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Impact of mechanization on time savings and timeliness of operation in cotton cultivation

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Abstract

India is a significant cotton producer, occupying 23 per cent of the global cotton growing area and contributing about 10 per cent of the total cotton production. However, the average productivity in India is lower as compared to other countries. Improved farm implements and machinery are rightly called as 'input of inputs'. It has been recognized as an integral part of agricultural development for improving resource use efficiency and productivity in agriculture. Government spending huge amount on accelerating the pace of farm mechanization by providing various tools and machineries at subsidized rate to the farmers. As all these efforts of farm mechanization connected with investment on the part of government. The investigation was planned to assess impact of farm mechanization on cotton growers. The study conducted in forty villages of ten talukas and five districts of Western Vidarbha region of Maharashtra State. Respondent farmers were selected on the basis of use of improved farm implements& machineries in cotton cultivation from last 3 years either benefitted under the scheme or using it on hiring basis as user of mechanized farming and those farmers following the farm operations through traditional method and non-beneficiary of any mechanization scheme as non-user. A pre-tested structured interview schedule was used to collect the data from the respondents by personal interview method. Two parameters were selected to study the impact namely, time saving and timeliness of operation in cotton cultivation. The finding of the study revealed that there was 67.15per cent change in timeliness of operations and 62.97 per cent change in time saving. Thus, cotton growers who adopt mechanized farming techniques experience an overall impact of 65.06 per cent as compared to those who practice non-mechanized farming, excluding cotton picking operation. Therefore, further efforts are needed to raise awareness among farmers about the importance of mechanization in cotton farming to elevate the impact from a high to a very high level.

Keywords: Impact, farm mechanization, timeliness of operation, time saving, cotton growers

Introduction

Agriculture occupies pivotal role in Indian economy. Over the past decade, there has been a growing recognition of the significance of farm mechanization. Consequently, new farming equipment and implements have been developed and brought into the market. This has resulted in increasing productivity, boosting food production to meet the needs of the growing population, while simultaneously reducing the physical toll associated with farming activities. Farmers suffer due to labor shortages during critical agricultural operations. Therefore, there is a strong case for the adoption of labour-saving farm machinery. It is important to note that, certain agricultural activities are time-bound and any delay can result in losses for the farmers. To address the labour shortage, farmers have employed various strategies such as sourcing labor from outside their villages, contracting farm work, shared farming, and embracing farm mechanization. Farm mechanization is considered one of the pathways to agricultural development. Farm mechanization is nothing but application of engineering and technology in the agricultural operation to do a job in better way to enrich productivity.

Considering the need of hour, the farm mechanization has its own importance in upliftment of farming community. Government spending huge amount on accelerating the pace of farm mechanization by providing various tools and machineries at subsidized rate to the farmers. Especially the mechanized operations are being carried out by cotton growers to perform different farm operation on time and to reduce the time of operation. As all this efforts of farm mechanization connected with investment on part of government.

As per oxford dictionary, impact is the powerful effect of something on something/someone. It is operationally defines as changes (economical, social and environmental) happened by the use of mechanization in farming on cotton growers. The present investigation was planned to assess impact of farm mechanization on time saving and timeliness of operation by cotton growers.

Methodology

The study was conducted in Western Vidarbha region of Maharashtra state comprises five districts i.e. Buldana, Akola, Amravati, Washim, Yavatmal. The list of talukas were obtained from Department of Agriculture in which the area under cotton cultivation was more and where maximum tractors, machineries and improved tools were distributed through various mechanization schemes. Based on maximum beneficiaries in talukas, two talukas were selected from each district. The lists of villages having the beneficiaries of mechanization scheme and having more area under cotton cultivation were obtained from the Taluka Agricultural Officer (TAO). Accordingly, forty villages were selected from ten talukas of five districts in western Vidarbha. Selection of farmers was done on the basis ofuse of improved farm implements& machineries in cotton cultivation from last 3 years either benefitted under the scheme or using it on hiring basis as user of mechanized farming and those farmers following the farm operations through traditional method and non-beneficiary of any mechanization scheme as non-user. A pre-tested structured interview schedule was used to collect the data from the respondents by personal interview method and exploratory research design was used in this study.

