



## Needs and gaps of cotton mechanisation in India

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**ABSTRACT :** Realising 1000 kg/ha lint yield is the target for 2020 which requires strong partnership among diverse stakeholders in the value chain with technology and gap improvements. India is lagging behind many other large producers of cotton in mechanization of harvesting the crop. To cope up with the shortage of labour and increase the productivity, mechanization at certain stages of the crop cycle might be a probable solution. A lot of changes in agronomic practices of cotton cultivation need to be implemented as well. Contract or Cooperative farming in cotton can be encouraged for effective and optimum utilization of the resources to achieve highest yield as targeted for 2020. Increasing irrigation facilities and adoption of scientific innovations and modern technologies like mechanised farming and the high density planting programme are some of the key focus areas which can provide the much needed fillip to increase the productivity level further.

**Key words:** Cotton yield, labour force, , partial budgeting, selective mechanization

India is the largest cotton grower but it still lags behind in mechanisation of farm operations of the fibre crop. With the country facing labour shortage and farm wages rising, cotton growers are looking at various ways to cut costs. For example, the cost of picking cotton from the farm has increased to Rs. 12 to 15/ kg now from Rs. 4 in 2007. Labour availability, too, dropped from 70.3 per cent of the population in 1961 to 48.9 per cent in 2010. Among nations growing cotton, cotton picking is completely manual in India. In contrast, a country such as Turkey has mechanised cotton farming within a short span of time. Almost 60 per cent of its cotton operations was mechanised within a decade. In China's Xinjiang province, 40 per cent of cotton operations has been mechanised, while in the US, mechanisation helps in baling cotton on the farm itself. The Chinese Government is supporting mechanisation, and by 2020, 60 per cent of cotton-farm operations will be

mechanised in Xinjiang.

The problems confronting Indian growers in mechanising cotton production are many. Cotton picking is one of the critical operations of cultivating the fibre. Small sized farms in India is another issue and, therefore, small machines are required. Also, the opening of the cotton boll has to be synchronised. However, the most important thing to be done before mechanised picking is to defoliate the plant. No appropriate defoliant is available in the country. Controlling the cotton plant's height is another major issue in India. The problem in India and Pakistan is that not many varieties are available for mechanised picking, In India, farmers pick cotton twice or thrice from the plant in a season. Mechanisation means the picking can be done only once. Can our farmers afford to lose the extra pickings. All farms need not be mechanised in India. However, mechanisation will depend upon the Government's will and right agronomic

practices that have helped countries such as the US, Turkey and China.

Mechanization is a key input in any farming system. It aims to achieve increased productivity per unit area due to improved timeliness of farm operations; an expansion of the area under cultivation where land is available; accomplishment of tasks that are difficult to perform without mechanical aids; improvement of the quality of work and products; a reduction of drudgery in farming activities, thereby making farm work more attractive. The principal labour demand peaks in the farming cycle are for land preparation and subsequent weeding. The constraints to increased farm production which mechanizations can contribute to relieving are due, to a large extent, to three factors: an excessive reliance on human power; the low productivity of human labour and a decrease in the labour available.

According to some predictions, agricultural output will have to double by 2050 (Anonymous, 2011), with simultaneous management of sustainability. This will require increasing TFP from the current level of 1.4 for agricultural production systems to a consistent level of 1.75 or higher. To reach that goal, we will need significant achievements in all of the factors that impact TFP. Mechanization is one factor that has had a significant effect on TFP since the beginning of modern agriculture. Mechanized harvesting, for example, was a key factor in increasing cotton production in the last century. In the future, mechanization will also have to contribute to better management of inputs, which will be critical to increasing TFP in global production systems that vary widely among crop types and

regional economic status.

With this overview, the following objectives have been framed to trace the mechanization gap and needs for a sustainable cotton production in India.

- To compute the intensity of labour shift from cotton to other sectors.
- To trace the current mechanisation status and future needs among the different categories of cotton farmers.
- To enumerate the constraints faced by the cotton farmers without mechanisation and suggest viable means for increased productivity in cotton.

#### **Current mechanisation status in India**

: Indian cotton contributes to over 10 per cent share in total export earnings, 14 per cent share in national industrial production, 6 per cent contribution to the GDP, 5 per cent share in the global textile trade, 3.9 per cent share in the global apparel market, 30 per cent share in world trade of cotton yarn, second largest textiles and clothing industry after China.

