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Impact of Mechanization under Maize Cultivation in Karimnagar District of Telangana State, India for Enhanced Profitability

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ABSTRACT

Maize (Zea mays L.) is one of the major crops in Telangana state grown for commercial and seed-production purposes. For better returns to farmers and to arrest inefficiencies in cultivation techniques, it is imperative to take up mechanization extensively as it would also help in handling labour shortage in villages. The studycum demonstrations were conducted in Karimnagar district of Telangana state in India during the period of 2017-20 to find out the effect of mechanization on labour use and profitability in maize cultivation with the utilization of seed cum fertilizer driller, vacuum precision planter, Boom sprayer, combined harvester. The findings indicated that the mechanization in maize for sowing operation with seed cum fertilizer drill saves 15% cost (Rs.1675/ha), and with vacuum precision planter saves 32 % (Rs.3510/ha) , than compared to the conventional method of sowing behind plough (Rs.10850/ha), The mechanized spraying with Boom sprayer indicated saving of 74 % on labour cost (Rs.325/ha) as compared to spraying with Knapsack spraying (Rs.1250/ha) . The mechanization for maize harvesting and threshing operation with a combined harvester amounted to (Rs.11250/ha) whereas the cost with conventional harvesting was Rs.19125/ha. Thus saving of Rs. 7875/ ha i.e., 41 % saving of expenditure on harvesting operation. The comparison of mean grain yield over three years under mechanization was 7354 kg/ha where as under the conventional method, the mean grain yield was 7380 kg/ha which indicated negligible difference. The study concludes that mechanization helps in reducing the cost of cultivation, saving on timeliness and reducing drudgery, and improves farm productivity, thus facilitating realizing the goal of doubling farmer income

Keywords: *Mechanization, Maize, vacuum planter, seed cum ferti drill, cost of operation, combined harvester*

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INTRODUCTION

Maize, is considered the queen of cereals because of its huge utility as food, feed and fodder apart from its use as raw material in industries and for biofuel production and it can play a vital role in ensuring food and nutritional security for India.. The demand for maize has been remarkable after the introduction of sweet corn, baby corn, and popcorn which have almost captured the Indian market [1]. Today, maize is the third largest food crop in India in terms of area and is growing fast due to the higher benefits of crop. It is cultivated throughout the year. In India, Maize is grown in an area of 90.3 lakh ha, with a production of 277.2 lakh tons and productivity of 3.07 t/ha. In Telangana state, maize occupied an area of 5.43 lakh hectares with a production of 20.8 lakh tons and a productivity of 3.8 t/ha [2]. The farmers are aware of the fact that maize is a high feeder crop with comparatively higher investment; still, they prefer it due to its higher net return. In this context, maize is the most preferred diversified crop in the country and is even promoted for the food security of the country [3]. In India not only production and consumption of maize have been rising consistently, but also the consumption pattern of this food crop has also changed over the years [4]. Mechanization of farms helps in the reduction of human drudgery besides ensuring the timeliness of operation and solving the problem of scarcity of labours during peak cropping season [5]. In Telangana, under maize cultivation, the farmers are taking up sowing

of maize crop behind the plough, spraying operation with power / Knapsacks sprayer, and harvesting operation manually by labour and threshing by maize sheller. These conventional operations followed consume much time, energy, labour intensive, and costly [6] and also involves drudgery for the farmers [5]. Presently shortage of labour, also nonavailability of labour during peak periods, and a huge rise in wages affect the timeliness of taking up various operations and in turn adversely limit crop productivity. In Paddy cultivation due to adoption of mechanization in transplanting and harvesting operations has enabled the farmers to easy cultivation of paddy in large areas. Similarly, in maize cultivation also, it is the need of the hour and a challenge to change the strategy of maize cultivation from conventional methods of cultivation practices to appropriate mechanization with improved implements suited to local conditions [7].[8].[9]. Further mechanization adds organic matter and enriches soil fertility upon decomposition [10]. [11] stated that benefit-cost ratio of mechanized farms was higher 26.6% than that of traditional farms. Hence, to study the possibility of mechanization in maize cultivation, to promote the mechanization in maize cultivation, and to demonstrate the cost reduction with mechanization in maize cultivation, the present study was undertaken.

Strategies Adopted

This study was carried out at the Agricultural Research Station, Karimnagar during *Kharif* for three years from 2017-18 to 2019-20. Simultaneously, demonstrations were taken up in farmers' fields. This study was carried out with two treatments, 1) Conventional method i.e., Farmer's practice. 2) Mechanization with implements, in an area of 0.4 ha for each treatment. The techniques adopted in maize cultivation, the sowing, for mechanization and conventional methods of cultivation as given in Table 1.

