

MAIZE CROP PRODUCTION DYNAMICS IN PAKISTAN: TRENDS, ECONOMIC IMPACTS, TRADE LINKAGES AND FUTURE PROSPECTS

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Abstract

Maize is an important cereal crop in Pakistan, serving as human food, poultry feed, livestock fodder and an industrial commodity for wet milling. This study evaluates maize production trends (cultivation area, volume, yield, pricing, and market availability), demand-supply dynamics, and farm-level cost-profitability. It utilized secondary data from Pakistan Bureau of Statistics (PBS), FAO and other sources, with demand-supply forecasts using the ARIMA model and cost analysis via AIMS data. Pakistan accounts for 0.78% of global maize area and 0.80% of production. Pakistan's maize yield averaged to about 6.02 tons/ha in last five years, lags far behind from Turkey (12.92 tons/ha) and the US (11.13 tons/ha) due to poor practices, inadequate extension services and climate challenges. In the last one decade (from 2014-15 to 2024-25), Pakistan maize area has grown by 39%, at an annual growth rate of 3.3%, there has been about two-fold increase in the production (1.8 times), with annual growth rate of 6.2%, and productivity gone up by 31.8%, with a growth rate of 2.8% per annum. Maize production forecasted through ARIMA model for the year 2026-27 is 9484.2 thousand tonnes, with 95% confidence level lower and upper limits of 8465.5 and 10502.8 thousand tonnes, respectively. Maize demand for the year 2026-27 is estimated at 8926.9 thousand tonnes. An inverse relationship between net worth of exports of maize and net worth of imports of soybeans has been observed in last five years. It means that in years when value of maize exports remains low, the country must import more soybeans. Thus, the country has to import either maize or soybeans to cater increasing maize demand, specifically in the years with low production. In 2023-24, benefit-cost ratio of maize production cost per acre in Punjab was 1.50:1.00, outperforming competing crops like wheat and cotton in profitability. Key constraints in maize production include reliance on imported seeds (92% in 2023-24), climate-related stress, imbalanced fertilizer use, and lack of drying/storage facilities.

INTRODUCTION

Maize (*Zea mays* L.) is one of major crop in Pakistan. Maize is used in production of cornstarch, corn syrup, corn flakes and dextrose.

Dextrose is a simple sugar, commonly used as sweetener in food and beverages or a quick energy source in medical setting. It is used to treat

hypoglycemia, a condition where blood sugar drops below normal, typically below 70 mg/dL, or provide calories to patients unable to eat. Each of these corn-derived products serves distinct purposes, from enhancing food texture and sweetness to industrial and household applications. The kernel is composed of starch (72%), protein (10%), oil (5%), sugar (2%), ash (1%) and a little bit of moisture (Gul *et al.* 2021).

In Pakistan, Maize is an essential multi-purpose agricultural as well as industrial commodity sustaining the poultry sector (65% consumption share), dairy silage (10%), industrial wet milling (20% for cornstarch, syrup, and dextrose) and household human consumption (5%), (TDAP, 2025). Despite of its high strategic value, Pakistan only accounts for 0.78% of global maize area and 0.80% of total production with a per capita availability influenced by its 3.1% share of the global population (USDA, 2025). While major factors like historical technology adoptions, especially hybrid seed usage boosted yield structures across the country along with, high volatility can be seen in recent maize production vectors. Following a peak production of 10.99 (million tonnes) in 2022–23, output dropped to 9.84 (million tonnes) in 2023–24 and further contracted down to 8.79 (million tonnes) by 2025–26 due to depressed farm-gate prices, escalating production costs, and monsoon flood variations (GoP, 2026).

Keeping in view the importance of maize crop, this study has been designed with following core systematic dimensions: to evaluate current status of the maize crop (area, production, yield, prices, and availability) in relation to government policies; the demand-supply gaps by statistical forecasting model for future production; the prospects of maize production in the backdrop of international scenarios especially correlation with soyabean import; and analyze the cost of maize production and its profitability and compare its returns with competing crops.

Research Methodology

This study investigates the descriptive trend assessment of maize based on statistical analysis, macroeconomic and trade balanced calculation and time series forecasting model (ARIMA).

Data Sources

The study is based on secondary data on agricultural area, production, yield, and prices of maize, time spanning from 1990 to 2025, this historical data was amassed from published official sources including Pakistan Bureau of Statistics (PBS), Ministry of National Food Security & Research (MNFS&R). Publications by international organizations like FAO, WTO, World Bank, and ITC Trade Map database were also considered for data related to international trade. Financial cost structures were extracted from localized survey parameters of Agriculture Marketing Information Service (AMIS), Government of Punjab. Academic papers, research reports, and market analysis studies were consulted to get insight into the trend and challenges in maize production and trade.

Trend Analysis

Growth in maize area, production and productivity was assessed by comparing the beginning and ending values of the study period (1990 to 2025) and by calculating the corresponding overall and annual growth rates reported in the source data. Market prices were compared across major wholesale markets to assess broad price movements.

