chickpea production. A 1% increase in wheat price resulted in a 5.644% decrease in chickpea production. Wheat is a competitive crop in unirrigated areas of Khyber Pakhtunkhwa, and its effect on chickpea production is elastic. Minimum temperature has a positive and significant impact on chickpea production. A 1% increase in minimum temperature resulted in a substantial 34.89% increase in chickpea production. Maximum temperature had a negative and significant effect on chickpea production. A 1% increase in maximum temperature could lead to a 27.40% decrease in chickpea production. High temperatures are detrimental to chickpea yields. Precipitation positively and significantly affects chickpea production. A 1% increase in precipitation resulted in a 2.01% increase in chickpea production.

Based on the empirical findings, the following policy recommendations can be made:

- Implementation of price support mechanisms for chickpea to stabilize prices and encourage production. Farmers should be provided with fair and consistent prices for their produce to incentivize chickpea cultivation.
- Promotion of crop diversification by encouraging farmers to grow chickpea alongside wheat. This can help mitigate the negative impact of wheat price increases on chickpea production.
- Dissemination of climate-resilient farming practices to help chickpea farmers adapt to temperature variations. This includes advising on suitable planting times and heat-tolerant chickpea varieties.
- Improvement in water management practices to mitigate the effects of changing precipitation patterns. Investing in irrigation infrastructure can help ensure stable chickpea production.
- Investment in research and development to breed chickpea varieties that are more tolerant to temperature fluctuations, especially high temperatures.

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