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Growth and Instability of Cotton Area, Production, and Yield in Afghanistan

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ABSTRACT

Cotton is one of the most significant industrial crops worldwide. It plays a vital role in the world's economic, political, and social affairs. The objective of this study is to evaluate the growth and instability of cotton in Afghanistan from 2009-2010 to 2024-2025.The study utilized secondary data for analysis. Compound Growth Rate (CGR) was employed to estimate growth trends, while the Cuddy-Della Valle Index (CDVI) was used to assess instability. The analysis was conducted at both regional and national levels.The results revealed that the Herat region registered the highest and considerable growth rates in area and production of cotton during period I (2009-10 to 2016-17) and the overall period. Spin Zar (Kunduz), however, showed negative growth rates in area and production across all periods. The Helmand region registered the highest and significant growth rates in area, production, and yield during period II (2017-18 to 2024-25). Whereas, Balkh, Spin Zar (Kunduz) and Nangarhar regions in period II registered negative growth. At the national level, steady growth was observed during Period I, with 5.58, 6.50, and 0.88 percent growth in area, production, and yield, respectively. This instability may be associated with climatic variability, input supply constraints, and market fluctuations; however, these factors were not directly tested in the present study. Based on the findings, improving farmers' access to credit and strengthening institutional support are essential to increasing cotton production and enhancing Afghanistan's competitiveness in global markets.

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INTRODUCTION

Cotton is one of the most important industrial crops worldwide, contributing significantly to the textile industry, employment, and rural livelihoods. Global cotton production is highly concentrated in a few countries, with China accounting for 26.01% of total world production in 2023, followed by India (21.52%) and the United States (12.16%). Although India possesses the largest share of global cotton-growing area (39.37%), China remains the leading producer, indicating substantial differences in productivity, technology adoption, and production efficiency among major cotton-producing countries (FAOSTAT, 2024).

This imbalance between production share and area allocation highlights the critical importance of yield differences, technological efficiency, and input utilization in determining national competitiveness in cotton production systems. The introduction was reorganized to provide a clearer progression from the global context to Afghanistan, followed by the research gap and study objective. Afghanistan, although a relatively small producer globally, plays a significant role in regional cotton supply chains and domestic agro-industrial development. The agricultural sector remains a key driver of food security, employment, and macroeconomic performance in Afghanistan (Naseri et al., 2025). In 2024–25, the country cultivated 105.06 thousand hectares of cotton and produced 159.586 thousand metric tons, with production highly concentrated in a few key provinces. Balkh emerged as the leading cotton-producing province, with 32.46 thousand hectares under cultivation and a production of 46.55 thousand tons, yielding 1434 kg per hectare. Helmand contributed 94.79 thousand tons from 59.71 thousand hectares, while Spin Zar (Kunduz) produced 7.07 thousand tons from 4.99 thousand hectares. Collectively, these regions accounted for approximately 91% of Afghanistan's total cotton production from 90.65% of the cultivated area, indicating a strong spatial concentration and structural dependence on limited production zones, which further increases vulnerability to climatic shocks, input constraints, and market fluctuations (NSIA, 2025).

From a broader historical and economic perspective, cotton has been cultivated for more than 7,000 years and remains one of the world's most important cash crops. It contributes approximately 35% of global fiber consumption and remains a key raw material for the textile industry. Major cotton-producing countries include China, India, the USA, former USSR states, Brazil, Pakistan, Turkey, Mexico, Egypt, and Sudan, which together account for nearly 85% of global cotton production, while the top three producers alone contribute about two-thirds of total output (Wani et al., 2024; Samuel et al., 2015). In many developing economies, cotton serves as a vital cash crop supporting millions of rural households through income generation, employment opportunities, and agro-industrial linkages. Strengthening agricultural production can contribute significantly to overall economic growth and rural development in Afghanistan (Naseri et al., 2024B). However, cotton production is highly input-intensive, requiring careful and efficient use of seeds, fertilizers, pesticides, and irrigation systems to achieve optimal yields.

