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THE FLAWED SPIN TO INDIA'S COTTON STORY

Relevant for: Indian Economy | Topic: Major Crops, Cropping Patterns and various Agricultural Revolutions

Genetically Modified (GM) pest resistant Bt cotton hybrids have captured the Indian market since their introduction in 2002. These now cover over 95% of the area under cotton, with the seeds produced entirely by the private sector. India's cotton production in 2019 is projected as the highest ever: 354 lakh bales. Bt cotton's role in increasing India's cotton production, which GM proponents have highlighted as being instrumental, has also been used to argue for extending GM technology to increase food crop yield. However, critics say that Bt cotton hybrids have negatively impacted livelihoods and contributed to agrarian distress, particularly among resource-poor farmers.

This year, India is expected to be the world's largest cotton producer, surpassing China in output. However, India's productivity (yield per unit area), is much lower than other major cotton-producing countries, meaning a much larger area is used for cotton production. Indeed, India's productivity has been only a third of these countries for over four decades. Why is this so? It cannot be explained by agronomic or socio-economic differences because these countries include both developed and developing countries, and different geographies. Which feature of cotton cultivation in India differs from other countries and might account for this large anomaly?

India is the only country that grows cotton as hybrids and the first to develop hybrid cotton back in 1970. Hybrids are made by crossing two parent strains having different genetic characters. These plants have more biomass than both parents, and capacity for greater yields. They also require more inputs, including fertilizer and water. Though hybrid cotton seed production is expensive, requiring manual crossing, India's low cost of manual labour make it economically viable. All other cotton-producing countries grow cotton not as hybrids but varieties for which seeds are produced by self-fertilization.

A key difference between hybrids and varieties is that varieties can be propagated over successive generations by collecting seeds from one planting and using them for the next planting; hybrid seeds have to be remade for each planting by crossing the parents. So for hybrids, farmers must purchase seed for each planting, but not for varieties. Using hybrids gives pricing control to the seed company and also ensures a continuous market. Increased yield from a hybrid is supposed to justify the high cost of hybrid seeds. However, for cotton, a different strategy using high density planting (HDP) of compact varieties has been found to outperform hybrids at the field level.

For over three decades, most countries have been growing cotton varieties that are compact and short duration. These varieties are planted at high density (5 kg seeds/acre), whereas hybrids in India are bushy, long duration and planted at ten-fold lower density (0.5 kg seeds/acre). The lower boll production by compact varieties (5-10 bolls per plant) compared to hybrids (20-100 bolls/plant) is more than compensated by the ten-fold greater planting density. The steep increase in productivity for Brazil, from 400 to 1,000 kg/hectare lint between 1994 and 2000 coincides with the large-scale shift to a non-GM compact variety. Cotton is a dryland crop and 65% of area under cotton in India is rain-fed. Farmers with insufficient access to groundwater in these areas are entirely dependent on rain. Here, the shorter duration variety has a major advantage as it reduces dependence on irrigation and risk, particularly late in the growing season when soil moisture drops following the monsoon's withdrawal. This period is when bolls develop and water requirement is the highest. The advantages of compact varieties over hybrids are considerable: more than twice the productivity, half the fertilizer (200 kg/ha for hybrids versus 100 kg/ha for varieties), reduced water requirement, and less vulnerability to

damage from insect pests due to a shorter field duration. Yet, India has persisted with long-duration hybrids, many years after benefits of compact varieties became clear from global experience.

If one grants that India would have benefited greatly from deployment of compact cotton varieties as supported by the evidence, then the question arises: why was this not done? Two phases of policy have contributed to this situation. The first is before GM cotton, when India persisted with hybrids from 1980-2002, while other countries shifted to HDP. Why was such a significant innovation in cotton breeding ignored for so long and what kept public sector institutions and cotton research centres from developing and releasing such varieties? The answers lie with the agricultural research establishment. The second phase where the question of hybrids versus compact varieties could have been considered, was at the stage of GM regulation when Bt cotton was being evaluated for introduction into India. It would not have been out of place to have evaluated the international experience, including the context of introduction of this new technology. Information should have been considered on the form in which it would be deployed (hybrids versus varieties). Importantly, agro-economic conditions where it would be used should have been a guiding factor. However, the scope of evaluation by the GM regulatory process in India was narrow, and did not take this into account. Consequently, commercial Bt hybrids have completely taken over the market, accompanied by withdrawal of public sector cotton seed production. The Indian cotton farmer today is left with little choice but to use Bt hybrid seed produced by private seed companies.

The current annual value of cotton seed used for planting is about 2,500 crore, and that of lint cotton produced is 68,000 crore. Therefore, it appears that the interests of the cotton seed industry have constrained the very much larger value of cotton production and the overall cotton industry. It is likely that production levels could have been much higher, with considerably lower risk and input costs, had compact varieties been developed and used in India. Agricultural distress is extremely high among cotton farmers and the combination of high input and high risk has likely been a contributing factor. Compact varieties would have significantly reduced distress as well as increased yield. Therefore, the hybrid seed model for cotton that India, and India alone, has followed for over three decades, is inferior to the HDP model being used in other countries on three important counts: much lower productivity; higher input costs; and increased risk particularly for low resource farmers in rain-fed areas.

There are several takeaways from the experience of Bt cotton worldwide, and in the context of hybrids in India. First, we must be clear that the outcome of using a technology such as Bt is determined by the context in which it is deployed, and not just by the technology itself. If the context is suboptimal and does not prioritise the needs of the principal stakeholders (farmers), it can have significant negative fallouts, especially in India with a high proportion being marginal and subsistence farmers. Second, there is a need for better consultation in policy, be it agriculture as a whole or crop-wise. Notably, India is a signatory to international treaties on GMO regulation (the Convention on Biological Diversity, and the Cartagena Protocol on Biosafety), which specifically provide for inclusion of socioeconomic considerations in GMO risk assessment. However, socioeconomic and need-based considerations have not been a part of GMO regulatory process in India.

It is important to recognise that adoption of any new technology such as Bt is a choice and not an imperative. For example, some of the major cotton-producing countries such as Brazil (until 2012) and Turkey (up to the present) have achieved high productivity without the use of GM cotton by using alternative pest-management approaches. The purpose of risk assessment in GMO regulation is to enable exercising of this choice by careful and comprehensive evaluation of costs and benefits. In the case of Bt cotton hybrids, the benefits were limited and costs may well have been too high, particularly for resource-poor farmers.

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