During Kharif, and Rabi, 2017-18 to 2019-20, demonstration of maize sowing with seed cum ferti drill and Vaccum precision planter were taken up in 20 ha each, and harvesting was carried out by combined harvester in an area of 20 ha each in the research station as well as in farmers fields of different divisions of Karimnagar district

The soil of the studied locations was suitable for growing maize. The soil texture was red sandy loam in all the locations including the research station. The temperature and relative humidity at all the locations were favourable for maize growth and development. In the experimental plots, the maize hybrid, DHM 117 was grown and all the cultural practices, fertilizer application, weed water, and pest management are taken up as per the recommended package of practices. In the demonstration plots, the farmers also followed all the practices for raising good crop. The data in both the treatments, after the sowing operation, the initial plant population as a number of plants/ m2 and plants/meter row was recorded as well as on-time taken, man-days and cost of sowing was worked out based on the local price and wages prevailing. During the spraying operation, the time taken for spray, man-days required and the cost of spraying are calculated. The observations during harvesting operation under both the treatments are taken in terms of time taken, man days, and damage of maize grain by weight and by number was recorded and compared between the two treatments are worked out by calculating the mean values and presented in the tables. The data on the yield was recorded and reported at 14.5% moisture content. The interpretation and conclusions are drawn based on these mean values so that the farmers of the region know the economics and saving of labour and time and understand the benefits of mechanization in comparison to conventional farmers' practice.

Table 1: Techniques Adopted:

Operations	Mechanization	Conventional method
Land preparation	Cultivator, Rotavator and levelling blade	Cultivator, Rotavator and levelling blade
Sowing	Seed Drill in 2017-18, Vacuum Precision planter in 2018-19 and 2019-20	Behind the plough
Spraying	Boom Sprayer (2019-20)	Knapsacks sprayer
Harvesting	Combined harvester	Manual
Threshing		Sheller

Effect Of Mechanization Vs Conventional Method In Maize Sowing

Sowing of maize under mechanization was carried out with Seed Cum Fertidrill during 2017-

18, While, Vacuum seed precision planter was used for sowing during 2018-19 and 2019-20. Seed Cum Fertidrill is a tractor drawn implement, Sowing can be done at a spacing of 60X20 cm and adjustments for spacing can be done, saves 20% of the seed rate, at the time of seed sowing itself, the required basal fertilizers can also be applied at a specified depth and uniform germination is observed. By using this implement both seed & fertilizers are dropped simultaneously in which fertilizers are dropped below the seed, takes 3.75 to 5 hours for sowing one hectare. The main limitations are land should be well ploughed, pulverized, without clods, leveled & without any weeds and before sowing, the cups adjustment for dropping of seed & fertilizer with reference to spacing should be checked up, otherwise more seed hill or no seed are dropped resulting in dense / gaps in plant population. [12] also studied the different sowing techniques under hilly conditions. Vacuum Precision Planter runs with above 50 HP Tractor, 4 rows are planted at a time with a spacing of 60 X 20 cm. The seed rate by normal conventional method is 20 kg/ha, while using this, the seed rate taken is 13 kgs / ha i.e., 35% saving of seed was observed at 60X20cm spacing. It drops the seed by way of vacuum hence it plants exactly 1 seed per hill so no thinning is required. [13] also stated that the pneumatic seed planter achieves precise seed distribution within the row as a result seed spacing was maintained. It places the seed exactly at a depth of 3-6 cm, *i.e.,* follows uniform depth so uniform germination is observed in the field. It is observed that Vacuum planter is more accurate. There is a provision for the application of basal fertilizers also. The time taken for sowing maize in one hectare is 2.5 hour. So about 3.2 to 3.6 ha can be covered in one day with diesel consumption is 4 liters for one hour. This implement costs 5.75 lakhs. The main limitations are the soil should be well ploughed, pulverized, leveled, and dry and should not be too wet. The sowing with this machine is difficult in paddy cultivated fields as land preparation will not be proper. The broken seeds in the seed pack should be removed otherwise the broken seed is also sown which results in gaps. The dropping of seeds and fertilizers should be checked regularly.