To measure impact of farm mechanization two dimensions were selected and calculated namely,

1. Change in timeliness of operation
2. Change in time saving

1. Change in timeliness

Timeliness refers to on time farm operation from sowing to cotton picking by the use of farm implement and machinery. The change in timeliness is operational zed as difference between on time farm operation take place in mechanized and non mechanized farming.

The per cent change in timeliness is calculated by using following formula.

$$\Delta T = \frac{Tfm - Tnfm}{Tnfm} \times 100$$

Where,
ΔT = Per cent change in timeliness
Tfm = Timeliness in mechanized farming
Tnfm = Timeliness in non mechanized farming

2. Change in time saving

The per cent change in time saving was calculated by using following formula.

$$\Delta Ts = \frac{Tsfm - Tsnfm}{Tsnfm} \times 100$$

Where,
ΔTs = Per cent change in time saving
Tsfm = Time saving by mechanized farming
Tsnfm = Time saving by non mechanized farming

Overall impact of farm mechanization in agriculture

The impact score of farm mechanization in agriculture was measured by summing up the mean values of change in percentage of selected impact parameter i.e. change in production, employment of human labour, timeliness of operation, time saving, input utilization, farming expenditure, and drudgery are as follows

$$\text{Impact} = \frac{\Delta T + \Delta Ts}{N} \times 100$$

Where,
ΔT= Per cent change in timeliness
ΔTs = Per cent change in time saving
N= No. of parameters

Results

Change in timeliness of operation

Timeliness of operation in agriculture refers to the strategic timing of various farming activities throughout the crop production cycle. It involves executing tasks such as planting, irrigation, fertilization, pest management, and harvesting at specific stages or under favorable conditions to optimize crop growth, yield, and quality. The concept emphasizes performing these activities promptly and in alignment with the crop's developmental needs and environmental factors, aiming to maximize efficiency, minimize risks, and enhance overall agricultural productivity.

The change in timeliness is measured as the difference between the occurrence of on-time operations in mechanized and non-mechanized farming on yes and no basis with scoring 2 and 1 respectively, as reported by respondents. Frequency scores for each operation were used to assess the variation in timeliness of operations between mechanized and non-mechanized farming. Details are provided in the table below.

Table 1: Distribution of the respondents according to change in timeliness of operation

Sl. No.	Cotton cultivation practices	Timeliness of operation			
		Users (n=200)		Non- Users (n=200)	
		Yes (2)	No (1)	Yes (2)	No (1)
1	Land preparation	183 (91.50)	17 (08.50)	59 (29.50)	141 (70.50)
2	Sowing	172 (86.00)	28 (14.00)	39 (19.50)	161 (80.50)
3	Fertilizer application	173 (86.50)	27 (13.50)	43 (22.50)	157 (78.50)
4	Intercultural operation	161 (80.50)	39 (19.50)	34 (17.00)	166 (83.00)
5	Plant protection	179 (89.50)	21 (10.50)	21 (10.50)	179 (89.50)
	Average	173.6 (86.80)	26.40 (13.20)	39.20 (19.60)	160.8 (80.40)

From the Table 1, it is observed that a majority (91.50%) of user respondents reported being able to undertake spraying operations on time, compared to only 29.50 per cent of non-user respondents. For sowing operations, 86.00 per cent of user respondents stated they could perform the task on time, versus 19.50 per cent of non-user respondents. 86.50 per cent of user respondents reported being able to apply fertilizer on time, compared to 22.50 per cent of non-user respondents. For intercultural operations, 80.50 per cent of user respondents could undertake the task on time, while only 17.00 per cent of non-user respondents agree with it. In plant protection operations, 89.50 per cent of user respondents could perform the task on time, compared to 10.50 per cent of non-user respondents.

Thus from the table, it was depicted that, overall on an average 86.80 per cent of the respondents agree that, there was on time operation takes place in mechanized farming, while only 19.60 per cent of the respondents are expressed that there was timeliness of operation by non mechanized way.

