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Impact of high density planting system on cotton growers in Yavatmal district

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Abstract

Cotton cultivation in rainfed areas is often associated with low productivity, increasing production constraints and limited farm income. The present study was conducted to assess the impact of High Density Planting System (HDPS) cotton technology on beneficiary cotton growers in Yavatmal district of Maharashtra. An ex-post-facto research design was followed for the study. Yavatmal district and three tehsils, namely Kalamb, Ralegaon and Bahlulgaon, were selected purposively. A total of 120 cotton growers were selected randomly, comprising 60 beneficiary farmers who cultivated cotton under HDPS demonstrations and 60 non-beneficiary farmers who followed traditional cotton cultivation practices. Data were obtained through personal interviews using a structured interview schedule. The impact was assessed in terms of changes in yield, productivity and annual income using percentage change. The results showed that 41.67 per cent of beneficiary farmers belonged to the medium-yield category, whereas 80.00 per cent of non-beneficiary farmers were in the low-yield category. In terms of productivity, 86.67 per cent of beneficiary farmers were in the high-productivity category, while 88.33 per cent of non-beneficiary farmers were in the low-productivity category. Regarding annual income, 20.00 per cent of beneficiary farmers belonged to the high-income category compared with 05.00 per cent of non-beneficiary farmers. The mean yield of beneficiary farmers was 41.90 qt compared with 30.25 qt among non-beneficiary farmers, showing a 38.51 per cent increase. The mean productivity was 35.00 qt/ha for beneficiary farmers compared with 16.42 qt/ha for non-beneficiary farmers, indicating a 113.15 per cent increase. Similarly, the mean annual income was ₹4,82,594 for beneficiary farmers compared with ₹3,30,830 for non-beneficiary farmers, showing a 45.88 per cent increase. The Z-test results indicated that the differences in yield (4.35), productivity (29.26) and annual income (5.14) were significant at the 0.01 level. The findings indicate that HDPS cotton technology had a positive and significant impact on yield, productivity and annual income, thereby improving the economic outcomes of beneficiary cotton growers under the study conditions.

Keywords: High Density Planting System, Cotton growers, Impact assessment, Yield, Productivity, Annual income

Introduction

Cotton is an important commercial crop in India and provides livelihood to a large number of farming families. It also contributes significantly to the textile industry and rural economy. However, cotton productivity continues to face several challenges. A considerable area under cotton is rainfed, making crop performance highly dependent on the amount and distribution of rainfall. High cultivation costs, pest incidence, labour problems and weather fluctuations further affect production and farm returns. These challenges are particularly important in Maharashtra, where cotton is one of the major crops and an important source of livelihood for farming households.

Yavatmal is one of the major cotton-growing districts of Maharashtra, where cotton is largely cultivated under rainfed conditions. Farmers in the district often face problems related to irregular rainfall, fluctuating productivity, increasing

cultivation costs and labour availability. Under such conditions, improving productivity from the available land area is important for increasing the returns from cotton cultivation. Therefore, suitable production technologies that can improve productivity and farm income have considerable importance.

The High Density Planting System is one such technology promoted for improving cotton productivity. It involves maintaining a higher plant population per unit area through closer spacing, timely sowing and appropriate crop management. Compared with conventional cultivation, the technology aims to make better use of available land present study was undertaken to assess the impact of High Density Planting and promote early and relatively uniform crop maturity. It may also facilitate timely harvesting and provide better scope for mechanized harvesting. Thus, High Density Planting System has emerged as a promising approach for

improving cotton production, particularly under conditions where productivity and labour-related problems are important concerns.