Results Of Maize Sowing Under Mechanization:

Initial plant population: The results of sowing of Maize with seed drill / Vacuum planter on initial plant population indicated that No. of plants with seed cum ferti drill is 6.3 pl/m^2 and 2.85 plants per meter row which is less than compared to the conventional and recommended no. plants. While, Sowing maize crop with Vacuum Precision planter, the No. of plants / m^2 or No. of plants / m row length is on par with Recommended No. of plants. The comparison indicates that sowing with a seed vacuum planter is more accurate and comparable and even more précised [14] over the conventional method to achieve the recommended initial plant population while the cups adjustment in seed cum ferti drill is most important [15] to achieve the required plant population (Table 2).

Time taken for sowing: The time taken for sowing by a conventional method, where farmers go for sowing the crop behind the plough is almost 15 hours for 1 hectare while sowing with vacuum precision planter is only 2.5 hours per ha, and sowing with seed cum ferti drill takes 5 hours/ ha (Table 3). This indicates more area can be covered in a day with mechanization & timeliness in carrying out the sowing [16] and [17]. [18] also stated similar results of saving time with mechanization.

Saving of seed rate : In the conventional method, the seed required for 1 hectare is 20 kgs while, sowing with a seed vacuum planter is 13 kg/ha which is 35% saving in seed rate & cost and Saving of seed rate with seed cum ferti drill is 20% (16.25 kg/ha) at 60x20 cm spacing (Table 3).

Thinning: In the conventional method of sowing and with seed cum ferti drill, the thinning operation is to be carried out compulsorily which amounts to Rs.1250/ha while, sowing with seed vaccum planter does not required this thinning operation as 1 seed/hill is sown (Table 3).

Cost of Sowing operation: In the conventional method, the cost of operation of sowing, basal fertilizer application, required seed, and thinning is Rs.10850/ ha. While in the mechanized method of sowing with seed cum ferti drill is Rs. 9175/ ha which indicates a saving of Rs.1675/h i.e. 15% Saving, While sowing with Vacuum Precision planter is Rs.7340/ha, saving Rs. 3510/ha i.e., 32% saving is observed over the conventional method of sowing (Table 3). Similar findings were also reported by [19].

Table 2: Initial plant population after sowing with seed cum ferti-drill and Vacuum precision planter

	Reco mmended plants/m^2	Observed Plants / m^2			Reco mmended Plants /m row	Observed Plants / metre row		
		* Kharif, 2017	Khar-if,2018	Kharif, 2019		* Kharif, 2017	Khar-if,2018	Kharif, 2019
Mechanization	8.3	6.3	8.65	8.4	5	2.85	4.36	4.48
Conventional		8.25	8.15	8.3		3.7	3.72	4.2

** During Kharif, 2017, Sowing of Maize was taken up with seed cum Fertidrill and during Kharif, 2018-19 and 2019-20, Sowing of Maize was taken up with Vaccum precision planter

Table 3: Comparison of Time taken, Man days, Cost of Seed and Sowing, Basal Fertilizer application and thinning under Conventional Vs Mechanized sowing of maize

	Conventional Method	Mechanized Method	
		Seed cum ferti drill	vacuum planter
Time taken (hours/ha)	15	5	2.5
Seed required(Kg/ha)	20	16.25	13
Seed cost (Rs./ha)	3600	2925	2340
Thinning	1250	1250	-
Man days/ha required	12.5	-	-
Labour/hiring cost	6000	5000	5000
Total cost of seed , sowing, labour, basal fertilizer and thinning operation,	**10850**	**9175**	**7340**

Table 4: Effect of Mechanization Vs Conventional method in maize spraying

Particulars	**Conventional method**	**Mechanization with Boom sprayer**
No. of Nozzles	1	20
Time taken for spraying /ha	10 hours	25-30 minutes
Cost on labour usage/hire (Rs./ha)	1250 (5 labour @Rs. 250)	325
Man days required /ha	5	-
Saving on labour cost (%)	**-**	**74**

Effect Of Mechanization Vs Conventional Method In Maize Spraying

Spraying of maize was carried out with a Boom sprayer during 2019-20 under mechanization. It is a tractor-mounted sprayer, that has 20 adjustable nozzles based on crop spacing and three types of nozzles 1, Flatjet nozzle for herbicides 2. Nozzles for drenching 3. General nozzles for pesticides. The time taken is 25-30 min/ha and hire charges are Rs. 325/ha. In the conventional method, the Knapsacks sprayer is used for spraying which takes 10 hours/ha with 5 man-days and costs Rs. 1250/ha (Table 4). Thus, 74% saving is observed with mechanized spraying with Boom spraying.

Effect Of Mechanization Vs Conventional Method In Maize Harvesting

In maize under mechanization, harvestings are carried out with a combined harvester in a farmers field.

