# RESEARCH ARTICLE

## MECHANIZED HARVESTING IN COTTON IN INDIA – AN OVERVIEW

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| ARTICLE INFO | ABSTRACT |
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| | 'Cotton' the white gold is one of the most important commercial crops playing a key role in the economical, political and social affairs of the country. India, is the third largest producer of cotton in the world. Recent technological advances and trade liberalization have made India a major player in international cotton markets. Demand for cotton is expected to remain robust in India and in future there is a clear need to improve the productivity to meet this increasing demand. In recent years labour shortages during peak periods of cotton production, have been quite frequent and widespread. The delay in completion of operations leads to loss of yield and increase the cost of cultivation. This problem is more severe during harvesting. Because of the staggered blooming characterizes of cotton varieties in India, mechanical pickers were not considered suitable for our conditions. But currently the biological scientists are gearing up to develop plant types/ varieties amenable to mechanical picking. Also hand picked cotton contains 7% trash, mainly due to deficiencies in labour practice compared internationally, where trash content is less than 2.5 % harvested mechanically. In this line research has been conducted all over India on two important aspects for mechanical cotton production. The foremost is to develop compact cotton varieties with no monopodial, more sympodial and synchronized maturing cotton varieties. Second one is the change in the agronomic practices, for high density cotton planting with geometry to suit mechanization and for enhanced productivity. |

## INTRODUCTION

Cotton is one of the most important crops throughout the history of India and it also plays an important social and economic role in the Indian society in the present age. India has made tremendous gains in the cotton sector in recent times, as it stood second in the world in terms of production, consumption and exporting in 2010-2011 (FAO, 2012). The increasing role of the Indian cotton sector in international markets is a direct challenge to major cotton exporters like the United States especially in fast growing markets like China. In this context, a better understanding of the Indian cotton production system is necessary in order to comprehend its future role in international cotton markets. Like most of the other crops grown in India, cotton production is also associated with low productivity compared to world average. The average cotton yield in India is only 0.49 t/ha compared to a world average of 0.73 t/ha. Various reasons have been attributed to the existence of low yields of cotton in India: the inadequate inputs, lack of awareness about modern cultivation practices among Indian farmers, lack of irrigation facilities, lack of proper timing of field operations and too much dependence on labour to cultivate cotton (Majumdar. 2012). Along with the above reasons, the shortage of labour along

with the associated rise in wages in some fast industrializing areas of India is impacting the profitability of the cotton crop. Within this context, a better understanding of the Indian cotton sector and the impact of mechanization on cotton cultivation are needed to assess India's competitive position in international markets. The success of mechanization of cotton harvesting depends not only on the availability of suitable harvesters, but also depends upon various other factors. So this paper analyses the impact of mechanical harvesting of cotton on the profitability of Indian cotton farmer as well as the practical feasibility of the adoption of the mechanical harvesting by Indian farmers. In the following section, a brief description of the cotton production and its cultivation aspects, the status of mechanization of farm operations and the status of mechanization of cotton harvesting in India are presented.

**Cotton production and mechanization in India:** Cotton is an important cash crop for Indian farmers. It takes the third place in total acreage planted among all crops in India behind rice and wheat. In the last decade, cotton acreage increased by almost thirty two lakh hectares from 2005 to 2011 as shown in Table 1. Cotton is produced in three zones in India, namely the Northern zone comprising the states of Punjab, Haryana and Rajasthan, the Central zone comprising the states of Maharashtra, Madhya Pradesh and Gujarat, and the Southern zone comprising the states of Andhra Pradesh, Karnataka and Tamil Nadu. The states of Gujarat, Maharashtra and Andhra Pradesh contribute about three quarters of the total production.

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About 65% of the cotton acreage in India is dependent on rain and so the annual variation in monsoon rainfall plays an important role in production and yield for any particular year (Aggarwal *et al.,* 2008). The cotton production in India is also plagued by inefficient labour operations and labour shortages. In many parts of India, the farmers still use human labour for many of the operations like planting, weeding and picking, and use inefficient farm implements/machinery for those operations. Along with the inefficiencies in cotton cultivation, various states in India especially industrialized ones like Gujarat, Maharashtra, Punjab and Andhra Pradesh, etc., are experiencing labour shortages due to migration of labour to urban areas and due to various employment generation schemes due to infrastructure projects sponsored by government. Modernisation of cotton cultivation with improved seeds, soil moisture conservation with appropriate techniques and mechanisation of important operations like sowing and harvesting are some of the critical interventions to improve cotton productivity. Mechnisation of cotton farming operation has been very slow and it requires a boost to usher in the second green revolution.