Despite significant increases in cotton production over the past decade, yields in many developing countries, including Afghanistan, remain below potential due to inefficient input use, limited access to modern technologies, and structural constraints in agricultural systems. Empirical evidence suggests that productivity gaps persist largely due to inadequate adoption of improved seed varieties, weak extension services, and suboptimal resource allocation, which collectively hinder the realization of full production potential (Barakova et al., 2018). Instability in agricultural products is usually influenced by various factors, such as production technology, improved varieties, nature, economic conditions, climate sensitivity, and access to inputs (Rana et al., 2021). Moreover, agricultural policy environments and

market structures significantly influence cropping patterns and production decisions, often leading to instability in cultivated area and output levels over time (Rasikh et al., 2023). Studies on agricultural growth dynamics further indicate that cotton-producing regions frequently experience significant fluctuations in area, production, and yield due to climatic variability, price volatility, and policy inconsistencies, which collectively contribute to production instability (Zankat et al., 2025). Similar evidence from comparative agricultural trade and production systems highlights that instability is a common characteristic of agricultural commodities in developing economies, particularly where institutional support systems are weak and market integration is limited. In addition, broader agricultural productivity analyses emphasize that yield variability is strongly associated with technological adoption, input availability, and environmental conditions, which together determine the stability and sustainability of agricultural output over time. Limited empirical evidence exists on the growth and instability of cotton area, production, and yield in Afghanistan. Therefore, this study attempts to assess the growth rates of cotton area, production, and yield in Afghanistan over time and to measure the degree of instability in these variables, to generate empirical insights that can support policymakers in improving productivity, stabilizing production systems, and enhancing the overall contribution of cotton to rural development and national economic growth.

1. To study the growth in area, production, and productivity of major cotton-producing regions in Afghanistan.
2. To evaluate the stability or instability in the area, production and yield of main cotton-producing regions in Afghanistan.

MATERIALS AND METHODS

The study employed a quantitative, time-series analytical design to examine growth and instability in cotton area, production, and yield in Afghanistan over time. The analysis was based on secondary data, focusing on temporal and spatial variations across major cotton-producing regions within Afghanistan.

Research Site

The study covered major cotton-producing regions of Afghanistan, namely Balkh, Helmand, Herat, Nangarhar, and Spin Zar (Kunduz). These regions collectively account for more than 70% of national cotton production.

Data Collection Tools and Procedure

Secondary data on cotton area, production, and yield were used for the study. The data were obtained from the National Statistics and Information Authority (NSIA) and related published statistical reports. Time-series data for the period 2009–2010 to 2024–2025 were compiled and organized for analysis. The study period was divided into two equal sub-periods: Period I (2009–2010 to 2016–2017) and Period II (2017–2018 to 2024–2025), along with the overall period, to enable comparative assessment of changes over time.

Data Analysis

Compound Annual Growth Rate (CAGR)

The exponential growth function of the following form was used to calculate the CAGR of Afghan cotton data (Alizadah et al., 2026; Naseri et al., 2024A; Esar et al., 2024; Champaneri & Patel, 2022; Jadhav et al., 2020; Nithin, 2016):

$$Y_t = ab^t \times u_t \qquad (1)$$

Where,

Y_t = the variable amount in year t,

t = year, which takes the value 1, 2, 3... n,

u_t = disturbance term,

'a' and 'b' are regression parameters to be estimated.

Equation (1), after taking the logarithm, is transformed into the following linear form:

$$lnY_t = lna + t\, lnb + lnu_t \qquad (2)$$

Equation (2) was estimated using the Ordinary Least Squares (OLS) method, and after estimating the parameter b, the annual compound growth rate (g) was calculated according to the following relationship:

$$(3)\ g = (anti\ log\ of\ b - 1) \times 100$$

Where,

g = Compound annual growth rate in percentage form

b = estimated regression coefficient from the log-linear model

Instability analysis

The coefficient of variation (CV) is the dispersion of standard deviations around the mean, and it was used to measure variation in cotton area, production, and yield in Afghanistan from 2009-10 to 2024-25. The CV, or index of instability, was determined using the following formula:

$$\text{CV(per cent)} = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

Further, the instability in area, production and yield of cotton in Afghanistan during 2009-10 to 2024-25 was examined in related terms by the Cuddy Della Valle Index (Cuddy & Della Valle, 1978), which was employed by many researchers (Shilpa & Sharma, 2021; Bhatia et al., 2021) as a measure of variability in time series data. The coefficients of variation overstate the instability of time series data. In contrast, the Cuddy-Della Valle index corrects the CV, shows the precise direction of the instability, and de-trends the annual rate.