Results Of Maize Harvesting Under Mechanization

Time taken for harvesting: In the conventional method 270 hours/ha are required for harvesting,

dehusking drying, and shelling. While, in mechanized harvesting, 2.5 hours/ha is required for harvesting thus saving of 93% of the time over conventional harvesting (Table 5).

Labour required

The conventional method of harvesting required 62.5 labour/ha while with mechanized harvesting 5 labour are required which shows a saving of 92% in labour cost for harvesting (Table 5).

Cost of harvesting

In the conventional method of harvesting, the cost of removal of cobs, de-husking, shelling, drying, and stalk cutting amounts to Rs.19125/ha. While mechanized harvesting with a combined harvester amounts to Rs.11250/ha (Table 5). Hence an amount of Rs.7875/ha is saving per hectare which is 41% saving in the cost of harvesting. [19] were also of the opinion that harvesting by mechanization saves time, money, and drudgery.

Damage of grains

The damage to the seed mainly depends on the moisture content in the grains of cob. At a moisture content of 21 %, the impurities and damaged grains percentage under mechanized harvesting is 6-7% while in conventional harvesting is 2% (Table 6). In 100-grains, the no. of good seeds are 94 & 98 in mechanized & conventional harvesting respectively indicating 6% loss as broken & damaged & impurities in mechanized harvesting, while in conventional harvesting, loss is 2% (Table7).

Table 5: Time, Mandays and Cost of Harvesting operation under conventional Vs Mechanized cultivation of maize

Particulars	Conventional Method	Mechanized Method
Time taken for harvesting (hours/ha)	270	2.5
Mandays/ha	62.5 (Rs. 15625)	5 (Rs. 1250/-)
Hiring cost (Rs./ha)	-	10000

Maize grain yield and Harvesting loss

The comparison of mean grain yield over three years under mechanization was 7354 Kg/ha, whereas, under the conventional method, the mean grain yield was 7380 Kg/ha which indicates a negligible difference. The Harvesting loss by use of a combined harvester is 10.5% during Kharif 2017, while the harvesting loss with a combined harvester of Johndeer is 2.4 - 5.2% (Table 8). [19] expressed the same opinion that grain damage is low in maize shelling by mechanical methods (2.1-2.3%) in comparison to the conventional method of shelling (5.7%) (Table8). The yield & economics of Mechanization in Maize crop are graphically represented in Figure 1.

CONCLUSION

From our study, it was concluded that mechanization in maize for sowing operation with seed cum fertilizer drill saves 15% (Rs.1675/ha) and with vacuum precision planter saves 32 % (Rs.3510/ha) compared to the conventional method of sowing behind plough (Rs.10850/ha). The time saving with seed cum ferti drill (5 hours/ha) and vacuum precision planter (2.5 hours/ha) is 75 & 88% respectively over farmers' practice (15 hours/ha). The saving in seed usage is 20% with seed cum fertilizer drill (16.25 kg/ha) and 35 % with vacuum precision planter (13 kg/ha) over the conventional method (20 kg/ha). Spraying of maize under mechanization with a Boom sprayer saves Rs. 925/ha on labour i.e., 74% than compared to the conventional spraying with Knapsacks sprayer. An amount of Rs.7875/ha is saving per hectare which is 41% saving in the cost of harvesting.

Presently the usage of farm machinery for maize cultivation in Telangana is limited. There is lot of scope for mechanization in maize crops and also this study inference that implementation of mechanization is economically attractive and depicts a proactive sign for increasing the profitability in maize cultivation

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Table 6: Damage of maize grains by weight under mechanized harvesting

	Total wt (g)	Grain wt (g)	Impurities + broken (g)	% of damaged grains
Mechanization (moisture % 25.5%)	100	88	12	7
Conventional (moisture % 24.2%)	100	96	4	2

Table 7: Damage of maize grains by number under mechanized harvesting

	Total no. of grains	Mean no. of Brokens	Mean no. of Impurities	Mean no. of Good seed	Mean % of damaged grains
Mechanization	100	6	19	94	6
Conventional	100	-	2	98	2

Table 8: Grain yield and Harvesting loss under conventional Vs Mechanized cultivation of maize

	Grain Yield (Kg/ha)				Harvesting Loss (Kg/ha)			Harvesting Loss (%)		
	Kharif, 2017	Kharif, 2018	Kharif, 2019	Mean	Kharif, 2017	Kharif, 2018	Kharif, 2019	Kharif, 2017	Kharif, 2018	Kharif, 2019
Mechanization	6313	7583	8166	7354	632	391	195	10.5	5.2	2.4
Conventional	7033	7027	8081	7380	-	-	-	-	-	-

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