Forecasting Measurement: ARIMA Model

Future maize production projection was envisaged by employing an Autoregressive Integrated Moving Average (ARIMA) algorithm. ARIMA is a powerful statistical technique that models and forecasts time series data by accounting for autocorrelations, trends, and seasonality within the data. It is particularly useful for short to medium-term forecasting (Box and Jenkins, 1970). The time-series models are methodically indexed as $ARIMA(p, d, q)$ are presented in expression 1.

$$\Delta^d Y_t = c + \sum_{i=1}^p \phi_i \Delta^d Y_{t-i} + \varepsilon_t + \sum_{j=1}^q \theta_j \varepsilon_{t-j} \quad (1)$$

Whereas: p is the autoregressive lag order, d is the integration differencing level to yield stationarity and q represents the moving average sequence. The following steps are taken for ARIMA technique:

- **Stationarity Check:** Time series data must be stationary (i.e., mean, variance, and autocorrelation structure should be constant over time). Thus, data was checked for stationarity. Non-stationarity can be assessed by graphical distribution in raw levels. For empirically testing the first-order regular differencing ($d = 1$) successfully standardized the mean and variance structures.
- **Model Identification:** Autocorrelation (ACF) and Partial Autocorrelation (PACF) Plots are used to identify the potential orders of the ARIMA model.
- **Model Selection:** Based on the ACF and PACF plots, most appropriate model for forecasting production has been selected.
- **Model Estimation:** Parameters of the selected ARIMA model have been estimated through maximum likelihood estimation (MLE) by using Minitab software version (22).
- **Model Diagnostics:** The residuals of the model were evaluated to ensure they behave like white noise (i.e., no autocorrelation).
- **Forecasting:** The fitted ARIMA model was used to forecast future demand.

The study involves estimating maize demand for the year 2026-27, and projects its supply for next few years. The supply projections are made by ARIMA model.

Cost and Profitability Analysis

The farm-level economic assessment uses the weighted cost of hybrid maize production in Punjab. Costs include land preparation, seed and sowing operations, irrigation, fertilizer, manure, pesticides, weedicides, harvesting, land rent, crop administration, and produce transportation. Gross revenue, residual returns, net revenue and profit were then calculated. Profitability was also

compared with its competing crops i.e., rapeseed/mustard, cotton, wheat and sunflower.

Results and Discussion

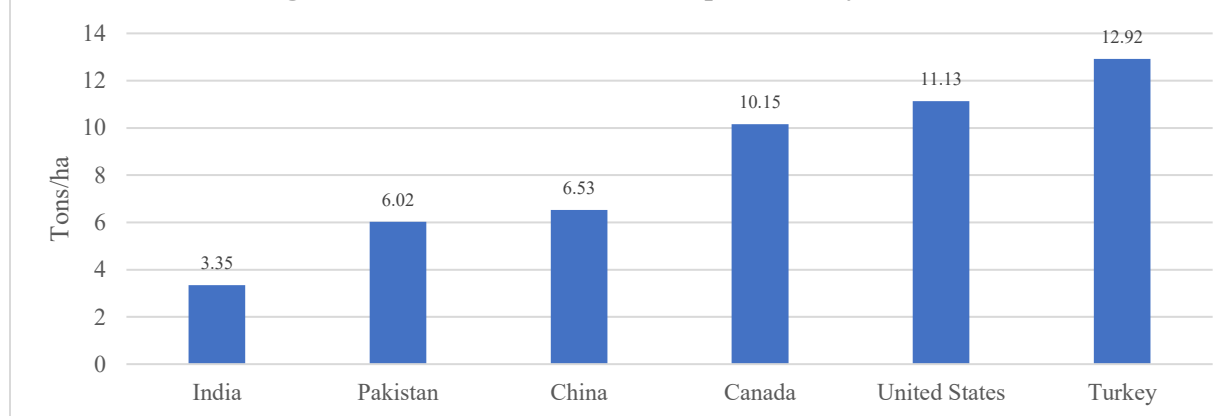
The study covered the important dimensions of maize crop production including local supply and demand, trade, cost of production and profitability. The findings are helpful in devising future production strategy for maize crop production.

Maize production - Global and Regional Context

Maize production is concentrated in East Asia, South Asia and Southeast Asia. Total maize production of these regions was reported 369.75 million metric ton in year 2023-24, and as per preliminary estimates of 2024-25 was 379.80 million metric ton. Thus, these selected regions of Asia shared 30.0% in the world maize production of 1230.52 million metric ton in year 2023-24. Total maize production of South Asian region was 50.37 million metric ton in year 2023-24. In the South Asian region, India, Pakistan and Nepal are main maize producing countries with share in the total regional production of 74.8, 19.5 and 5.7 percent, respectively. While Southeast Asia produced 30.54 million metric ton maize in year 2023-24. In the Southeast Asia, Indonesia was leading maize producer with share in the sub-regional production of 41.6%, followed by Philippines (26.5%), Thailand (17.4%) and Vietnam (14.5%), (USDA, 2025).

As far as, productivity of the maize crop is concerned, Pakistan therefore occupies a meaningful position in South Asian maize production, but its yield performance remains well below the leading international producers (Figure 1). Maize productivity is lower in Pakistan than Turkey due to poor production practices, inadequate extension services (Aslam, 2016, Hussain et al., 2024), inefficient insect-pest and disease management (Shah et al., 2014), limited access to credit and inputs (Chandio et al., 2017), soil and water issues (Syed et al., 2022) and climate change impacts (Shakoor et al., 2017). These constraints imply that future output growth cannot rely solely on expanding cropped area.