$$\text{Instability index} = CV \times \sqrt{(1 - R^2)}$$

Where,

CV = simple coefficient of variation (per cent) and

R^2 = coefficient of determination from time trend regression adjusted for degrees of freedom.

Data Validity and Reliability

The study used official and published secondary datasets, ensuring that the data were reliable, consistent, and widely accepted for agricultural research. Cross-checking with published statistical reports was conducted to ensure internal consistency. The use of standardized statistical methods such as OLS-based growth estimation, CV, and Cuddy-Della Valle Index enhances the reliability and reproducibility of the results. The time-series nature of the data and consistent methodological framework further support the robustness of the findings.

FINDINGS

The results of the study are presented in line with the stated objectives, using secondary time-series data and appropriate analytical tools to examine growth and instability in cotton area, production, and yield across major producing regions of Afghanistan.

Growth Rates in Cotton Area, Production and Yield

The growth in area, production, and yield of cotton in all major producing regions, as well as in Afghanistan as a whole, has been presented in Table 1. The Herat region noted the largest and significant growth rate in area (13.95%) during the overall period. In contrast, the lowest and negative growth rate was observed in the Spin Zar (Kunduz) region (-4.15%). The decline in cotton area in Kunduz may be associated with climatic variability and production constraints. In the production sector, Herat region recorded the highest growth rate at 16.72 percent, followed by Helmand at 14.77 percent and Balkh at 9.58 percent. Regarding yield growth rate, the Herat region recorded the highest and significant growth rate (2.43%).
During Period II, the Helmand region registered the highest and most significant growth rate in area (28.69%), followed by Afghanistan as a whole (16.73%) and the Balkh region (11.54%). Spin Zar was the only region where cotton area showed negative growth rate (-0.26%).

In terms of production, Helmand region recorded the highest growth rate in the country (36.05%), although this estimate was not statistically significant. Afghanistan as a whole registered a statistically significant growth rate of 18.25 percent. The growth rate in cotton yield was also positive and significant in the Helmand region (5.72%). Whereas, Balkh, Spin Zar (Kunduz) and Nangarhar regions in period II registered negative growth.

The Herat region demonstrated the greatest and most significant growth rates in both areas (20.02%). and production (17.01%) during period I. The Balkh region showed positive growth in area (12.81%), production (15.16%) and yield (2.08%) during period I, while the national

level maintained steady growth with 5.58, 6.50 and 0.88 percent growth in area, production and yield, respectively, over the study period.

Spin Zar (Kunduz) experienced negative growth in both area (-9.48%) and production (-8.68%). Similarly, yield growth rates in numerous key regions were negative throughout this period, with Herat showing the largest decrease (-2.51%), followed by Nangarhar (-1.77%) and Helmand (-1.30%). This highlights the importance of developing and promoting high-yielding, pest-resistant cultivars to boost productivity and resilience.

