

## A STRUGGLE FOR RECOGNITION

### Food security in India through genetically modified crops

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#### India's urgent needs

India's agriculture, like that of its easterly neighbour, is confronting a massive population. The country's 1.21 billion people, increasing at an average rate of more than 10 million a year, are expected to reach 1.69 billion by 2050 – compared with China's 1.4 billion in 2025.

For nearly three-quarters of India's people living in some 820,000 villages, agriculture has been a way of life. But the pressures on output are enormous, as incomes rise along with demand for more and higher-quality food. At the same time, the area of cultivable land is being lost to degradation, and irrigation facilities remain largely inadequate. These restrictions have put India at the bottom of the productivity ladder in the developing world and placed it 63rd (out of 78 countries) on the 2013 Global Hunger Index. Some 76 per cent of India's people are living on less than US\$ 2 per day. To ensure its food security, India needs more than 65 million more tonnes of food grain every year.

#### Agriculture under stress

Indian agriculture has to refocus itself to align production with the growing demands of its booming population. Modernisation and mechanisation are urgently needed, as are many more hectares of useable land, which could be acquired through technological innovation to enhance soil health and improve water supply and irrigation. The water table is dropping very rapidly, and electricity for irrigation pumps will not be free to the majority of farmers forever, as it is now. Productivity also needs to improve. Indian food crop yields have not kept up with those of the USA, China and Egypt, and compare very unfavourably with world averages in general.

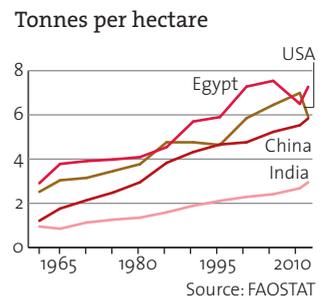
In short, after the beneficial effects of the Green Revolution began to be seen in the late 1960s, the country's agriculture seems to have reached a plateau. Its areas fit for farming cannot be appreciably expanded and its water resources, forever subject to the vagaries of nature, are restricted, sometimes to alarmingly low levels.

Even agricultural extension programmes for guiding farmers on their choice of seeds, fertilisers, insecticides, irrigation methods and alternate cropping patterns based on

#### KEY THEMES

- Agriculture under stress.
- Limits to the Green Revolution.
- Variable success of genetically engineered crops.
- Activism, public opinion and politics.

**Figure 10.1 Cereal yields in India relative to other major producers, 1961–2012**





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**Native to India, the mung bean is an orphan crop with a short growing season. It is also heat and drought-resistant and has few insect or disease problems, making it a valuable food source.**

Soil analyses and other factors have all been largely ineffective. Sometimes this is for purely agricultural reasons, such as the unsuitability of soils. Sometimes the human element intervenes: farmers can be lured into making poor choices by the prospect of better financial returns.

### **What did the Green Revolution achieve?**

India's Green Revolution, launched in the 1960s, was designed to:

- establish scientific and agricultural research bodies for improving technologies and crop varieties, and introducing the new dwarf cereal crops;
- improve fertilisers, pesticides and herbicides;
- address irrigation deficiencies;
- promote effective management.

By and large, this plan worked, showing that barriers to food production could be overcome and that the country could be transformed, through technological innovation, from an import-dependent nation to a net food exporter. Unfortunately, however, the Green Revolution's benefits to India did not last. Although they initially reduced fluctuations in food production, increased incomes, assuaged poverty and brought about more sustainability, over time the pendulum began to swing back. A number of warning signs were simply ignored by those managing India's agriculture, with serious adverse consequences.

The overzealous use of agrochemicals rendered large tracts of farmland uncultivable, while overstretched irrigation facilities meant that no further land could be brought under irrigation. Any benefits from improved crop varieties started to level out, and the farmers' need of cash crops lowered their output of millet, pulses and oilseeds. Alongside all that, financial hardship and electric power shortages eroded the chance of sustaining any hard-won gains.