The acreage under cotton in India, which was 8.73 million ha in 2001-2002 has increased to 12.22 million ha during 2016-2017 and India now has a share of 37 per cent of the world's total cotton acreage. Cotton production in the country, which was 15.80 million bales in 2001-2002 has more than doubled and touched 31.45 million bales of 170 kg during 2016-2017.

The value of cotton now being produced in the country every year is 16.50 billion dollars in seed cotton form. Similarly, consumption of cotton in India has also witnessed a healthy growth and is estimated at 30.60 million bales

**Table 1.** Global yield of cotton (2016-2017)

Countries	Cotton yield (kg/ha)
Australia	2322
Israel	1905
China	1713
Mexico	1601
Turkey	1751
Brazil	1524
USA	908
Pakistan	712
Uzbekistan	683
India	530
<b>World average</b>	<b>831</b>

Source: *www.cotton.org*, Economics, Crop Information

during 2014-2015. India has exported 11.79 million bales in the year 2013-2014 and the approximate value of cotton now being exported from India every year is over 3.30 billion dollars. With a massive acreage of over 12.22 million ha, India requires a huge infrastructure to process the increased crop size of over 40.00 million bales.

Realising 1000 kg/ha lint yield is the target for 2020 which requires strong partnership among diverse stakeholders in the value chain with technology and gap improvements. The current yields are significantly lower compared to world average and other major cotton growing countries like Australia, Brazil, USA, China (Table I). 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. The average cotton yield in India is only 0.53 t/ha compared to a

world average of 0.83 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

**Table 2.** Population engaged in agriculture vis-a-vis level of farm mechanization

Countries	Share of labour (%)	Contribution to farm mechanization (%)
USA	2.4	95
Wn. Europe	3.9	95
Brazil	14.8	75
Argentina	9.4	75
Africa	60	20
China	64.9	38
India	55	40

Cotton employs 7 per cent of the total labour force in developing countries. As ICAC asserts, "cotton is truly a small farmers' crop". Indeed, in very general terms, it should be noted that, while larger farms (mainly in developed countries) account for around one quarter of world total cotton planted area and one third of world output, they only employ a small fraction of the global cotton labour force. On the contrary, small cotton farms use almost all of the global labour employed in cotton to produce 65 per cent of the world's output on 72 per cent of the planted area. India is lagging behind many other large producers of cotton in mechanization of harvesting the crop (Table 2). In the USA, machines harvest the entire cotton crop, whereas in some regions of China, it is

estimated that by 2020, about 60 per cent of cotton will be mechanically picked. Cotton farms in India are found in the 'cotton belt' that starts in the north-west, crosses through the centre of the country and ends in the south-east. Estimates of the number of farmer involved in cotton cultivation vary widely:

It is reported that the labour availability has dropped from 70.3 per cent of the population in 1961 to 48.9 per cent in 2010 and cost of picking cotton from the farm has increased to Rs 12 to 15 a kg now from Rs 4 in 2007. It is expected that India will soon have to mechanize its cotton harvesting operations as it is facing labor shortages and rising farm wages (Table 3).

Picking is entirely by hand. In the context of the smallholder systems which employ the vast majority of labour associated with cotton cultivation, cotton farming entails a significant volume of labour inputs during the most labour-intensive phases of the cultivation cycle: Land preparation and planting, Hand weeding and thinning, irrigating (where crop is not rainfed) and picking of cotton. The countries' factor endowments and use of advanced technology are important parameters for decreasing costs relating to agricultural production. As regards

competitiveness in cotton markets, reducing cost of production is no less a requisite than attaining a high level of productivity. Mechanization of harvest is of immense importance for decreasing cost of cotton production.

In a land abundant labour scarce economy, it is generally accepted that capital in the form of mechanization can be economically substituted for the relatively scarce element of production because of the reasonable expectation that the mechanical cultivation will enable a farmer to expand his hectareage of tillage and that the increase in farm income resulting from this extended cultivation will more than offset the costs incurred. Farming consists of series of operations from ploughing the land to marketing the crops. Partial or selective mechanization of a given operation will induce changes in the pattern of labour inputs in other operations. There is thus a good chance that on balance, selective mechanization will increase the total labour requirements of a unit of land. In other words, in a dynamic setting, selective mechanization may create rather than eliminate jobs.