Table 1. *Compound annual growth rate in area, production and yield of cotton in major producing regions in Afghanistan, 2009-2010 to 2024-2025*

Regions	Variables	Compound growth rate (% per annum)		
		Period-I	Period-II	Overall-Period
Spin Zar (Kunduz) Region	Area	-9.48*	-0.26	-4.15**
	Production	-8.68	-0.19	-2.01
	Yield	0.88	0.06	2.24***
Balkh Region	Area	12.81**	11.54***	7.82
	Production	15.16**	8.91*	9.58
	Yield	2.08	-2.35	1.63**
Helmand Region	Area	1.83	28.69***	12.23
	Production	0.51	36.05	14.77
	Yield	-1.30	5.72***	2.26**
Herat Region	Area	20.02***	6.74	13.95***
	Production	17.01***	9.57	16.72
	Yield	-2.51	2.65	2.43***
Nangarhar Region	Area	14.44*	4.78	0.25
	Production	12.41	4.47	0.54
	Yield	-1.77	-0.29	0.29
All Afghanistan	Area	5.58***	16.73***	6.93
	Production	6.50**	18.25***	9.03
	Yield	0.88	1.31	1.96***

Note: CAGR in per cent per annum *, ** and *** indicate significance of values at P=0.1, 0.05 and 0.01 per cent, respectively

Average (Triennium Ending) in Area, Production and Yield

The average (Triennium Ending) trends in cotton area, production, and yield across the major producing regions of Afghanistan namely Spin Zār (Kunduz), Balkh, Helmand, Herat, and Nangarhar are summarized in Table 2. Over the study period, the total cultivated cotton area in Afghanistan expanded steadily, rising from 33 thousand hectares during TE 2011–12 to 40.81 thousand hectares in TE 2018–19, and further to 84.52 thousand hectares in TE 2024–25. Among the regions, Helmand recorded the largest cultivated area (45.42 thousand hectares) in TE 2024–25, followed by Balkh (28.75 thousand hectares), Spin Zār (Kunduz) (5.03 thousand hectares), Nangarhar (3.44 thousand hectares), and Herat (1.87 thousand hectares). Regarding production, Helmand regions dominated national output, producing

67.42 thousand tonnes during TE 2024–25. This was followed by Balkh with 37.17 thousand tonnes and Spin Zār (Kunduz) with 6.94 thousand tonnes. Throughout the study period, Helmand consistently recorded the highest cotton production, largely due to its extensive cultivated area and comparatively higher productivity. During the study period, Helmand showed the highest production compared to other regions, mainly due to a large area under cotton cultivation and the crop's high productivity. In terms of yield, cotton yield in Afghanistan has increased from 1099.72 kg/ha in TE 2011-12 to 1382.65 kg/ha in TE 2024-25. Among the states, Helmand recorded the highest yield of 1465.04 Kg/ha during TE 2024-25, followed by the Herat region (1400.45 kg/ha), the Spin Zar (Kunduz) region (1355.65 kg/ha), and the Balkh region (1282.92 kg/ha). On the other hand, it was the lowest in Nangarhar region with 1123.12 kg/ha.

***Table 2**. Average (triennium ending) in area, production and productivity of cotton in major producing regions in Afghanistan, 2009-2010 to 2024-2025*

Regions	Variables	Average (Triennium Ending)		
		2011-12	2018-19	2024-25
Spin Zar (Kunduz) Region	Area	10.09	5.08	5.04
	Production	11.08	6.42	6.94
	Yield	1098.12	1262.94	1355.65
Balkh Region	Area	10.09	18.25	28.75
	Production	11.11	25.67	37.17
	Yield	1101.17	1397.03	1282.92
Helmand Region	Area	9.42	11.33	45.42
	Production	10.36	12.33	67.42
	Yield	1099.96	1100.93	1465.04
Herat Region	Area	0.25	1.18	1.87
	Production	0.28	1.31	2.68
	Yield	1100.00	1130.76	1400.45
Nangarhar Region	Area	3.15	4.98	3.44
	Production	3.47	5.32	3.97
	Yield	1099.42	1106.53	1123.12
Afghanistan	Area	33.00	40.81	84.52
	Production	36.29	51.07	118.18
	Yield	1099.72	1254.57	1382.65

(Note: Area in thousand hectares, production in thousand metric tonnes, yield in kg/ha)