### **Strong governmental response**

This alarming situation called for powerful and urgent remedial measures. In 2011 the Indian government tabled its Food Security Bill to facilitate heavily subsidised, adequate grain supplies for poor families. This aimed to alleviate the food-supply problems of up to 75 per cent of the rural population and 50 per cent of urban dwellers, at enormous cost to the public purse.

But reducing malnutrition and hunger-related deaths in India needs concerted management and technological effort if it is to be sustainable. Conventional agricultural

### CASE STUDY *Bt* cotton proves its worth

**India, like China, has enjoyed immense success with *Bt* cotton. In the decade 2002–2012 the *Bt* crop area under cultivation grew phenomenally, from 0.5 million hectares to 10.6 million hectares, while the number of cotton farmers rose from 50,000 to 7 million. Average yield went up by more than 60 per cent and total production soared from 13.6 million bales to 35.5 million.**

This transformation allowed India to stop being a cotton importer and instead become

the world's second-largest exporter. The new cotton enhanced total farm income by US\$ 3.2 billion in 2011 alone, much to the benefit of the country's 7 million resource-poor small farmers.

The biggest gains came from the reduced use of insecticides – more than 38 million kilos less since 2002. Yields went up, as did the physical and psychological health of farm workers and local people.

practices could never deliver the much-needed 65 million additional tonnes of food each year; new technologies are seen as the only option.

### Genetically engineered crops: a chequered history

India has around 60 universities, 10 autonomous institutes and 65 companies now involved in the research and development (R&D) of genetically improved crops. They are looking to develop some 80 desired characteristics in around 30 crops, with pest resistance being the most common trait.

India also has a biosafety regulatory system that is more elaborate and rigid than that of most other countries. At first sight, its structure of research, guidelines and standards, checks and balances before field trials and commercial release are approved appears highly rigorous. In practice, however, the top-level governing body – the Genetic Engineering Appraisal/Approval Committee (GEAC) – has often dismayed the scientific community with what the latter regards as irrational decision making. At the same time, the GEAC has attracted the disapproval of anti-GM activists at various stages of development of novel plants. Their criticisms reached a peak with the commercial release of *Bt* cotton in 2002 and *Bt* brinjal (eggplant or aubergine) in 2009.

For all the attempts of the Indian government to create a smooth regulatory path for the new technology, consulting widely with all parties, including the public, there

***Bt* brinjal was developed to combat losses caused by the brinjal fruit and shoot borer – the larval phase of the moth *Leucinodes orbonalis*.**



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is still some way to go. Whereas *Bt* cotton has been a success, the introduction of insect-resistant *Bt* brinjal has foundered.

### The power of activism

A decade of persistent intense activism has profoundly affected India's development of new crop technologies. Medical and environmental biotech products, on the other hand, escape the attentions of activists who, so far, have concentrated their opposition on GM crops. Even the commercialisation of Golden Rice, which became available to India without any technology costs, has been slowed down by political activism, with scheduled field trials having to be postponed.

#### CASE STUDY *Bt* brinjal hits a barrier

**How different from *Bt* cotton is the story of *Bt* brinjal (aubergine or eggplant) – a valuable food crop which is now under an indefinite moratorium curbing its commercialisation. Both cotton and brinjal were opposed by activists: one crop made it, the other did not.**

*Bt* brinjal contains the same gene from the universally occurring soil bacterium *Bacillus thuringiensis* as cotton and several other crops such as maize and soybeans, which have been safely consumed since 1996. The *Bt* gene controls shoot, fruit and now root-boring pests. Normally, high-quality non-*Bt* brinjal is sprayed with insecticides up to 40 times.

Development of the new brinjal crop started in India in 2002 and gained all the necessary official permissions from the regulatory system. Many institutions and hundreds of experts evaluated the efficacy, field performance and biosafety of the *Bt* brinjal, culminating in the Genetic Engineering Appraisal/Approval Committee (GEAC)

accepting recommendations for commercial release in 2009. But within a matter of months things went drastically wrong.