Cropping systems of a region are decided by and large, by a number of soil and climatic

**Table 3.** Population dynamics of Indian agricultural workers (No. in million)

Particulars	2001	2011	2020
Country's population	1029	1211	1323
No. of workers as (%) of population	39	39.8	42.8
Total no. of workers	402	482	566
Percentage of agricultural workers to total workers	58.2	54.6	40.6
No. of agricultural workers	234	263	230
Percentage of females in agriculture work force	39	37.2	45
No. of male agricultural workers	143	165.7	126.5
No. of female agricultural workers	91	97.31	103.5

**Table 4.** Shift in cropping pattern over years

States	Change in acreage between 2000-2001 and 2012-2013 ('000, ha)						
	Rice	Wheat	Maize	Pulses	Oilseeds	Cotton	Sugarcane
Punjab	0.24	0.11	-0.04	-	-0.04	0.01	-0.04
Haryana	0.17	0.14	-	-0.01	0.16	-0.35	-0.04
Rajasthan	-	0.51	0.02	0.88	2.27	-0.06	-0.18
<b>North - change</b>	<b>0.41</b>	<b>0.76</b>	<b>-0.02</b>	<b>0.87</b>	<b>2.39</b>	<b>-0.40</b>	<b>-0.26</b>
Gujarat	0.12	0.76	0.10	0.04	-0.21	0.88	0.19
Maharashtra	0.04	-1.72	0.51	-0.28	1.14	1.07	0.34
Madhya Pradesh	0.17	1.99	0.01	1.80	2.01	0.11	-0.03
<b>Central-change</b>	<b>0.33</b>	<b>1.03</b>	<b>0.62</b>	<b>1.56</b>	<b>2.94</b>	<b>2.06</b>	<b>0.50</b>
Andhra Pradesh	-0.75	-	0.44	0.05	-0.77	1.38	-0.02
Karnataka	-0.21	-0.04	0.64	0.28	-0.45	-0.47	0.01
Tamil Nadu	-0.50	-	0.25	-0.06	-0.41	-0.04	0.06
<b>South-change</b>	<b>-1.46</b>	<b>-0.04</b>	<b>1.33</b>	<b>0.27</b>	<b>-1.63</b>	<b>0.87</b>	<b>0.05</b>
India	-2.0	4.23	2.1	3.12	3.76	2.45	-3.65

parameters which determine overall agro ecological setting for nourishment and appropriateness of a crop or set of crops for cultivation. Nevertheless, at farmers' level, potential productivity and monetary benefits act as guiding principles while opting for a particular crop/cropping system. These decisions with respect to choice of crops and cropping systems are further narrowed down under influence of

several other forces related to infrastructure facilities, socio economic factors and technological developments, all operating interactively at micro level.

Cropping patterns are improving over years. There is a significant shift towards high value crops between 2000-2001 and 2012-2013 wherein labour demand is high (Table 4). To cope up with the shortage of labour and increase the

**Table 5.** Per cent increase of human labour cost to total operational cost

Year	Pun	Har	Raj	Guj	Mah	MP	AP	Kar	TN
2004-2005	38.53	49.66	51.12	43.13	27.73	39.65	40.18	40.33	55.38
2009-2010	48.85	54.69	57.47	44.54	38.26	46.00	51.40	48.77	60.36
2011-2012	48.55	56.87	62.41	49.79	44.88	51.59	50.85	47.44	64.15
<b>Per cent increase</b>	<b>25.99</b>	<b>14.51</b>	<b>22.09</b>	<b>15.45</b>	<b>61.88</b>	<b>30.12</b>	<b>26.56</b>	<b>17.64</b>	<b>15.85</b>

productivity, mechanization at certain stages of the crop cycle might be a probable solution. Mechanisation gap is found in almost all the stages of the crop excepting during the land preparation stage. Top priority of mechanization to be given to the cotton farms during sowing, intercultivations mainly weeding and harvesting stages. Cotton harvesting has to be

mechanized so as to counter act 50 per cent of the cost of cultivation as seen in Table 5 below;

There has been an increase of almost 15 to 30 per cent increase in human labour cost when compared to total operational cost with exceptionally higher value of 60 per cent in case of Maharashtra.