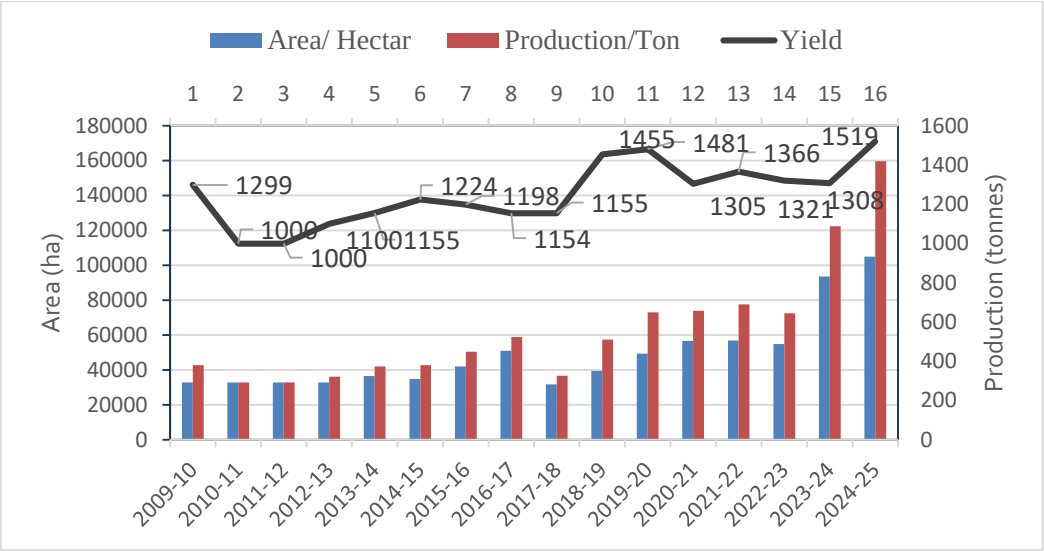

Figure 1. *Trend in area, production and yield of cotton in Afghanistan, 2009-2010 to 2024-2025*

Instability in area, production and Productivity of cotton

The situation of instability regarding cotton area, production and yield in Afghanistan's major producing regions is illustrated in Table 3. The instability in the area under cotton cultivation was 22.50 percent over the overall period. Herat region registered the highest instability (69.91%), whereas the Balkh region was demonstrated stability, with an instability index of 21.62%. The instability index was 53.01 percent in Nangarhar, 40.48 percent in the Helmand region, and 30.69 percent in the Spin Zar (Kunduz) region during the study period. On the contrary, these four regions were unstable in terms of extent during the study period. This condition existed due to price swings and the migration of land to other industrial crops.

Regarding production, the Herat region recorded the largest instability during period II and the overall period. The Nangarhar region registered 45.64 percent instability in production during period I. Thus, all regions recorded the highest instability index in production during Period I, Period II, and the overall period. This was attributed to greater production costs and the greatest yield instability indices in these regions.

In terms of yield, instability in the Helmand region was 14.67 percent during the entire period. The highest instability in productivity was registered in the Nangarhar region at 17.08 percent, whereas Helmand, at 8.01 percent, showed the lowest instability during period II. During period I, the lowest yield instability (12.07 percent) was observed in the Nangarhar region. At the Afghanistan level, yield was stable over period II and the overall period compared to period I.

Table 3. *Instability in area, production and productivity of cotton in major producing regions in Afghanistan, 2009-2010 to 2024-2025*

Regions	period-i			period-ii			overall-period		
	A	P	Y	A	P	Y	A	P	Y
Spin Zar (Kunduz) Region	23.15	29.64	11.52	40.14	48.85	12.45	30.69	39.04	12.60
Balkh Region	27.69	34.82	11.57	15.51	22.71	13.11	21.62	26.92	14.19
Helmand Region	14.21	23.46	17.64	18.16	16.17	8.01	40.48	48.72	14.67
Herat Region	20.56	23.33	9.72	65.32	65.96	13.03	69.91	69.70	14.20
Nangarhar Region	45.92	45.64	8.74	18.33	35.59	17.08	53.01	50.51	13.87
Afghanistan	10.55	14.06	9.50	13.69	17.10	8.24	22.50	24.84	8.65

DISCUSSION

The current study used the compound annual growth rate (CAGR) and the Cuddy-Della Valle instability index to assess the growth performance and volatility of cotton area, production, and yield throughout Afghanistan's major cotton-producing regions from 2009-10 to 2024-25. The findings reveal strong spatial and temporal variation in cotton dynamics, reflecting the influence of agro-climatic conditions, input accessibility, policy environment, and market structures.