Table 2: Distribution of the respondents according to change in timeliness of operation

Sl. No.	Cotton cultivation practices	Average timeliness of operation			
		Users (n=200)	Non-users (n=200)	Difference	Percent Change
		Mean	Mean		
1	Land preparation	1.96	1.19	0.78	65.40
2	Sowing	1.97	1.20	0.77	64.44
3	Fertilizer application	1.95	1.21	0.75	61.83
4	Intercultural operation	1.94	1.17	0.77	65.38
5	Plant protection	1.99	1.11	0.88	79.64
	Total	09.80	05.86	3.94	67.15

The data depicted in 2, it is shown that the average timeliness of operation score was 09.80 in mechanized farming, whereas it was 05.86 in non-mechanized farming. This indicates a difference of 3.94 in on time operation in mechanized and non-mechanized farming, representing a 67.15 per cent change due to mechanization.

Table 3: Distribution of the respondents according to per cent change in timeliness of operation

Sl. No.	Per cent change in timeliness of operation (%)	Respondents (n=200)	
		Frequency	Percentage
1	Delayed (12.50 to 34.37)	10	05.00
2	Fairly in time (34.38 to 56.25)	42	21.00
3	Mostly in time (56.26 to 78.12)	79	39.50
4	In time (78.13 to 100)	69	34.50
	Total	200	100.00

From the Table 3, it is observed that, 39.50 percent of respondents reported completing various operations mostly on time, with a 56.26 to 78.12 percent change in mechanized farming. This was followed by 34.50 percent of respondents who reported operations being completed on time (78.13 to 100 percent). Additionally, 21.00 percent indicated a 34.38 to 56.25 percent change, with tasks being completed fairly on time, while 05.00 percent of respondents noted delays (12.50 to 34.37 percent) in performing different farm operations.

The result supported by Dipankar *et al*. (2002) [2] and Singh *et al*. (2010) [5]

Change in time saving (Hr/ Ha)

Time saving refers to the practice or result of reducing the amount of time required to complete a task, process, or activity. It involves using efficient methods, tools, or strategies that minimize unnecessary delays or inefficiencies. The goal of time saving is to optimize productivity by allocating resources effectively and completing tasks more quickly without compromising quality or effectiveness.

It is defined in practice as the actual hours saved when performing various farm operations such as land preparation, sowing, fertilizer application, intercultural operations, plant protection, and harvesting in both mechanized and non-mechanized farming.

The change in time saving is quantified as the difference between the time required for these operations in mechanized versus non-mechanized farming. Mean scores for each operation were used to assess the variation in time saved (hr/ha) across different farm activities between mechanized and non-mechanized farming methods. Details can be found in the table below.

Table 4: Change in time saving among respondents

Sl. No.	Cotton cultivation practices	Average time saving (hr/ha)			
		Users (n=200)	Non-Users (n=200)	Difference	Percent Change
		Mean	Mean		
1	Land preparation	08.34	18.28	-09.87	53.99
2	Sowing	02.50	10.16	-07.66	75.39
3	Fertilizer application	07.73	18.47	-10.74	58.14
4	Intercultural operation	18.97	44.55	-25.58	57.41
5	Plant protection	13.63	46.87	-33.24	73.99
	Total	51.18	138.34	-87.16	62.97

From the Table 4, it is observed that, in case of time saving in mechanized farming, The average time required for land preparation was 08.34 hr/ha, against to 18.28 hr/ha in non-mechanized farming with difference of -9.87 and resulted in change of 53.99 per cent. For sowing operations there was 2.50 hr/ha in mechanized farming, compared to 10.16 hr/ha in non-mechanized farming with difference of -7.66 and resulted in 75.39 per cent change. For fertilizer application, mechanized farming required an average of 7.73 hr/ha, whereas non-mechanized farming required 18.47 hr/ha with difference -10.74 and resulted 58.14 per cent change. Intercultural operations in mechanized farming required 18.97 hr/ha, whereas in non-mechanized farming it required 44.55 hr/ha with difference of -25.58, resulted in 57.41 per cent change. Plant protection operations required 13.63 hr/ha in mechanized farming, while non-mechanized farming required 46.87 hr/ha with difference of -33.24 and resulted in 73.99 per cent change.