Fig. 1. Selected international maize productivity indicators



Source: USDA, 2025

Decade-wise Production trends of Maize crop (2013-14 to 2024-25)

Maize is a major feeding crop in Pakistan, and it places at third in production among cereals crops after rice and wheat. The crop has share of 0.5 percent in the GDP and 2.3 percent in agriculture value addition (GoP, 2026). During 2025-26, maize crop was cultivated on 1.59 million ha, showing a slight decrease of 0.1 percent over last year's cultivation. Maize production in Pakistan was 8.79 million tonnes in year 2025-26 compared to last year years 9.04 million tonnes. Thus, it reduced by 2.7 percent in year 2025-26. The restraint in production was primarily due to lower yields following flood-related effects in some maize-growing areas, while the cultivated area remained largely stable. In addition, the growing use of maize in poultry feed continued to influence planting decisions in line with feed demand and prevailing price signals (GoP, 2026). Pakistan exported 1.2278 million tonnes of maize in year 2024. While in year 2023 and 2022, maize exports of the country were 1.4966 and 0.7921 million tonnes, respectively. Thus, from year 2022 to 2024 exports of the commodity averaged 1.1721 million tonnes, which is about 11.8% of the average production of three years i.e. 9.9203 million tonnes (World Bank, 2026 and GoP, 2025). Along with reliance on imported seed,

there are many challenges in the production of the crop. These includes, climate related abiotic stress (Shakoor *et al.*, 2017 and Rizwanullah *et al.*, 2023), imbalanced use of fertilizers, specifically low use of Potash (Adnan, 2020); furthermore, markets are not stable due to lack of drying and grain storage facilities etc. (Tariq and Iqbal, 2010).

Maize area, production and productivity in last decade, i.e. from year 2014-15 to year 2024-25 are presented in Table 1. All crop statistics exhibited improvements over time. Crop area has grown by 39 percent, from 1142.5 thousand hectares in year 2014-15 to 1587.7 thousand hectares in year 2024-25, with annual growth rate of 3.3 percent. Similarly, during the decade production of the crop has gone up by about double i.e. 1.8 times, increased from 4936.8 thousand tonnes in year 2014-15 to 9036.7 thousand tonnes hectares in year 2024-25. Increase in the production has happened as the crop gain more area over time along with increase in the productivity. Productivity of the crop increased by 31.7 percent, i.e. from 43.7 maunds per acre in year 2014-15 to 57.6 maunds per acre in year 2024-25. Average production of the crop in last five years is 9645.1 thousand tonnes per year.

Table 1. Maize area, production and productivity in last decade (2013-14 to 2024-25)

Years/Statistics	Area (000'/ha)	Production (000'/tonnes)	Productivity (kgs/ hec)	Maunds/ acre
2014-15	1142.5	4936.8	4321.1	43.7
2015-16	1210.0	5337.0	4410.7	44.6
2016-17	1348.4	6134.3	4549.3	46.0
2017-18	1251.4	5901.6	4716.0	47.7
2018-19	1374.0	6826.3	4968.2	50.3
2019-20	1404.3	7883.0	5613.5	56.8
2020-21	1417.8	8940.0	6305.4	63.8
2021-22	1652.5	9524.5	5763.9	58.3
2022-23	1720.0	10985.1	6386.6	64.6
2023-24	1641.4	9739.1	5933.1	60.0
2024-25	1587.7	9036.7	5691.7	57.6
2025-26	1590.0	8790.0	5528.3	55.3
Total Growth (%)	39.0	83.0	31.7	31.7
Growth Rate / annum (%)	3.3	6.2	2.8	2.8

Source: GoP, 2025 /Agricultural Statistics of Pakistan 2024-25, & GOP 2026/ Pakistan Economic Survey 2025-26

Farm Structure and Smallholder Importance under maize crop

Cultivation patterns are shaped through the land holding inequities. Out of 8.26 million private farms in the country, 1.19 million farms (14.4%) reported to grow maize crop (GOP, 2025). About fifteen percent of small farms, and eight percent

each of medium and large farmers each grow maize crop in the country (Table 2). As per area coverage of the maize crop is concerned, small (74%), medium (12%) and large (13%) farmers share, highlighting that the crop remains important to smallholder livelihoods.

Table 2. Maize crop reporting farmers and cropped area by farm size categories

	Total Farms (Number)	Maize Reporting Farms (Number)	% of Total Farmers	Area (hectare)	% of Total Maize Area
Small	7398100	1122823	15.2	719897	74.4
Medium	562206	45555	8.1	117946	12.2
Large	304225	25048	8.2	129993	13.4
All	8264480	1193463	14.4	967839	100.0

Source: GoP, 2025 /Agricultural Statistics of Pakistan 2024-25

Wholesale price dynamics and market conditions of maize

Average nominal wholesale prices of maize produce in main markets in the country from

2013-14 to 2024-25 are presented in Table 3. It can be observed that maize markets in the country are quite integrated with little differences in wholesale prices across different cities. Surge in

the maize prices in 2024-25 can be linked to decrease in Soybean imports by Pakistan in years 2023-2024.

Table 3. Average wholesale prices in main markets in Pakistan (Rs. /40 kgs)

Year/Markets	Lahore	Hyderabad	Peshawar	Quetta	All
2013-14	1150	1183	1031	1282	1162
2014-15	1150	1173	982	1390	1174
2015-16	1017	1158	1003	1390	1142
2016-17	1013	-	1010	1435	1153
2017-18	1031	1164	1095	1480	1193
2018-19	1225	1267	1283	1480	1314
2019-20	1337	1327	1300	1471	1359
2020-21	1669	1618	1527	1549	1591
2021-22	1749	1896	-	1599	1748
2022-23	2664	3075	2865	3424	3007
2023-24	2180	2679	2980	4147	2997
2024-25	3087	3207	2941	3980	3304