The data reveal that the Herat region demonstrated the highest and most substantial rise in cotton acreage and production during Period I. and the overall study period. This suggests that Herat benefited from relatively favorable production conditions, improved access to inputs, and possibly better adaptation of farmers to cotton cultivation practices. However, the relatively low or negative yield growth in some periods indicates that area expansion, rather than productivity improvement, played a major role in production growth. This pattern is consistent with findings by Devegowda et al. (2023), who reported that cotton production growth in developing regions is often driven more by expansion in cultivated area than yield improvement.

In contrast, the Spin Zar (Kunduz) region consistently showed negative growth in area and production across most periods, indicating a structural decline in cotton cultivation. This may be attributed to climatic stress, reduced profitability, pest pressures, and possible crop substitution toward more profitable or less risky alternatives. Similar regional decline patterns have been observed in other studies, where farmers shift away from cotton due to price volatility and pest infestation risks (Shwetha et al., 2022).

The Helmand region emerged as a key growth center during Period II, with the highest and most significant growth in area, production, and yield. This suggests a strong expansion phase likely supported by improved irrigation, increased investment in agriculture, or favorable policy interventions. The positive yield growth in Helmand also indicates improved productivity, possibly due to better agronomic practices or adoption of improved varieties.

This supports broader evidence that technological adoption and input availability significantly enhance agricultural productivity (Barakova et al., 2018).

At the national level, Afghanistan exhibited steady growth in cotton area, production, and yield during Period I, followed by stronger expansion in Period II, particularly in area and production. However, yield growth remained relatively modest compared to area expansion, suggesting that productivity improvements have not kept pace with cultivated land expansion. This suggests inefficiencies in input use, limited access to improved seed varieties, and weak extension services, which are commonly identified constraints in developing agricultural systems.

The triennium-ending analysis clearly shows a sustained expansion in cotton cultivation in Afghanistan, reflected in rising area, production, and yield over time. The sharp increase in total cotton area from 33 thousand ha during TE 2011-12 to 84.52 thousand ha during TE 2024-25 indicates renewed farmer interest in cotton, likely driven by relatively better price incentives, expanding demand from domestic ginning units, and gradual improvements in access to inputs and irrigation in major producing regions. Similar findings by Ahmadzai et al. (2020) revealed that during the past three decades, growth in area, production, and yield has increased in nearly all of the country major states.

The instability analysis further revealed moderate to high variability in cotton area and production across regions, while yield instability remained relatively lower. High instability in the area and production, particularly in Herat, Nangarhar, and Helmand, reflects sensitivity to climatic variability, market fluctuations, and changes in input costs. These findings are consistent with Cuddy and Della Valle (1978), who emphasize that agricultural instability is largely driven by both structural and external shocks, especially in developing economies.

The relatively lower instability in yield compared to area and production suggests that productivity per unit land is more stable than farmers' decision-making regarding cultivated area. This indicates that farmers are more responsive to external economic and environmental signals when allocating acreage, whereas yield is more dependent on agronomic and technological factors. This study is based on secondary time-series data, which limits the ability to capture micro-level factors such as farm-level decision-making, input usage patterns, and household socio-economic conditions. In addition, the analysis focuses on selected major cotton-producing regions, which may not fully represent smaller or emerging cotton-growing areas in Afghanistan. The study also does not explicitly incorporate the effects of climate variability, policy shifts, and market price transmission mechanisms due to data constraints. Future research should therefore focus on incorporating primary farm-level data to better understand the determinants of productivity and instability in cotton production. Moreover, integrating climate variables, input use efficiency, and price transmission analysis would provide deeper insights into the structural drivers of cotton sector performance. Advanced econometric or spatial modeling approaches could further enhance understanding of regional disparities and long-term sustainability of cotton production in Afghanistan.