Several studies have reported encouraging results from High Density Planting System in cotton. Venugopalan *et al.* (2013)^[11] emphasized the importance of plant population and crop geometry for improving cotton productivity. Saritha *et al.* (2024)^[8], in a comparative analysis of High-Density Planting System and traditional cotton cultivation practices, reported better performance under high density planting. B. Raja and Madhushekar (2025)^[2] reported positive outcomes from High Density Planting System demonstrations among cotton farmers. Thakare *et al.* (2026)^[10] highlighted the potential of the technology for improving cotton yield, while Phanisri *et al.* (2026)^[4], through an impact and gap analysis of High Density Planting System in cotton, identified both its potential and gaps requiring attention for effective adoption. Although earlier studies have shown the potential of High Density Planting System, its benefits may vary under different farming and local conditions. Therefore, assessing the performance of the technology among beneficiary farmers under actual field conditions is important, particularly in major cotton-growing areas such as Yavatmal district. Hence, the System cotton technology on beneficiary cotton growers in Yavatmal district of Maharashtra. The impact was assessed in terms of changes in yield, productivity and annual income by comparing beneficiary and non-beneficiary cotton growers.

Objectives

To assess the impact of HDPS cotton technology on beneficiary cotton growers

Methodology

Mean of beneficiary – Mean of non-beneficiary

Change (%) = ----- X 100

Mean of non-beneficiary

To assess the significance of the difference between beneficiary and non-beneficiary farmers with respect to the selected impact parameters, the Z-test for difference between two independent means was used.

The Z-value was calculated as:

$$Z = \frac{|X_1| + |X_2|}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Where,

X_1 = Mean of beneficiary farmers

X_2 = Mean of non-beneficiary farmers

σ_1 = Standard deviation of beneficiary farmers

σ_2 = Standard deviation of non-beneficiary farmers

n_1 = Number of beneficiary farmers

n_2 = Number of non-beneficiary farmers

The calculated Z-values were tested for significance at the 0.05 and 0.01 levels of probability using the appropriate critical values.

Results and discussion

1. Change in yield

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The present study was carried out in Yavatmal district of Maharashtra, an important cotton-growing region where High Density Planting System (HDPS) cotton demonstrations had been conducted by Krishi Vigyan Kendra, Yavatmal during the previous two years. An ex-post-facto research design was followed because the HDPS technology had already been introduced to the farmers and its impact was assessed after implementation. Yavatmal district was selected purposively considering its importance in cotton cultivation and the availability of HDPS demonstrations. Three tehsils, namely Kalamb, Ralegaon and Babhulgaon, were selected purposively based on the presence of both beneficiary and non-beneficiary cotton growers. From these tehsils, 120 cotton growers were selected randomly, including 60 beneficiary and 60 non-beneficiary farmers, with 20 respondents from each group in each tehsil. Beneficiary farmers had cultivated cotton under HDPS demonstrations, while non-beneficiary farmers followed conventional cotton cultivation practices.

The required information was collected through personal interviews using a structured interview schedule prepared in line with the objectives of the study. The schedule included information on yield, productivity and annual income along with other relevant characteristics of the respondents. Before the final survey, the schedule was pre-tested among farmers from non-sampled villages and necessary changes were made to improve the clarity and sequence of questions. The data obtained from the respondents were organized and analyzed using frequency, percentage, mean and standard deviation.

The impact of HDPS cotton technology was assessed by comparing beneficiary and non-beneficiary farmers with respect to yield, productivity and annual income. The percentage change in each indicator was calculated using the formula:

Table 1: Distribution of respondents according to their yield

Sr. No	Yield	Beneficiary farmers (n=60)		Non-beneficiary farmers (n=60)	
		Freq.	%	Freq.	%
1	Low	24	40.00	48	80.00
2	Medium	25	41.67	09	15.00
3	High	11	18.33	03	05.00
Mean		41.90		30.25	
Change in%		38.51%			

The distribution of cotton growers according to yield showed a clear difference between beneficiary and non-beneficiary farmers (Table 1). Among the beneficiary farmers, the largest proportion (41.67%) belonged to the medium yield category (37-58 qt), followed by 40.00 per cent in the low yield category (up to 36 qt), while 18.33 per cent achieved a high yield (above 58 qt). In contrast, a large majority (80.00%) of non-beneficiary farmers were in the low yield category, with only 15.00 per cent in the medium and 05.00 per cent in the high yield category.

The mean yield of beneficiary farmers was 41.90 qt, compared with 30.25 qt among non-beneficiary farmers, indicating a considerably better yield performance among farmers cultivating cotton under HDPS. The yield of

beneficiary farmers was 38.51 per cent higher than that of non-beneficiary farmers. This improvement may be attributed to the higher plant population under HDPS, better utilization of available resources and improved crop management practices associated with the technology.