Source: GoP, 2025 /Agricultural Statistics of Pakistan 2024-25

Dependence on imported Hybrid Seed

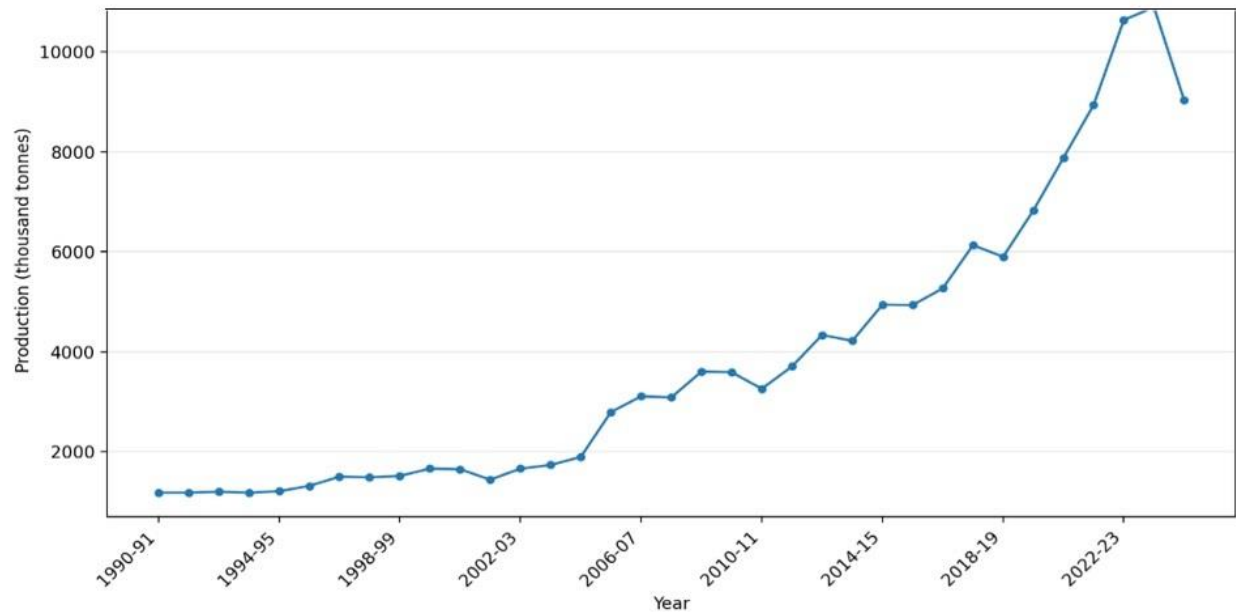
Seed dependence is one of the most important structural vulnerabilities of Pakistan's maize sector. Total maize seed availability in 2023 was 22,617 tonnes, of which 20,778 tonnes were imported and only 1,839 tonnes were produced by the private domestic sector. Thus, approximately 91.87% of seed availability was imported. Such dependence describes the farmers' decisions to international price movements, exchange-rate pressures, supply disruptions and regulatory changes (GoP, 2026). The policy issue is not simply reducing imports. Imported germplasm can contribute substantially to productivity, but Pakistan requires a stronger domestic breeding and multiplication system that can develop and commercialize hybrids adapted to heat, water stress, local soils and emerging pests and diseases.

Forecasting Maize Production Using ARIMA Model

Maize Supply

Maize supply has been forecasted for the year 2025-2026 to 2029-30 (04 years) by employing ARIMA model and adopting four necessary steps of model specification, its estimation, diagnostic checking and forecast. A glance at time series plot of maize production indicates that data is non-stationary (Figure 2). The selected ARIMA (1,1,1) model contains one autoregressive term, one order of differencing and one moving-average term. Thus, to make the data series stationary AR (1) and MR (1) were carried out. It is found that data series becomes stationary at first difference AR (1) and moving average i.e. MA (1), (Table 4). The reported MA (1) coefficient is strongly significant, whereas the AR (1) coefficient and constant are marginally significant at the 10% significance level, meaning the model is reliable.

Fig. 2: Time series plot of maize production in Pakistan (1990-2026)



ARIMA (1,1,1) Model Results for Maize Production

An ARIMA (1,1,1) model with a constant term was fitted to the annual maize production series. One regular difference was applied to the original series to achieve stationarity. The original dataset contained 36 annual observations, while 35 observations remained after first-order differencing (Table 4). The MA (1) coefficient was statistically significant at the 5% significance level because its p-value was less than 0.05. This finding

indicates that the moving-average component makes a statistically significant contribution to the model. However, the AR (1) coefficient was not statistically significant at the 5% significance level because its p-value was 0.063. Nevertheless, it may be considered marginally significant at the 10% significance level. Similarly, the constant term was not statistically significant at the 5% significance level but was marginally significant at the 10% significance level, with a p-value of 0.078 (Table 4).

Table 4. Final Estimates of Parameters

Type	Coefficient	SE	t-Value	p-Value
AR (1)	-0.3825	0.1987	-1.93	0.063**
MA (1)	-0.9340	0.0837	-11.16	<0.001*
Constant	306.6	168.5	1.82	0.078**

* and ** are significant at 5% and 10% significance levels, respectively

The ARIMA (1,1,1) model forecasts maize production of approximately 9,484.2 units in 2026-27. Production is projected to increase

gradually over the forecast period, reaching approximately 10,012.7 units by 2029-30 (Table 5).