Similarly as seen in Table 6, the cost of

**Table 6.** Per cent increase of human labour cost over years

Year	Pun	Har	Raj	Guj	Mah	MP	AP	Kar	Tamil Nadu
2004-2005	8483.93	8612.30	5670.51	7474.05	4375.92	6168.72	8358.65	3227.68	11035.83
2009-2010	14084.38	17252.78	13078.47	12960.87	9819.59	7133.63	13073.08	7669.65	21934.12
2011-2012	18989.52	21893.14	22199.22	20013.24	20127.28	11486.45	19351.12	13994.61	30403.40
<b>Per cent increase</b>	<b>123.83</b>	<b>154.21</b>	<b>291.49</b>	<b>167.77</b>	<b>359.96</b>	<b>86.20</b>	<b>131.51</b>	<b>333.58</b>	<b>175.50</b>

human labour has increased enormously when compared to other inputs by 87 per cent in Madhya Pradesh to 350 per cent in case of Maharashtra.

**Table 7.** Share of human labour cost of the operations in cotton field

S.No.	Field operations	Per cent
1.	Land Preparation	16.22
2.	Sowing	4.06
3.	Fertilizer application	8.11
4.	Plant protection	9.63
5.	Weeding	29.40
6.	Harvesting	32.58
<b>7.</b>	<b>Total labour cost</b>	<b>100</b>

It could be seen from the Table 7 that human labour cost of weeding and harvesting operations account for 60 per cent of the total labour cost followed by land preparation (16%), plant protection (9.63%), fertilizer application (8.11%) and sowing (4.06%), respectively.

Partial budgeting technique was used to find the economic viability of mechanization under selective operations wherein the labour use is high with special reference to sowing, weeding and harvesting operations. The results showed an increased benefit of Rs.8000 to Rs.9000/ ha in all these three operations.

## CONCLUSIONS

Selective mechanization is the need of

the hour. In other words, considering the huge size of population, a policy of selective mechanization will be most suitable where the labour displacement effects should be minimum. Thus, full-scale mechanization is not needed as in other developed countries of the world. However, the large holdings can safely be mechanized. Besides, machines suitable for small farms and those suitable for large cooperatives and state farms can be introduced. On small farms, the use of second hand tractors and operations through custom hiring of farm machinery can be taken up on large scale. The investment in agricultural machinery vis-a-vis their utilization on small farms is quite high because of which farmers give comparatively low priority to purchase of agricultural machinery in comparison to other inputs viz., seeds, fertilizer, chemicals etc. However, in the present circumstances when labour wages are increasing at a high rate and their availability at peak times of sowing and harvesting is decreasing, the farmers are now getting more inclined towards use of agricultural machinery

**Policy issues :** Land Fragmentation has gone up with number of marginal farmers increasing to 67.3 per cent in 2012. Shift into services sector for better working condition. 39 per cent of annual employment under MGREGA is provided during the peak agricultural season creating shortage of unskilled labour. Shortage



of Labor in the Agricultural sector drives need for mechanization and it calls for Machines with minimal human intervention. Increasing urbanization and migration of villagers in search of greater opportunities and there is a rise of rural entrepreneurs who are looking to set up businesses of their own. The present and future scenario is high density planting in cotton. Delinting and ensuring the uniform size of seeds will be critical for precision mechanized planting of cotton. The present challenges in cotton farming are the cost constraints, land fragmentation, unpredictable monsoon etc. Problems of low production and productivity cannot be solved by mechanization alone. Collection of general indicators on farm power, farm machinery supply chain, supporting institutions, the policy framework have to be identified along with their problems and constraints.

The entire cotton farms need not be mechanized. Farm mechanization zone is to be identified in both the rainfed and irrigated cotton farms in all the three cotton zones where labour is of immense scarce. A lot of changes in agronomic practices of cotton cultivation need to be implemented as well. The height of the plants need to be uniform and much lower than in the conventional way. The cotton plants that are going to be mechanically harvested also need to be sprayed with defoliant chemicals in order to make the harvesting process clean and efficient, which leads to an increase in input expenditure again as well as increase in the labor expenses. Lastly the harvested cotton also needs to be pre-cleaned before sending it to the cotton gin as cotton pickers gather more debris than by manual picking. All the above changes

in cultivation practices are going to increase the expenditure, but it is also expected that the yields under this process will be up to 35 per cent more than the conventional method of cotton cultivation.

Contract or cooperative farming in cotton can be encouraged for effective and optimum utilization of the resources to achieve highest yield as targeted for 2020. Cotton is grown in India across 10 States under diverse agro-climatic zones. Increasing irrigation facilities and adoption of scientific innovations and modern technologies like mechanised farming and high density planting programme are some of the key focus areas which can provide the much needed fillip to increase the productivity level further.

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