Introduction of Biotechnology in India’s Agriculture: Impact, Performance and Economics


The introduction and spread of biotechnology in agriculture has been reckoned as one of the most significant technological innovation in the world. Although its potential and impacts are still an on-going debate among different stakeholders, it has covered most of the cotton area (10.8 million ha) and production (35 million bales) in 2016 and the percentage of adoption increased to 96 per cent (ISAAA, 2016). Among the various countries adopting GM crops in their agricultural production, the Government of India permitted its commercial cultivation in 2002 with three Bt-cotton hybrids. This book comes as a timely snapshot of Indian agriculture’s experience two years post its commercial adoption. It examines specifically the impact, performance and economics of Bt-cotton versus non-Bt-cotton from primary data pertaining to the agricultural year 2004-05 in Andhra Pradesh, Gujarat, Maharashtra and Tamil Nadu that cover approximately 69 per cent of the total area and 61 per cent of cotton production in India (2004-05). This reflects the strength of the sampling framework adopted by the researchers.

The study undertaken on behest of the Ministry of Agriculture by the authors examines several dimensions of the subject in six sections and 28 sub-sections, including its environmental impacts, farmer satisfaction with the technology and ways of augmenting its effectiveness. The sections flow fluidly and systematically introducing the reader to the adoption and development of Bt-cotton in India. Section one provides a purview for the analysis of sample households that drives the rest of the book. Moreover, the literature on pertinent scientific, technological and agricultural studies
are balanced and elucidates the pros and cons across countries with the adoption of Bt-cotton. Section two presents the consolidated summary and conclusion of the studies undertaken in the four target states of India and briefly discusses the differences in nature, performance, economics and farmer perceptions of Bt-cotton and non-Bt-cotton cultivation. The next three sections delve into each state’s performance by assessing the empirics of Bt-cotton and non-Bt-cotton and highlights the agronomic and economic advantages that have been witnessed two years since its introduction. Each state’s analysis has been sub-divided into five sections. These sections cover the status of cotton cultivation, sampling and methodology, nature and performance and economics of Bt-cotton in relation to non-Bt-cotton and lastly the perception of farmers on Bt-cotton’s various features.

Across states by seasons, the common aspects evident in the analysis of Bt-cotton versus conventional cotton cultivation reveals that irrigation plays a vital role in obtaining higher production levels. The insect-resistant trait from the Bt trans-gene has also significantly reduced pesticide sprays in the sampled states, which corroborates with the existing literature (Huang et al, 2002; Gianessi et al. 2002). Recently, Kouser and Qaim (2011) using fixed effects Poisson models also confirmed the reduction in the incidence of acute pesticide poisoning among cotton growers that signifies sizeable health cost savings. Therefore, in mitigating bollworm, the accompanying hazards of pesticide dependence, namely poisoning and indebtedness, have also been reduced. However, the intensity of attack of secondary pests was found to persist in all the states. Further, Bt-cotton exhibited susceptibility to bacterial blight, alternaria and grey mildew noticed in Andhra Pradesh, other sucking pests/insect infestations in Gujarat that required spraying of insecticides.

Hereinafter, the book provides a detailed estimation of production costs and shows that certain costs, namely human labour accounted for the highest, followed by harvesting and seed prices for Bt-cotton, while fertilizers and pesticides figured among the top three after labour for non-Bt-cotton growers. The authors found that the cost of cultivation of Bt-cotton was relatively higher than non-Bt-cotton in the sampled states, but was compensated by higher yields, resulting in increased net incomes for farmers. The authors noted a discouraging factor in the promotion of Bt-cotton voiced across states was the inflated price of seeds which contributed to the financial costs of farmers.
Some features of Bt-cotton cultivation in Gujarat revealed that the quantity of pesticides saving was lower than expected and cost intensive. A significant issue that repeats itself throughout the book was the use of non-approved/non-confirmed varieties especially in Gujarat. The extent of counterfeit and spurious seed distribution was not yet known as transgenic cotton hybrids have become an illegal rural cottage industry (Gupta and Chandak, 2005) and hindered a credible assessment of Bt-cotton’s impact. In Salem and Perambalur districts of Tamil Nadu, the farmers have witnessed a fall in production and the maximum yield was obtained in the period 1984-1985.