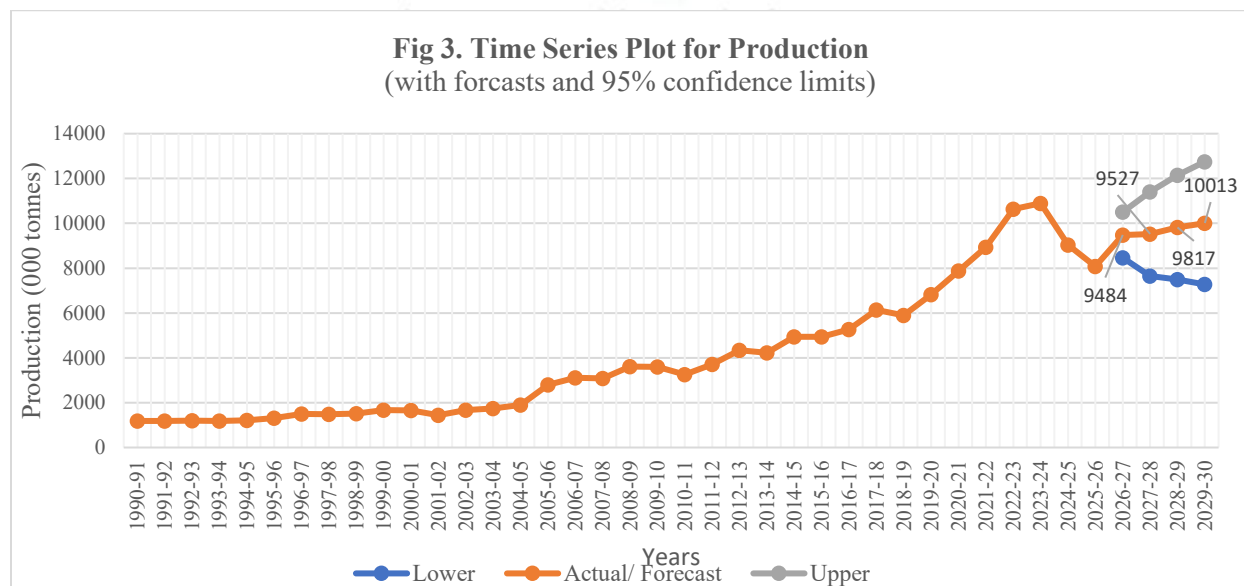
Table 5. ARIMA Forecasts of Maize Production

Forecast Period	Forecast	95% Lower Limit	95% Upper Limit
2026–27	9,484.2	8,465.5	10,502.8
2027–28	9,526.8	7,646.6	11,407.0
2028–29	9,817.1	7,493.4	12,140.8
2029–30	10,012.7	7,274.8	12,750.5

It is apparent from data in Table 5, the 95% prediction intervals become wider as the forecast horizon increases, indicating greater uncertainty in the longer-term forecasts. For example, the prediction interval for 2026–27 ranges from 8,465.5 to 10,502.8 (interval=2037.3), whereas the interval for 2029–30 ranges from 7,274.8 to 12,750.5 (interval=5430.7).

Overall, the ARIMA (1,1,1) model indicates a gradual upward trend in future maize production. The MA (1) component is statistically significant

and contributes strongly to the model. In contrast, the AR (1) coefficient and the constant term are only marginally significant at the 10% level. Therefore, the model may be used for forecasting, provided that residual diagnostic tests confirm that the residuals are independent, approximately normally distributed, and have constant variance. However, the forecasts should be interpreted cautiously because the uncertainty increases as the forecast horizon becomes longer.



Domestic demand of maize

Maize is a widely used crop in Pakistan. It is the third most important cereal crop after wheat and rice. It is traditionally used in feed industry, wet milling industry, dairy sector, for seed and other purposes. It is primarily for poultry feed (65%), livestock feed and silage (10%), wet milling industry for preparation of corn starch, corn syrup, corn oil, corn gluten meal and ethanol (20%), human food, seed of the crop/ maize

fodder seed (5%), Growth drivers of maize consumption are poultry sector (growing at 7.5%), silage use (growing at 8.0%), food and feed (growing at 10%) and wet millers' industry (growing at 3%). (TDAP, 2025).

International trade dynamics of maize

Pakistan imported maize with mean worth Rs. 20.240 million per annum in last five years, while

mean value of the exports per annum during same period was Rs. 56.976 million (Table 6). Thus, net export value of the commodity is 36.736 million per annum, which is 0.5% of the annual production. Pakistan imports maize mainly from USA and Thailand. Both countries share 94.3% of the import value in last five years (2020-2024). Sometimes, maize is also imported from Turkiye, Brazil, Italy, France and South Africa. The country exports maize mainly to Vietnam, with mean share in the export value in last five years of Rs. 14.911

million per annum, which is 48.7% of the total exports. Malaysia and Sri Lanka are other main destinations for the maize exports, with shares in total annual exports of 17.1 and 10.6 percent, respectively. The commodity is also exported to Oman, Philippines, Qatar and Bahrain. Net exports, i.e. excess of exports over imports, were negative in year 2020 by Rs.7.0 billion. It became positive since then and averaged Rs. 36.736 million per year, in last five years (Table 6).

Table 6. Maize Trade by of Pakistan (Rs. Million)

	2020	2021	2022	2023	2024	Average
Import of maize						
Total Import	9.136 (100)	13.070 (100)	19.977 (100)	20.326 (100)	19.073 (100)	20.240 (100)
USA	4.048 (44.3)	6.200 (47.4)	9.987 (50.0)	10.806 (53.2)	9.117 (47.8)	9.782 (48.3)
Thailand	4.059 (44.4)	6.421 (49.1)	8.820 (44.1)	9.302 (45.8)	9.292 (48.7)	9.302 (46.0)
Others (Turkiye Brazil, Italy, France & South Africa etc.)	1.028 (11.2)	0.452 (3.2)	1.170 (5.8)	0.218 (1.1)	0.664 (3.5)	1.157 (5.7)
Export of maize						
Total Export	2.136 (100)	19.125 (100)	59.404 (100)	97.780 (100)	80.800 (100)	56.976 (100)
Vietnam	1.314 (61.5)	9.108 (47.6)	29.143 (49.1)	49.249 (50.4)	32.737 (40.5)	14.911 (48.7)
Malaysia	0.295 (13.8)	4.876 (25.5)	11.941 (20.1)	17.899 (18.3)	6.420 (7.9)	5.151 (17.1)
Sri Lanka	0.176 (8.2)	0.106 (0.56)	3.725 (6.3)	11.945 (12.2)	12.285 (15.2)	3.248 (10.6)
Others (Oman, Philippines, Qatar & Bahrain etc.)	0.351 (16.5)	5.034 (26.3)	14.594 (24.5)	18.687 (19.1)	29.357 (36.4)	33.583 (23.6)
Net Exports (Exports-Imports)						
Total	7.000	6.053	39.427	77.454	61.727	36.736