Overall, the study highlights that cotton production in Afghanistan is characterized by uneven regional growth and significant instability, with clear dependence on a few major producing regions. This structural concentration increases vulnerability to shocks such as droughts, input shortages, and price fluctuations. Therefore, policy interventions to improve input supply systems, promote climate-resilient varieties, strengthen extension services, and expand access to credit are essential for stabilizing and enhancing cotton production in Afghanistan.

CONCLUSION

Based on the results, it can be concluded that during period I and the entire period, the Herat region recorded the greatest and significant growth rates in both area and production of cotton. While in yield, it registered the highest growth rate only during the overall period.

Spin Zar (Kunduz), however, showed negative growth rates in area and production across all periods. The declining growth rate in the area and in cotton production in the Spin Zar (Kunduz) region was mainly due to climatic conditions. These patterns may be associated with climatic variability, input constraints, and market-related factors. The Helmand region registered the highest and most significant growth rates in area, production, and yield during period II. Whereas, Balkh, Spin Zar (Kunduz) and Nangarhar regions in period II registered negative growth. During period I, all Afghanistan levels maintained steady growth, with 5.58, 6.50, and 0.88 percent growth in area, production, and yield, respectively. The growth rate in cotton yield was also positive across all major regions in all periods, except in the Nangarhar Region in periods I and II. The study also observed that total area under cotton in Afghanistan was 84.52 thousand ha during TE 2024-25.

The study also revealed substantial instability in cotton area, production, and yield across regions and periods. This instability may be associated with climatic variability, input supply constraints, and market fluctuations; however, these factors were not directly tested in the present study. Government and financial institutions should take appropriate steps to expand credit facilities for growers, thereby increasing cotton production across Afghanistan and helping the country compete in the global market. Cotton growers are encouraged to adopt improved management practices and suitable varieties to enhance productivity.

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Authors' Contributions

All authors contributed significantly to the publication of this article. Abdul Baqi Ahmadzai and Nasir Ahmad Ahmadzai led the conceptualization and writing of the original manuscript draft. Ayaz Khan Naseri contributed to methodology and analysis—review, editing, and finalization. Noorullah Halimzai performed review, editing, and finalization.

Conflict of Interest Statement

The authors declare that they have no conflict of interest regarding the publication of this study. All the research, data collection, analysis, and interpretation were conducted independently, and no financial, personal, or professional relationships influenced the results or conclusions presented in this paper.

Data availability Statement

The corresponding author can provide the data supporting the study's conclusions upon reasonable request.

REFERENCES

Ahmadzai, A. B., & Sidana, B. K. (2020). Economic analysis of growth and instability of coffee in India. *International Research Journal of Agricultural Economics and Statistics*, 11(1), 29–35. https://doi.org/10.15740/HAS/IRJAES/11.1/29-35

Alizadah, M. H., Hosainy, S. A. H., & Ghafori, S. (2026). Production and export performance of Afghan saffron over the past decade. *Journal of Natural Science Review*, *4*(1), 114–126. https://doi.org/10.62810/jnsr.v4i1.387

Naseri, A. K., Ahmadzai, K. M., & Honaryar, G. (2024A). Performance of agriculture export commodities from Afghanistan to world. *Journal of Natural Science Review*, 2(Special Issue), 316–329. https://doi.org/10.62810/jnsr.v2iSpecial.Issue.148

Naseri, A. K., Shahnoushi, N., Dourandish, A., Nematollahi, Z., & Kiani Feyzabad, Z. (2025). Impact of changes in agriculture import tariffs on Afghanistan's food availability and macroeconomic factors. *Journal of Natural Science Review*, *3*(3), 15–32. https://doi.org/10.62810/jnsr.v3i3.267

Naseri, A. K., & Jauhar, S. (2024B). Macroeconomic impact of foreign remittances on Afghanistan's agriculture sector. *Journal of Natural Science Review*, 2(Special Issue), 240–254. https://doi.org/10.62810/jnsr.v2iSpecial.Issue.128

