choices are very limited, most likely because the big GM seed companies have purchased many of the independent producers[5]. Also, to get a decent price on required farm chemicals that are also sold by the GM seed companies, the farmers may have to purchase the GM seed even though the GM trait itself is useless to them. In addition, the purchase of GM seeds is sometimes a defensive measure because farmers know they can be put out of business by biotech company–initiated lawsuits if their non-GM crops become contaminated by GM pollen from neighboring farms[6]. Finally, in developing countries the farmers frequently do not know what they are buying and they rely on local representatives who promote the latest, most expensive seeds that have not been properly tested for the area[7]. Third world officials have been known to take bribes from US companies[8].

If *Nature Biotechnology* wants to represent itself as an unbiased advocate for technology, then it should ensure that its reporting covers all sides of an issue.

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1. Sheridan, C. *Nat. Biotechnol.* **27**, 588–589 (2009).
2. Gurian-Sherman, D. *Failure to Yield: Evaluating the Performance of Genetically Engineered Crops* (Union of Concerned Scientists, Washington, DC, 2009) <http://www.ucsusa.org/assets/documents/food_and_agriculture/failure-to-yield.pdf>. Accessed July 2009
3. Heinemann, J.A. *Hope Not Hype: The Future of Agriculture Guided by the International Assessment of Agricultural Knowledge, Science and Technology for Development* (Third World Network, Penang, Malaysia, 2009).
4. Begley, S. Feeding the 900 million: let them eat micronutrients. *Newsweek* **152**, 53–54 (2008). <http://newsweek.com/id/160075>.
5. Fernandez-Cornejo, J. *et al.* in *The Seed Industry in U.S. Agriculture. Agriculture Information Bulletin Number 786* (Publishing Resource Economics Division, Economic Research Service, USDA, Washington, DC, 2004) p. 30–40 <http://www.ers.usda.gov/publications/aib786/aib786h.pdf>.
6. Kimbrell, A. & Mendelson, J., eds. *Monsanto vs. U.S. Farmers* (Center for Food Safety, Washington, DC, 2005) <http://www.centerforfoodsafety.org/Monsantovsusfarmersreport.cfm>.
7. Stone, G.D. *Curr. Anthropol.* **48**, 67–103 (2007).
8. Anonymous. Monsanto fined $1.5m for bribery. *BBC News*, January 7, 2005 <http://news.bbc.co.uk/2/hi/business/4153635.stm>.

***Nature Biotechnology* replies:**

We agree with Schubert that the article's use of "public sector" as a descriptor for the crop scientists quoted in the piece was potentially misleading, given their ties to industry. Schubert also refers to the IAASTD report as support for the Gurian-Sherman manuscript. For this journal's analysis of IAASTD, the reader is referred to an editorial[1] and related correspondence[2,3].

1. Anonymous. *Nat. Biotechnol.* **26**, 247 (2008).
2. Heinemann, J.A. *Nat. Biotechnol.* **26**, 499–500 (2008).
3. Chataway, J., Tait, J. & Wield, D. *Nat. Biotechnol.* **26**, 500–501 (2008).

To the Editor:

A News story in your July issue highlights a controversial report from the Union of Concerned Scientists concluding that commercialized genetically modified (GM) crops have had negligible effect on food crop yields in the United States[1]. Despite the increasing use of GM crops around the world[2], agricultural biotech remains contentious in some countries, especially in Europe[3]. Influenced by biased reports, Europeans tend to overrate GM crop risks, while underrating the benefits[4]. Claims that the technology is needed to ensure food security and poverty reduction are often considered empty promises and are dismissed as industry propaganda. This in turn prompts widespread public concerns about negative social implications in developing countries[5]. Correspondence in this journal has also documented how GM crop opposition in Europe is hurting farmers and researchers[6]. More seriously, through trade relations and lobbying efforts of antibiotech groups, European attitudes are spilling over to developing countries, where they crucially impede biotech developments as well[7]. Here, we summarize our recent research on the socioeconomic effects of insect-resistant *Bacillus thuringiensis* toxin (*Bt*) cotton in India[8,9]. In this case, at least, there is strong evidence that the trait in this crop is already contributing to poverty reduction in the subcontinent.

Bt cotton containing the gene for the Cry1Ac protein was commercialized in India in 2002. Although only a few *Bt* cotton hybrids were initially available, their number has increased substantially to over 150 since 2004. Some of them also carry the gene for Cry2Ab. In 2008, around five million Indian small-scale farmers had adopted *Bt* technology, with an average cotton area of 1.5 ha. Many of them live below the poverty line. Several rounds of a representative farm survey reveal that *Bt*-adopting farmers use 41% less pesticides and obtain 37% higher yields, resulting in an 89% gain in cotton profits on average[8]. In spite of seasonal and regional variation, these advantages have been sustainable over time. In monetary terms, mean profit gains are $135 per ha. For the 7.6 million ha currently under *Bt* cotton in India, this means an additional $1 billion in the hands of small-scale farmers. These are the technology's direct benefits.

Yet, there are also indirect benefits. For instance, higher cotton yields provide more employment opportunities for agricultural laborers and a boost to rural transport and trading businesses. Income gains among farmers and farm workers entail higher demand for food and nonfood items, inducing growth and household income increases also in other local sectors. Using a village modeling approach and taking into account such spillovers to other markets and sectors, we find that each hectare of *Bt* cotton creates aggregate incomes that are $246 higher than those of conventional cotton (**Fig. 1**)[9]. For the total *Bt* cotton area in India, this translates into an annual rural income gain of $1.87 billion. That is, each dollar of direct benefits is associated with over 80 cents of additional indirect benefits in the local economy.

In terms of income distribution, all types of households benefit, including those below the poverty line (**Fig. 1**). Sixty percent of the gains accrue to the extremely and moderately poor. *Bt* cotton also generates net employment, with interesting gender implications. Compared to conventional cotton, *Bt* increases aggregate returns to labor by 42%, whereas the returns for hired female agricultural workers increase by 55% (**ref. 9**). This is largely due to additional labor employed for picking cotton, which is primarily a female activity in India. As is known, women's income has a particularly positive effect for child nutrition and welfare[10].

Numerous studies show that sizeable direct benefits are also observed for other GM crop applications in developing countries (reviewed by M.Q. in ref. 4), although a comprehensive evaluation of indirect social effects remains

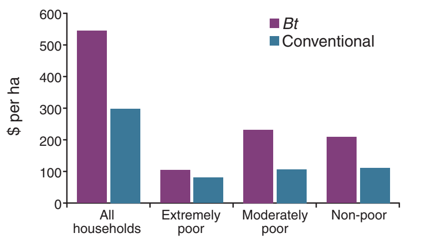

Figure 1 Household income effects of *Bt* cotton in comparison to conventional cotton in rural India. The results shown include direct benefits among cotton farmers as well as indirect effects through spillovers to other rural markets and sectors. For the evaluation of income distribution effects, households were disaggregated using local poverty lines, which are very near to the World Bank's thresholds of $1 and $2 a day (purchasing power parity) for extreme and moderate poverty, respectively (ref. 9).