The average time required for performing different farm operation in mechanized farming was 51.18 hr/ha. While for non-mechanized farming was 138.34 hr/ha, with difference of -87.16 hr/ha of time saving and resulted in 62.97 per cent change in time savings dimension due to use mechanization in farming.

Table 5: Distribution of the respondents according to per cent change in time saving

Sl. No.	Per cent change in time saving	Respondents (N=200)	
		Frequency	Percentage
1	Very low (59.16 to 60.54)	07	03.50
2	Low (60.55 to 61.93)	32	16.00
3	Medium (61.94 to 63.32)	78	39.00
4	High (63.33 to 64.71)	63	31.50
5	Very high (64.71 to 66.1)	20	10.00
	Total	200	100.00

From the data depicted in Table 5, it is clear that 39.00 per cent of the respondents encountered a medium level change (61.94 to 63.32%) of time savings as a result of mechanization in farming. This was followed by 31.50 per cent indicating high level change (63.33 to 64.71%), however 16.00 per cent were stated low level change (60.55 to 61.93%), 10.00 per cent observed very high level (64.71 to 66.1%) change. Whereas only 04.00 per cent them experienced very low level (59.16 to 60.54%) of change in time savings due to use of mechanization in farming.

The result observed by Suleiman *et. al.* (2014) [8], Pooja *et al.* (2019) [3], Tiwari (2021) [4] and Singh (2023) [6].

Overall Impact

Table 6: Overall impact of Time Savings and Operational Timeliness in Mechanized Cotton Farming

Sl. no.	Impact Parameter	Respondents (n=400)		
		Mean		Percent Change
		User	Non user	
1	Timeliness of operation	09.80	05.86	67.15
2	Time saving (hrs /ha)	51.18	138.34	62.97
	Overall impact			65.06

From the data presented in the Table 6, it was observed that the overall impact of farm mechanization on cotton growers was 65.06 per cent. This figure was derived by averaging the percentage changes timeliness of operations (67.15%) and time saving (62.97%) Thus, cotton growers who adopt mechanized farming techniques experience an overall impact of 65.06 per cent compared to those who practice non-mechanized farming. This indicates significant improvements in several aspects of their agricultural operations.

Table 7: Distribution of the respondents according to overall impact of time savings and timeliness of operation in mechanized cotton farming

Sl. No.	Impact categories (%)	Respondents(n=200)	
		Frequency	Percentage
1	Very low (37.59 to 46.57)	09	04.50
2	Low (46.58 to 55.56)	30	15.00
3	Medium (55.57 to 64.54)	39	19.50
4	High (64.55 to 73.53)	69	34.50
5	Very high (73.53 to 82.52)	53	26.50
	Total	200	100.00

The Table 7 shows that, 34.50 percent of respondents reported a high level of change (64.55 to 73.53%) in the impact of time savings and operational timeliness in mechanized cotton farming. This was followed by 26.50 per cent who noted a very high level of change (73.53 to 82.52%). Additionally, 19.50 percent observed a medium level of change (55.57 to 64.54%), while 15.00 percent experienced a low level of change (46.58 to 55.56%). Lastly, 4.50 percent reported a very low level of change due to the impact of time savings and operational timeliness in mechanized cotton farming.

Conclusion

The study concluded that, farmers who utilized mechanized farming techniques benefited more than those who followed traditional practices. For respondents using mechanized farming, the mean value for timeliness of operations was 09.80, compared to 05.86 for non-users, showing a 67.15 per cent improvement. The mean time required for performing various farm operations was 51.18 hours per hectare for mechanized users, while it was 138.34 hours per hectare for non-users, indicating a 62.97 per cent reduction in time. This efficiency is likely due to the use of machinery and improved equipment, allowing for quicker, more efficient work by skilled labor, which ensured timely operations and saved time. Overall, mechanization resulted in a 65.06per cent impact on various farm operations, excluding cotton picking. Therefore, further efforts are needed to raise awareness among farmers about the importance of mechanization in cotton farming to elevate the impact from a high to a very high level.

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