Source: Trade Map, 2025 (Note: Figures in parenthesis are percentages)

Soybean Trade by Pakistan

Time series data from 2020 to 2024, depict that Pakistan mainly imports soybean from Brazil, followed by USA (Table 7). The produce is also

imported from Nigeria, Ukraine, Benin, Togo and Ethiopia in decreasing value of imports. Pakistan also exports soybean occasionally to Bangladesh, Vietnam, Oman and other countries. Net imports

of soybeans in real terms range from Rs. 94.745 million in 2023 to a maximum of Rs.245.655 million in 2021.

Table 7. Soybean Trade by Pakistan (Rs. Million)

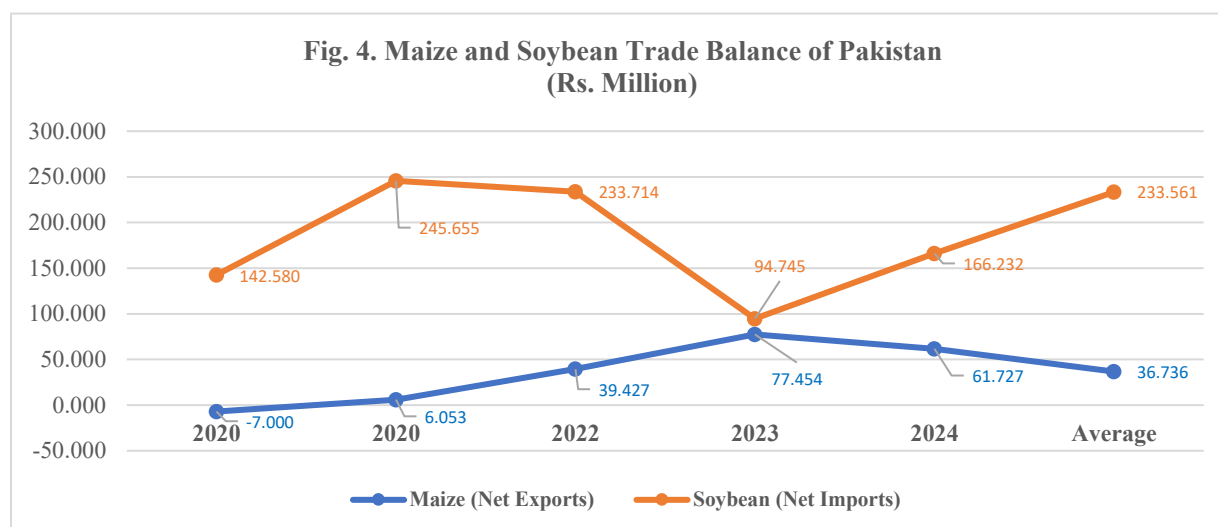
	2020	2021	2022	2023	2024	Average
Total Import	142.587 (100)	245.692 (100)	233.744 (100)	105.621 (100)	166.267 (100)	235.749 (100)
USA	59.926 (42.0)	76.253 (31.0)	72.945 (31.3)	21.536 (20.4)	0.199 (0.12)	65.963 (28.0)
Brazil	82.467 (57.8)	163.651 (66.6)	157.624 (67.6)	26.839 (25.4)	0 (0.0)	122.665 (52.0)
Nigeria	0.194 (0.1)	0 (0.0)	0 (0.0)	13.048 (12.4)	39.977 (24.0)	10.586 (4.5)
Others (Ukraine, Benin, Togo & Ethiopia etc.)	0 (0)	5.775 (2.4)	2.724 (1.17)	44.198 (41.8)	126.091 (75.8)	36.534 (15.5)
Total Export	0.007 (100)	0.037 (100)	0.029 (100)	10.875 (100)	0.035 (100)	2.188 (100)
Bangladesh	0 (0.0)	0 (0.0)	0 (0.0)	10.837 (99.6)	0 (0.0)	2.152 (98.4)
Vietnam	0 (0.0)	0 (0.0)	0 (0.0)	0.035 (0.3)	0.031 (88)	0.013 (0.6)
Oman	0 (0.0)	0.034 (90.8)	0 (0.0)	0 (0.0)	0 (0.0)	0.010 (0.5)
Others (Afghanistan, Sri Lanka, Japan, & Qatar)	0.007 (100)	0.003 (9.2)	0.029 (100)	0.004 (0.1)	0.004 (12.0)	0.012 (0.5)
Net Imports (Imports-Exports)	142.580	245.655	233.714	94.745	166.232	233.561

Source: Trade Map, 2025 (Note: Figures in parenthesis are percentages)

Maize-Soybean Trade Linkage

Value of net exports of maize and net imports of soybean over time are presented in Figure 4. An inverse relationship between net exports of maize

and net imports of soybean has been observed in last five years. This indicates that in years when the value of maize exports is low, the country must import more soybeans.