**Farm mechanisation–need and growth:** Agricultural labour is becoming increasingly costlier with labour efficiency going down. Turnover of work and duration of working hours are deplorably deteriorating resulting in poor crop management, increasing the cost of cultivation and reduced income to the farmers. Necessiating the need to mechanise critical farm operations. Mechanisation is not in itself the key to better the yields of crops as is often thought or implied in development projects. Mechanisation is to achieve field capacities that assure timelines in seed bed preparation and to bring precision in metering seed, fertilizer, pesticides, irrigation and harvesting which helps in increasing productivity with reduced losses, unit cost of production and drudgery to the agricultural labour. It also helps in conserving the produce and by-products, promote agro processing and value addition and generating additional income and employment (Annamalai, 2004).

The principal advantages of mechanized agriculture are that it reduces the demand for labour and allows operations to be carried out faster and in time. Mechanisation is needed to get over some of the major constraints to enhance productivity and to make farming less arduous and attractive enough to enable educated youth to adopt willingly agriculture as a means of livelihood. Mechanisation also aims at increasing land labour efficiency by improving the safety and comfort of agricultural labour and to protect the environment by allowing precision operations and increasing the overall income. The deployment of tractors, farm machinery and equipments in our country is increasing gradually. Mechanisation not only means tractorisation, but also making available adequate other matching equipments and implements to the farmer to reduce the human effort and improve the working efficiency. With the spread of irrigation facilities, farm mechanization has also improved considerably in irrigated area. The multi fold increases in number of tractors and other farm equipments in the past 50 years explain by itself the increasing trend of mechanization. The future of farm mechanization technology package has to be both eco-and user friendly, facilitating the strenuous and hazardous farming operations to be safe and comfortable increasing the area and productivity and promoting custom hiring / contract farming of farm equipments and machinery.

**Status of mechanization of cotton harvesting in India:** A similar rate of mechanization also prevails in cotton sector as in other crops, it varies from 42 percent for soil working and seed bed preparation, 29 percent for seeding and planting, 34 percent for plant protection and 37 percent for irrigation. But regarding the harvesting operation, almost the entire cotton production in India is hand-picked by human labour spending about 0.9 man-h/kg of cotton and costing almost 10 times than irrigation and two times the weeding costs (Muthumilselvan *et al.,* 2007). Below is the level of mechanization in percentage for cotton. India is lagging behind many other large producers of cotton in mechanization of harvesting. In the USA, machines harvest the entire cotton crop, whereas in some regions of China, it is estimated that by 2020, about 60% of cotton will be mechanically picked. It is expected that India will soon have to mechanize its cotton harvesting operations as it is facing labour shortages and rising farm wages. It is reported that the labour availability has dropped from 70.3% of the population in 1961 to 48.9% in 2010 and cost of picking cotton from the farm has increased to Rs 10-12 a kg now from Rs 4 in 2007 (Business Line, 2012).

**Hand picking and mechanical picking:** In Hand Picking, the picking is done by hands. Huge amount of labour is required for this process. In this a labour picks the cotton boll manually by hands. This process requires labour hours ranging from 6 to 10 hours a day. Being done by labour the working hours are flexible and also result in low labour productivity. Physical conditions also effect this process as labour being human gets tired and different conditions effect them differently depending on their physical attributes. This process is also time consuming. But this process yields better cotton quality and also in this process the unwanted material is also very low which results in better yield. While in machine picking the picking is done by machine. Basically a full-fledged machine or a portable picker is employed for machine picking. In this process the machine takes the complete boll or in case of bigger machine the complete plant is taken out for the process. But in this process the fibre quality is not good compared to the hand picking process since in this there is too much unwanted material. This also is expensive as they are complicated machinery and there is also need for a separator chamber to separate the unwanted material from the cotton which also adds up to the cost. But this process is very productive as its yield is high. This also is a one time investment. This process is less time consumption and there is no time constraint it can work 24 hours a day also. Hand picking process is more favourable in India and generally practiced because it yields better quality cotton fibre than machine picking and also there is lack of effective mechanization for cotton harvesting and also less knowledge about the mechanical picking practices and farmers is also unaware of recent advancements in this field in India.