Venugopalan *et al.* (2013)^[11] emphasized the importance of plant population and crop geometry in improving cotton productivity. Similarly, Saritha *et al.* (2024)^[8] reported better performance of HDPS compared with traditional cotton cultivation practices. Comparable favourable yield responses under HDPS have also been reported by Thakare *et al.* (2026)

^[10], supporting the present finding.

The findings indicate that adoption of HDPS helped shift a greater proportion of farmers from the low-yield category towards medium and high yield levels. Thus, the higher mean yield and greater proportion of beneficiary farmers in the medium and high yield categories suggest that HDPS cotton cultivation has a positive effect on cotton yield compared with conventional cultivation practices.

2. Change in productivity

Table 2: Distribution of respondents according to their productivity

Sr. No	Productivity	Beneficiary farmers (n=60)		Non-beneficiary farmers (n=60)	
		Freq.	%	Freq.	%t
1	Low	00	00.00	53	88.33
2	Medium	08	13.33	07	11.67
3	High	52	86.67	00	00.00
Mean		35		16.42	
Change in%		113.15%			

The distribution of beneficiary and non-beneficiary cotton growers according to their productivity is presented in Table 2. Among the beneficiary farmers, most (86.67%) recorded high productivity (above 30.27 qt/ha), while 13.33 per cent had medium productivity (20.56-30.27 qt/ha). None of the beneficiary farmers were in the low productivity category. In comparison, 88.33 per cent of the non-beneficiary farmers had low productivity (up to 20.55 qt/ha), followed by 11.67 per cent with medium productivity. None of the non-beneficiary farmers recorded high productivity.

The mean productivity was 35.00 qt/ha among beneficiary farmers, compared with 16.42 qt/ha among non-beneficiary farmers. Thus, beneficiary farmers recorded 113.15 per cent higher productivity than non-beneficiary farmers. This noticeable difference suggests that farmers following HDPS were able to obtain better productivity than those following traditional cotton cultivation practices. The better performance may be related to the closer plant spacing and higher plant population maintained under HDPS, along with timely and improved crop management practices.

The magnitude of the productivity advantage is directionally consistent with the reported performance of HDPS in rainfed cotton by Chandra Shaker *et al.* (2026)^[11]. Pradeep *et al.* (2017)^[5] also examined the effect of HDPS and varieties on cotton yield, economics and quality, providing further support for the production advantages associated with the system.

Similar economic and performance benefits associated with HDPS demonstrations have been documented by Madhushekar *et al.* (2025)^[2]. Pradeep *et al.* (2017)^[5] also reported on the yield and economics of cotton under HDPS and varieties, supporting the economic relevance of improved production performance under HDPS.

Overall, the findings suggest that HDPS technology had a favourable influence on cotton productivity, with beneficiary farmers performing considerably better than non-beneficiary farmers.

3. Change in annual income

Table 3: Distribution of respondents according to their annual income

Sr. No	Annual income	Beneficiary farmers (n=60)		Non-beneficiary farmers (n=60)	
		Freq.	%	Freq.	%
1	Low	23	38.33	45	75.00
2	Medium	25	41.67	12	20.00
3	High	12	20.00	03	05.00
Mean		482594		330830	
Change in%		45.88%			

The distribution of beneficiary and non-beneficiary cotton growers according to their annual income is presented in Table 3. Among the beneficiary farmers, 41.67 per cent belonged to the medium-income category (₹3,88,894-₹6,48,786), while 38.33 per cent were in the low-income category (up to ₹3,88,893) and 20.00 per cent were in the high-income category (above ₹6,48,786). Among the non-beneficiary farmers, 75.00 per cent belonged to the low-income category, followed by 20.00 per cent in the medium-income category and 05.00 per cent in the high-income category.

The mean annual income of beneficiary farmers was ₹4,82,594, compared with ₹3,30,830 among non-beneficiary farmers. Thus, beneficiary farmers recorded 45.88 per cent higher annual income than non-beneficiary farmers. Although the largest proportion of beneficiary farmers was in the medium-income category, a comparatively higher proportion of them were also found in the high-income category than non-beneficiary farmers. This difference may be related to the better yield and productivity obtained under HDPS cotton cultivation, which contributed to improved returns from cotton production.