**Cost of maize production and its profitability**

Total cost of production and profitability of the crop per acre over last four years (from 2020-21 to

2023-24) in Punjab are presented below in Table 8. Both production cost and profitability increased in nominal terms over the time period.

Table 8. Cost of production and profitability of the crop in Punjab (Rs./acre)

Items	Crop Years				Nominal Change (D-A)
	2020-21 (A)	2021-22 (B)	2022-23 (C)	2023-24 (D)	
Cost of Production with land rent (at farm gate)	56,007	69,672	80,488	1,18,139	62,132 (110.94)
Average Yield of last three years	60.00	64.33	66.50	66.50	6.5 (10.83)
Price per 40 kg	1,159	1,331	1,524	2,659	1500 (129.42)
Gross Revenue	69,540	85,623	1,01,346	1,76,824	107,284 (154.28)
Residual	1,991	2,236	3,182	3,997	2,006 (100.75)
Net Revenue	71,531	87,859	1,04,528	1,80,821	1,09,290 (152.79)
Profit with land rent (at farm gate/ mandi gate*)	15,524	18,187	25,948*	62,628*	47,104 (303.43)
Profit per 40 kg	259	283	390*	943*	684 (264.09)
BCR	1.24	1.23	1.26	1.50	-

Source: GoP, 2024, Agriculture Marketing Information Service (AMIS), Agriculture Department, Government of Punjab, Pakistan (<http://www.amis.pk/Surveys.aspx>)

(Note: Figures in parenthesis are percentages)

Weighted Cost structure of hybrid maize production in year 2023-24

Fertilizer was the largest reported operating cost component at Rs. 24,301 per acre (20.6%), followed by land rent (21.2%), irrigation (15.5%), and seed and sowing (15.1%), (Table 9). Altogether, these four items together constitute

the major share of production cost (72.4%), influencing maize production. The findings indicate that the potential for increasing maize productivity lies primarily in improving input efficiency or quality rather than simply increasing application quantities.

Table 9. Weighted average cost of production of maize (Hybrid) in year 2023-24

Operation/Input	Avg. No. of Operation/ Unit /Acre	% of Usage (Weights)	Average Cost per Operation/ Unit (Rs. / acre)	Total Weighted Cost (Rs. / acre)
Deep Ploughing	1.0	79	3564	2816
Ploughing	3.8	76	1779	5138
Planking	2.0	80	1151	1842
Levelling	1.0	44	3343	1471
Cost of Land Preparation				11266 (9.5)
Seed Quantity (kg)	10.0	100	1354	13540
Seed Drilling	1.0	6	2000	120
Seed Transmission	1.0	75	2027	1520
Seed Treatment	1.0	68	789	537
Bridging	1.0	97	2183	2118
Cost of Seed & Sowing				17834 (15.1)
Irrigation Number	11.0	97	1720	18160
Irrigation Labour	1.0	41	254	104
Canal Charges	1.0	35	247	86
Cost of Irrigation				18351 (15.5)
Urea	2.7	100	2800	7560
DAP	1.2	97	11000	12804
Other Fertilizer	1.0	41	8344	3421
Fertilizer Labour	1.0	54	455	246
Fertilizer Transport	1.0	94	287	270
Cost of Fertilizer				24301 (20.6)
Dung Trolly	2.6	6	1858	290
Dung Transport	1	6	1417	85
Dung Labour	1	6	1359	82
Cost of Dung				456 (0.4)
Pesticides Spray	2.9	99	1499	4304
Pesticides Spray Labour	1	85	377	929
Cost of Pesticides				5233 (4.4)
Weedicides Spray	1	99	1488	1473
Weedicides Spray Labour	1	84	337	283
Cost of Weedicides				1756 (1.5)
Picking/ Dig Cost	1	5	6109	305
Cutting Cost	1	89	8016	7134
Threshing Cost	1	93	3482	3238

Cost Harvesting				10678 (9.0)
Half Yearly Land Rent				25000 (21.2)
Administration Cost	1	5	4732	237
Other Expenditures				237 (0.2)
Transportation/ Rent	1	56	4107	2300
Transport Labour	1	25	1330	333
Bar Dana (Bags)	1	23	1717	395
Cost of Transportation				3027 (2.6)
Total Cost of Production	At Mandi Gate (with land rent)		(Rs./ acre)	118,139
			(Rs./ 40kg)	1,777
Average Yield	Last 3 Years		(40kg/ acre)	66.5
Gross Revenue	at Mandi Gate Crop Price @		2659	176,824
	(Rs./40kg)			
	Residual			3,997
Net Revenue	at Mandi Gate			180,821
Profit	at Mandi Gate (with land rent)		(Rs./ acre)	62,682
			(Rs./ 40kg)	943

Source: Agriculture Marketing Information Service (AMIS), Agriculture Department, Government of Punjab, Pakistan (GoP, 2024), (<http://www.amis.pk/Surveys.aspx>)

Comparative Profitability of Hybrid-Spring Maize and Competing Crops

A comparative profitability analysis of hybrid spring maize with its competing crops revealed that hybrid maize was the most lucrative, generating a net profit of Rs. 62,682 per acre in 2023-24, the highest among the crops included in the comparison (Table 10). Although maize's profit per 40 kg was lower than that of the other crops, its shorter production cycle yielded the highest reported profit per crop day (Rs. 627 per acre). This is an important consideration for farmers to allocate land among competing crops as the land turnover and timing of returns matter besides the gross profit per unit of output.

The profitability advantage, however, should not be interpreted as uniform for all farmers or areas because maize profitability is sensitive towards hybrid seed prices, fertilizer and irrigation costs, farm-gate prices, yield variability and post-harvest losses. For maximized gains from maize, improved market institutions are therefore required to make this crop's potential profitable, more stable and farm incomes more reliable. Realizing the full economic potential of maize requires robust market institutions capable of mitigating price volatility, enhancing profitability, and ensuring sustainable farm incomes.