**Agronomic practices to suit mechanical harvesting:** Studies have been done on the feasibility of introducing mechanical pickers in India, and most of them have concluded that in order to adopt cotton pickers for harvesting, a lot of changes in agronomic practices of cotton cultivation need to be implemented. The first aspect is about the spacing between the plants in the field. In India, the spacing which we adopt normally is either too wide (hybrids) or too narrow (rainfed varieties) for working with the mechanical picker. If the spacing is wide with a range from 3 feet (inter-row) by 3 feet (inter-plant) to 5 feet (inter-row) by 2 feet (inter-plant),

**Table 1. Area, production and yield of cotton in India 2005-2011**

| Year | Area (million ha) | Production In Lakh Bales Of 170kgs | Yield (t/ha) |
|---|---|---|---|
| 2005-2006 | 8.68 | 241 | 0.48 |
| 2006-2007 | 9.14 | 280 | 0.52 |
| 2007-2008 | 9.41 | 307 | 0.55 |
| 2008-2009 | 9.41 | 290 | 0.52 |
| 2009-2010 | 10.31 | 305 | 0.50 |
| 2010-2011 | 11.14 | 339 | 0.50 |

Source: Cotton Advisory Board

| Crop | Seed bed preparation | Sowing/  planting | Weed and pest control | Harvesting and threshing |
|---|---|---|---|---|
| Cotton | 90-95 | 50-60 | 50-60 | 0 |

**Table 2 Additional expenditure and additional revenue due to mechanization of cotton harvesting**

| | $/acre |
|---|---|
| Seed cost and labor | 110 |
| Defoliant spray | 50 |
| Mechanized harvesting (including pre-cleaning) | 45 |
| Total additional expenditure | 205 |
| Additional revenue due to higher yields | 244 |

prefer to have a high density planting (HDP). In case of narrow planting with 2 feet, maintain an inter row spacing of 80 to 100 cm for efficient mechanisation of harvesting in cotton. Always maintain an inter plant spacing of 10-15 cm to have high density planting. For mechanical picking to be done, cotton industries prefer to have a high density planting (HDP) with a population of more than 50,000 plants per acre. This will lead to an increase in the input expenditure as well as the labour expenses for planting the seeds. Secondly, the cotton plant should not be too tall and having many branches, as it will be difficult for the picker to pick all the bolls. Also, the bolls should be well of the ground so that the amount of soil and dirt collected during the picking may be reduced (Muthumilselvan, 2007). Studies have shown that the trash content in hand-picked cotton is much less than in the mechanically picked cotton, thereby, creating a need for pre-cleaning of mechanically picked cotton before sending it to ginning mills. Thirdly, all the bolls should come to maturity at the same time, as mechanical picking is expensive to be done multiple times. The plants also need to be treated with defoliants in order to make the harvesting process clean and efficient.

**Benefits of cotton mechanization and farmer economics:** All the above changes in cultivation practices will increase the expenditure, but it is also expected that the yields under this process (HDP) will be up to 35% more than the conventional method of cotton cultivation. The additional expenditure incurred due to the above practices in order to mechanically harvest cotton using cotton pickers and the additional revenue obtained due to higher yields are given in Table 2. This yield increase provides a strong basis for adoption of cotton mechanization.

**Key drivers of cotton mechanization and adoption:** But adoption of mechanical harvesting through cotton pickers by Indian farmers is not dependent upon just the availability of suitable cotton pickers, but it also depends upon availability of appropriate cotton varieties, changing some of the agronomic practices as described above, pre-cleaning of cotton before sending it to cotton gins, and finally the adequate availability of repair and maintenance services for cotton pickers in India. It is expected that the practice of cotton harvesting by

mechanical means will take a long time to get established in India, expected to be up to a decade by some experts. In order for the change in agronomic practices adopted by Indian farmers, both the public and private extension agencies should play an active role in educating and training the farmers (Singh *et al,* 2002). The equipment manufacturers should come out with equipment suitable for Indian conditions like small land holdings and pre-cleaners suitable for cleaning cotton before sending them to cotton gins. Some international farm equipment manufacturers have already developed cotton pickers suitable for Indian conditions and trials are taking place.

**Conclusion**

This paper evaluates the impact of mechanical harvesting of cotton on the profitability of Indian cotton farmers as well as its implications on cotton supply in the international markets. The more usage of cotton pickers may lead to increase in yields and thereby increased cotton production in India, which may put a inverse pressure on international cotton prices. Labour is fast becoming a bottleneck and important cost factor, therefore manual picking will soon become unviable in Indian cotton production. Collaborative efforts by various organizations have successfully demonstrated machine picking is viable in India. Project farmers have experience 30 to 40% yield increase. Mechanization adoption rate will be driven by development of machine suitable hybrids and continuous support from the government. Also, efforts should be made by credit agencies to offer suitable credit facilities for farmers wanting to adopt mechanical harvesting and support should be offered for establishing custom service providers. As most farmers in India have small land holdings, it is essential that cotton pickers may be rented more than they are owned, which creates the need for custom service providers and farm equipment rental agencies. With the support of the public and private agencies, the adoption of mechanical harvesting of cotton by Indian cotton farmers can be successfully achieved.

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