Similar economic and performance benefits associated with HDPS demonstrations have been documented by Madhushekar *et al.* (2025) ^[2]. Pradeep *et al.* (2017) ^[5] also reported on the yield and economics of cotton under HDPS and varieties, supporting the economic relevance of improved production performance under HDPS.

Overall, the findings indicate that HDPS cotton technology had a favourable influence on the annual income of beneficiary farmers, who showed a comparatively better income position than farmers following traditional cotton cultivation practices.

Testing the significance of difference between means

The differences between beneficiary and non-beneficiary cotton growers were tested using the Z-test for difference between two independent means to assess whether the observed differences in the selected impact parameters were statistically significant. The results are presented in Table 4. The results showed that beneficiary farmers had higher mean values for all three parameters. For yield, the mean was 41.90 qt among beneficiary farmers compared with 30.25 qt among non-beneficiary farmers, showing a 38.51 per cent increase. The calculated Z-value (4.35) was significant at the 0.01 level, indicating a significant difference in yield between the two groups.

A clear difference was also observed in productivity. Beneficiary farmers recorded a mean productivity of 35.00 qt/ha, compared with 16.42 qt/ha among non-beneficiary

farmers, resulting in a 113.15 per cent increase. The calculated Z-value (29.26) was significant at the 0.01 level, confirming a significant difference in productivity.

Similarly, the mean annual income of beneficiary farmers was ₹4,82,594, while it was ₹3,30,830 among non-beneficiary farmers. This represented a 45.88 per cent increase, and the calculated Z-value (5.14) was significant at the 0.01 level.

The results are broadly consistent with earlier reports cited in the study. Venugopalan *et al.* (2013) ^[11] emphasized the contribution of plant population and crop geometry to cotton productivity. Saritha *et al.* (2024) ^[8] reported better performance under HDPS than conventional cultivation, while Madhushekar *et al.* (2025) ^[2], Chandra Shaker *et al.* (2026) ^[1] and Thakare *et al.* (2026) ^[10] documented favourable production and/or economic responses associated with HDPS. Phanisri *et al.* (2026) ^[4] additionally reported both the potential and implementation gaps associated with HDPS. The present findings add district-level evidence from Yavatmal and demonstrate that the differences extend beyond yield to productivity and annual income.

Thus, the significant differences observed for all three parameters, along with the higher mean values and percentage changes among beneficiary farmers, indicate that HDPS cotton technology had a positive and significant impact on the yield, productivity and annual income of beneficiary farmers.

Table 4: Testing the significance of difference between means

Sr. No	Impact parameter	Mean Score		Per cent change	z VALUE
		Beneficiary	Non-Beneficiary		
1	Yield	41.90	30.25	38.51	4.35**
2	Productivity	35	16.42	113.15	29.26**
3	Annual income	482594	330830	45.88	5.14**

Conclusion

The study clearly showed that HDPS cotton cultivation performed better than conventional cotton cultivation in terms of yield, productivity and annual income. Beneficiary farmers had a higher mean yield of 41.90 qt compared with 30.25 qt among non-beneficiary farmers, resulting in a 38.51 per cent increase in yield. A more noticeable difference was observed in productivity, where beneficiary farmers recorded 35.00 qt/ha compared with 16.42 qt/ha among non-beneficiaries, representing a 113.15 per cent increase. The mean annual income of beneficiary farmers was ₹4,82,594, compared with ₹3,30,830 among non-beneficiary farmers, showing a 45.88 per cent increase in annual income. The findings suggest that HDPS can help farmers achieve better crop performance and improve their economic returns when the recommended planting geometry and crop management practices are followed properly. The higher proportion of beneficiary farmers in the medium and high categories of yield and productivity further supports the usefulness of the technology under the study conditions. Overall, the study indicates that HDPS cotton technology has considerable potential to improve cotton productivity and farm income. Wider promotion of the technology through field demonstrations, timely technical guidance and continued extension support may encourage more farmers to adopt HDPS and realize its benefits.

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