Table 10. Comparative Profitability of Hybrid-Spring Maize in Year 2023-24 (Rs. per acre)

	Maize-Hybrid	Rapeseed & Mustard	Cotton	Wheat	Sunflower
Profitability per 40 kg	943	1,720	1,643	1,484	1,324
Profitability per acre	62,682	38,375	27,104	47,205	31,121
Profitability Comparison per acre	-	-24307 (-38.8)	-35578 (-56.8)	-15477 (-24.70)	-31561 (-50.4)
Crop Days	120	180	180	180	120
Profit per day	627	213	151	262	259

Source: Agriculture Marketing Information Service (AMIS), Agriculture Department, Government of Punjab, (GoP, 2024) (<http://www.amis.pk/Surveys.aspx>)

(Note: Figures in parenthesis are percentages)

Conclusion and Recommendations

While maize has become Pakistan's third most important cereal crop after wheat and rice, and a major success story driven by the contractual farming and poultry feed industry. Maize remains a highly profitable crop in the country; however, its growth is constrained by structural limits, viz. ever-increasing subsistence/ small scale farming, seed supply constraints, lack of drying and storage infrastructure, high input costs, highly uneven technological adoption and climatic vulnerabilities. Similarly, systemic and institutional bottlenecks restrict true yield potential of the crop. Pakistan's national average maize yield lags significantly behind global leaders like the United States, Canada and Turkey. To address the projected supply gaps and stabilize the market, the following policy measures are recommended: to reduce heavy reliance on imported seed by supporting public-private partnerships to develop domestic, heat-tolerant seed varieties; build solar-powered grain drying units and modern silo networks across major production clusters to minimize post-harvest losses and reduce price volatility; introduce targeted support for potash and zinc fertilizers to improve crop resilience against heat stress and increase overall yields, and to implement transparent contract farming frameworks between feed/ food processing mills and smallholder organization to protect farmers from sudden price drops and secure stable supplies for the poultry and livestock sectors.

REFERENCES

Adnan, M. (2020). Role of potassium in maize production: A review. *Open Access Journal of Biogenic Science and Research*, 3(5): 1-4.

Aslam, M. (2016). Agricultural productivity current scenario, constraints and future prospects in Pakistan. *Sarhad Journal of Agriculture*, 32(4): 289-303.

Box, G. E. P., & Jenkins, G. M. (1970). *Time Series Analysis: Forecasting and Control*. Holden-Day.

Chandio, A. A., Jiang, Y., Wei, F., Rehman, A., & Liu, D. (2017). Farmers' access to credit: Does collateral matter or cash flow matter?—Evidence from Sindh, Pakistan. *Cogent Economics & Finance*, 5(1): 1369383.

GoP (2026). *Economic Survey of Pakistan 2025-26*. Economic Adviser's Wing, Finance Division, Government of Pakistan, Islamabad USDA (2025) United States Department of Agriculture. <http://www.usda.gov>.

GoP (2025). *Agricultural Statistics of Pakistan 2024-25*. Economic Wing, Ministry of National Food Security and Research, Islamabad.

GoP (2024). *Agriculture Marketing Information Service (AMIS)*, Agriculture Department, Government of Punjab, Pakistan (<http://www.amis.pk/Surveys.aspx>)

Gul, H., Rahman, S., Shahzad, A., Gul, S., Qian, M., Xiao, Q., & Liu, Z. (2021). Maize (*Zea mays* L.) productivity in response to nitrogen management in Pakistan. *American Journal of Plant Sciences*, 12(8): 1173-1179.

Hussain, A., Akmal, N., & Altaf, M. Q. (2025). Minimizing productivity gaps of major crops by improving farmers' knowledge, adoption of recommended packages and investment in Pakistan. *ASSAJ*, 3(02): 1049-1070.

ITC (2025). *Trade Map, 2025*. International Trade Centre (ITC), 54-56 rue de Montbrillant, 1202 Geneva, Switzerland .

Rizwanullah, M., Yang, A., Nasrullah, M., Zhou, X., & Rahim, A. (2023). Resilience in maize production for food security: Evaluating the role of climate-related abiotic stress in Pakistan. *Heliyon*, 9(11).

Shah, H., Akhter, W., Akmal, N., & Khan, M. A. (2014). In competitiveness of maize production in Pakistan. In *12th Asian maize conference and expert consultation on maize for food, feed, nutrition and environmental security, book of extended summaries* (pp. 162-167).

Shakoor, U., Rashid, M., Saboor, A., Khurshid, N., Husnain, Z., & Rehman, A. (2017). Maize production response to climate change in Pakistan: A time series assessment. *Sarhad Journal of Agriculture*, 33(2): 320.

Syed, A., Ahmad, S., Giasuddin, M., & Raza, H. (2022). Evaluation of soil and water constraints impacting cereal crops production in semi-arid regions of Pakistan. *Pakistan Journal of Agricultural Sciences*, 59(3): 441-449.

Tariq, M., and Iqbal, H. (2010). Maize in Pakistan—an overview. *Agriculture and Natural Resources*, 44(5):757-763.

TDAP (2025). *Maize production and exports from Pakistan*. Trade Development Authority of Pakistan. Islamabad.

USDA (2025) Food Data Central. Agricultural Research Service. U. S. Department of Agriculture. Washington, DC, USA.

World Bank (2026). *Pakistan maize exports*. World Integrated Trade Solutions. The World Bank, Washington, D.C., United States.