The authors also chronicled the acceptance levels of Bt-cotton among farmers to gain insight into the dynamics of biotechnology. Farmer’s revealed preferences suggest that growing Bt-cotton in the last three years since its introduction has been profitable. The perceptions of sampled farmers across states indicated that the Bt-cotton plant was shorter and had a bigger boll size, staple length and good fibre colour, while few farmers in Maharashtra and Tamil Nadu indicated no difference. The authors inferred that farmers were cultivating Bt-cotton on “trial and error basis” without fully grasping its advantages and disadvantages as it was the initial years of Bt-cotton adoption. Further, the farmers perception in Maharashtra and a regression model concluded that adoption of Bt-cotton is scale neutral and not biased towards large farm sizes. However, higher benefit was reported with respect to upper caste, upper income and large farmers’ in AP and medium farmers in Tamil Nadu. From their experience, farmers have opined that Bt-cotton required a congenial environment including adequate and guaranteed resources for optimal production and were willing to continue growing Bt-cotton. Other enquiries in the study revealed that farmers interviewed were mostly motivated by the seed company, seed, fertilizers and pesticide dealers to cultivate Bt-cotton. Only a few farmers in Andhra Pradesh complained of skin irritation when it was stored in their homes. Across the states, farmers urged that government extension agencies play a crucial role in awareness and adoption of Bt-cotton. Farmers also highlighted the need for field demonstrations, guidance and seed quality which were lacking in all the states.

This book adds to the growing body of literature on biotechnology in Indian agriculture in spite of few limitations. The brief discussion on ‘voices
against Bt-cotton”, recognized by the authors in particular, illustrates that there is also significant resistance towards biotechnology in agriculture and care should be taken before over-emphasizing its value as a successful way forward in increasing productivity and insect resistance. This field is continuously evolving and therefore the analysis of comparing Bt and non-Bt-cotton production, yield and costs in this book should be read with caution. Studies post this research have revealed contrary findings such as stagnation in yield and weakening resistance to pest attacks specifically, pink boll worm (Tabashnik and Carriere 2010) and predation by secondary pests (white-fly, aphids, thrips) consequently escalating costs for farmers. As such, the authors do concur in their literature review that opinions on pest resistance are “divergent and require investigation”. Further analysis on high yielding varieties that lack the Bt trait and cultivated using sustainable techniques compared with Bt-cotton showed that non-Bt hybrids yield was better than Bt-cotton in Andhra Pradesh (Quyum and Sakkari 2005). Moreover, a detailed analysis concerning societal utility, a complicated multi-faceted aspect but essential feature in studying impact, could have provided a wholesome view of Indian agriculture’s experience in introducing biotechnology.

The authors also mention that “no systematic study reported any direct adverse impacts on the environment”. However, international studies in the time gap between field research and publication of this book have forewarned of concerns related to long-term agro-ecosystem interactions of out-crossing of transgenes, negative effects on non-target species such as the reduction in population of parasitic natural enemies (Catarino et al. 2015). Also, increased temperatures (Yuan et al. 2012) and water stress dynamics are likely to affect the efficacy of the Bt-cotton as reported yields were the highest in the irrigated areas of the states studied. Given the short-term nature of the study, the authors could have recommended a comprehensive ecological risk assessment and sustainability analysis considering the mounting long-term risks associated with cultivation of Bt-cotton in India.

In addition, the perceptions analysis could do with some robust economic tools such as propensity score matching used in various studies on analyzing impacts.
On the whole, it is a comprehensive and lucid analysis that makes this book a valuable contribution to literature on Bt-cotton adoption and its impacts. It is an informative resource for researchers and students interested in agricultural biotechnology.

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References