The Minister of Environment and Forests chose to impose a moratorium on the new crop, not on scientific, safety or environmental grounds but for political reasons. He argued that *Bt* brinjal would have met with public disapproval and expressed a fear that the majority of genetically modified seed would be under the control of one multinational company – Monsanto's Indian subsidiary, Mahyco, the Maharashtra Hybrid Seeds Company – which had simply provided the transgene and had no commercial interest in the ensuing *Bt* plant.

This moratorium has had serious effects on India's research and development of genetically engineered crops as a whole. Public investment has slowed down, and both India and foreign private investors have become hesitant about any future enterprise.

## Feeding 9 billion

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Why have anti-technology activists been so powerful? One reason is that they have the support of the pesticide industry, conventional seed developers and the organic farming lobby – all of which feel threatened by the large-scale adoption of GM crops – together with non-governmental organisations that are antagonistic to many forms of globalisation, including multinational companies and the perceived power of the USA.

Public opinion too has been shaped by such tactics as petitions in India's Supreme Court, and the vandalising of R&D sites and crops in official field trials. Activists have also made use of the media to spread information – some would say misinformation – on issues with a strong emotive pull on the general public. They argued, for example, that the risk of *Bt* brinjal crossing with its wild relatives might jeopardise their use in indigenous medicine.

Notwithstanding a voluminous peer-reviewed literature on the safety and benefits of GM crops, biosafety is a central preoccupation of activists. They argue, for example, that GM crops have adverse consequences for ecology and biodiversity, even though 10 years of experimental field research and commercial cultivation have shown no scientific evidence of environmental harm. They argue too that the new crops threaten indigenous varieties and hybrids. Despite these objections, however, the Indian government has decided to allow companies and institutions to put more than 200 transgenic varieties of rice, wheat, maize, castor and cotton on field trial to check their suitability for commercial production.

### Tangled interests

Anti-GM activism has also been fuelled by broad political and industrial antagonisms. In 2002 for example, the Indira Gandhi Agricultural University and Syngenta International – the Swiss multinational company involved in sequencing the rice genome and co-developing Golden Rice – proposed a collaborative research project. Their aim: to identify rice varieties and genes to develop novel hybrids of benefit to farmers. But there was immediate opposition from activists uneasy about the role and influence of multinationals. Negative and unsupported campaigning about farmer suicides due to the growth of *Bt* cotton over the years fuelled the fire. Threatened by violent agitation, Syngenta withdrew from the proposed arrangement.

Similarly, activists and opposition parties in the Indian government strongly opposed a deal made by the Indo-US Knowledge Initiative on Agriculture which aimed, among

***Bt* cotton is grown on about 90 per cent of India's cotton-growing area, making India the country with the largest GM cotton area in the world.**



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**Some of the objections to *Bt* brinjal reflected concern about gene flow to wild relatives of the crop, which are used in Ayurvedic medicine.**

other things, to build agricultural cooperation in biotechnology. On another occasion, an Indian state government – Bihar – blocked the development of GM crops for political rather than scientific reasons.

Untangling biosecurity issues from a mix of political, economic, social and ethical considerations would be a decisive step forward in India's deployment of the new genetic technologies. As things stand today, the country runs severe risks, in the opinion of the distinguished Indian expert Professor Chavali Kameswara Rao: "Today any GE [genetically engineered] crop can be released for cultivation in India, provided the developers do not say that it is GE, and in the process can as well save enormous amounts of time and money by bypassing the regulatory regime, benefiting farmers and consumers..."

There have already been several unconfirmed reports of illegal cultivation of pest-resistant and herbicide-tolerant cotton, virus-resistant papaya and *Bt* brinjal. So, clearly, urgent action is needed to balance the interests of a concerned public with that of India's future as a food-secure nation in which biotechnology needs to be given a fair hearing. Public education and informed dialogue are needed to address prejudice and ignorance, as well as vested interests, both political and commercial.