Barakova, T., Delchev, G., Valkova, N., Sturzu, R., Meluca, C., & Cojocaru, J. (2018). Effect of some herbicides and their mixtures with growth regulator and foliar fertilizer on protein content in cotton (Gossypium hirsutum L) seeds. *Romanian Agricultural Research*, No. 36: 3-10. https://doi.org/10. 10.59665/rar3621

Champaneri, D.D. & Patel, N.K., (2022). Photo selective shade net: An effective tool to reduce the impact of global warming and pesticide residues in vegetable production: A review. *Agricultural Reviews*. 43: 135-144. https://doi.org/10.18805/ag.R-2363

Cuddy, J. D. A., & Della Valle, P. A. (1978). Measuring the instability of time series data. *Oxford Bulletin of Economics and Statistics,* 40(1), 79–85. https://doi.org/10.1111/j.1468-0084.1978.mp40001006

Devegowda, S. R., Yadav, A., Nagaveni, M., & Kushwaha, S. (2023). Sowing seeds of prosperity: Uncovering the calculated growth, instability and decomposition of cotton in India. *Ecology, Environment and Conservation*, 36(3), 283–286. https://doi.org/10.61475/JFS.2023.v36i3.11

Esar, B.A., Singh, G. & Younisi, H. (2024). Afghanistan saffron and potential for the economy: An overview of international trade and domestic well-being. *Agricultural reviews*. https://doi.org/10.18805/ag.RF-290

FAOSTAT. (2024). Production-Crops and livestock products. Food and Agriculture Organization of the United Nations. https://www.fao.org/faostat/en/#data

Jadhav, D. S., More, S. S., Choudhari, S. D., & Chaudhari, S. A. (2020). Growth and instability in area, production and yield of cotton in India. *International Journal of Current Microbiology and Applied Sciences,* 9, 1411–1417. https://www.ijcmas.com/special/11/D.

National Statistics and Information Authority. (2025). *Annual statistical report*. Kabul, Afghanistan. https://nsia.gov.af/

Nithin, K. N. (2016). Production and export performance of grapes from India: an econometric analysis. *Research journal of agricultural sciences*, 7(3): 143-146. https:// www.rjas.org di: 3333-1103-2016-34.

Rana, M. J., Islam, S., & Kamruzzaman, M. (2021). Growth and instability in area, production and productivity of major spices in Bangladesh. *Journal of Agriculture and Food Research*, 6, 100216. https://doi.org/10.1016/j.jafr.2021.100216

Rasikh, Z. U. R., Amini, A., Niazi, S., Joolaie, R., & Mirkarimi, S. (2023). Analysis of the consequences of agricultural policies on the cropping pattern of agricultural products and employment in Afghanistan. *Australian Journal of Engineering, Innovation and Technology*, 5(5), 206–215. https://doi.org/10.34104/ajeit.023.02060215

Samuel, J., & Rejani, R. (2015). Production, growth and export competitiveness of raw cotton in India: An economic analysis. *Agricultural Research and Technology*, 1(1), 1–5. https://www.researchgate.net/publication/332141543

Shwetha, M. N., Devi, S., Lavanya, T., Suhasini, & Meena, A. K. (2022). Growth in area, production, and productivity of cotton crop in India: A state-wise analysis.

International Journal of Environment and Climate Change, 12(11), 51–57. https://doi.org/10.9734/ijecc/2022/v12i1130944

Wani, B. K., Kaspate, R. N., & Memane, S. R. (2024). Growth and instability in area, production and productivity of major cash crops in India. *Environmental Conservation Journal*, 30(2), 858–864. https://doi.org/10.53550/EEC.2024.v30i02.073

Zankat, K. M., & Bhatt, J. D. (2025). Growth and instability in Indian cotton: An analysis of area, production, yield and exports. *International Journal of Statistics and Applied* Mathematics, 10(3), 47–51. https://www.doi.org/10.22271/maths.2025.v10.i3a.2007