
Disaggregating Biotechnology and Poverty: Finding Common International Goals

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I was asked to provide concluding commentary for this conference. Fortunately, everyone attending realized that this task is unmanageable: the papers have been far too rich and wide-ranging for any tidy summary or conclusion. I will instead try to provide some sense of the thoughts stimulated by the sessions, in the hope that others may find them useful.

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The wealth of empirical materials engaged in the plenary and breakout sessions should send a strong signal to analysts of the public-policy issues in biotechnology: disaggregate, disaggregate, then disaggregate. There is significant variation in the relationship between technical change in agriculture and societal welfare implications along numerous dimensions. This variation is by crop, by agro-ecological system, by social structure, by property relations, by policy regime — both domestic and global. I will illustrate this lesson below with discussion on the relationships between biotechnology and poverty.

To begin disaggregating at the top, I suggest that we abandon use of the term “developing countries.” Though common shorthand, the construct increasingly strikes me as empirically imprecise, deceptively linear, philosophically glib, and vaguely patronizing. Equally, we need to keep before us the distortions that excessive aggregation creates for analytics of poverty. Mahatma Gandhi once said something to the effect that India was not a poor nation, but rather a rich nation inhabited by many poor people. What benefits a powerful landlord in rural India may have no effect whatsoever, or a negative effect, on a landless worker with nothing to sell but her labor power in a crowded market. There are far more of the latter than the former. Because of inappropriate aggregation, we hear discussion of “India’s interest” in biotechnology, or other technologies, when in fact there are multiple interests, often conflicting. Disaggregation gives us a better reading of the effects of new technologies of various sections of the population, and thus grounds for thinking about complementary policy.

Moreover, “development” is a process of—etymologically—“unfolding.” The meaning of development for a tadpole is beyond dispute, genetically given; one can tell whether or not the frog is coming into being. There is a defined end-state: a frog lacking lungs, or possessed of three legs, has not developed properly; something in the development process has gone terribly wrong.

Nations are quite different; much of politics is a struggle to define what vision, what potential should be unfolding, what criteria should mark progress as opposed to retrogression. In 2002, the United States, for the first time since 1958, experienced an increase in the infant mortality rate, already the highest rate of any OECD country. This outcome would consensually be a step backwards on any developmental trajectory, however large the GDP may become. There is no consensual end-state: all societies are at all times potentially “developing”—or slipping. Human societal development presents continuous challenges, moving targets, redefinitions of what is possible, conflicts over what is best, what is unacceptable. There is no consensual analog of a tadpole-to-frog template. Finally, the use of the construct “developing countries” suggests that currently low-income nations are on some defined path moving upwards. The reality is progress and retrogression, radically uneven over time and space, across epochs. To talk of “developing countries” when referring to most of Africa in the 1990s, for example, would not only imply a gloss that is imprecise and naïve, but analytically distorting. Just as imperial powers rise and fall over time, development miracles come and go: Pakistan of the go-go 1960s to the crisis-ridden 1970s to contemporary volatility is archetypal.

Finding Common International Goals is an ambitious conference theme in this context. As elaborated by Alan Wildeman (2004), all three constituent elements of this theme are of special importance to the poor: ensuring safe and healthy food, reducing ecological damage, and improving quality of life. We find in the optimistically evoked “international community” repeated declarations of a global commitment to reduction of poverty; in some formulations, poverty reduction

through application of biotechnology tools rises above the level of opportunity to the level of moral obligation (Nuffield Council, 1999). The absolute numbers of the absolute poor continue to increase globally, despite striking growth of GDPs and other measures of economic activity in many parts of the world. Of the many definitions of poverty available, one used by Robert McNamara as president of the World Bank in 1974 has always struck me as most apt, and I paraphrase here: absolute poverty is a condition of life so limiting as to deny the potential of the genes with which humans are born.

The very existence of absolute poverty in this sense constitutes a global imperative to apply new knowledge to alleviate limits on achievement of human potential. What might biotechnology have to do with alleviating such conditions as part of common international goals? For many in the NGO community, this very question is part of an instrumental ideological cover for corporate globalization. This flatly oppositional view of biotech lacks nuance, and certainly comes to premature conclusions about the poor, but is rooted in serious concerns about property and costs of cultivation of greatest importance to the marginal producer. The empirics thus far do not seem to bear out the most pessimistic scenarios of opponents to transgenics, yet their premises warrant our collective attention if we are serious about the condition of the poor.

DEVELOPMENT CONTEXT: DR. SWAMINATHAN'S CHALLENGE

In my breakout-session group, there was considerable puzzlement and surprise at the comment of Dr. M.S. Swaminathan in the keynote session to the effect that glyphosate-resistant transgenic crops are not appropriate for India. The reason for surprise is a persuasive Malthusian approach to world hunger and world poverty in the standard narrative of transgenics and the poor. If India is a poor country, should any productivity-increasing technology in agriculture not be of benefit to the poor? The ghost of the good Reverend Malthus remains quite influential. For example, Per Pinstrup-Andersen and Ebbe Schioler, in a book that won the World Food Prize for 2001, concluded, "Once again Malthus's clash between population growth and food production looms threateningly on the horizon" (Pinstrup-Andersen and Schioler, 2000). Though sophisticated analysts such as Pinstrup-Andersen and Schioler understand the many caveats embedded in the Malthusian narrative, there remains a widespread misconception—echoing corporate public-relations—that biotechnology means more food and more food means less poverty. Dr. Swaminathan's comment puts us on another, and more fruitful, analytical track, but one that is conceptually and empirically challenging.

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Broad statements about whether advances in biotechnology will benefit or disadvantage the poor are unlikely to be useful. Both “biotechnology” and “the poor” are heterogeneous categories. Yet the public and political discourse around biotechnology has largely taken a dichotomous and generalizing form¹, though more so in agriculture and food systems than in pharmaceuticals.

Biotechnology covers a wide range of practices and products. The most contentious—and potentially powerful—sphere is genetic engineering, though it is already clear that advances in biotechnology outside the transgenic realm make significant contributions to plant breeding. It is recombinant DNA work that has energized the debate, because of its unique potential and consequent susceptibility to suspicion. Transgenic organisms are regarded by proponents as offering unprecedented benefits to humanity and by their critics as introducing unacceptable uncertainty, perhaps serious risk. This disagreement becomes more pointed when proponents claim that genetic engineering offers means of improvement in the lives of the poor that can be approached in no other way, for example in creating nutrient-dense varieties of rice (Bouis, 2003). The ethical assumption is clear: poverty produces unnecessary suffering; human knowledge is a collective product and good; knowledge must be utilized to alleviate suffering if at all possible. Critics claim that it will be precisely the most vulnerable sections of the population that will be put most at risk by novel technologies, whether from ecological degradation, unsafe foods introduced via foreign aid or public distribution systems, allergenicity from new proteins, or monopoly control of genetic materials and thus of pricing and access to technology by multinational firms (Shiva, 2000; Altieri, 2001).

To take Dr. Swaminathan’s comment in this context, it is clear that disaggregation across nation states and agrarian structures is necessary to talk sensibly about transgenics and the poor. Herbicide-resistant crops save farmers money and labor under certain agronomic conditions. Dr. Swaminathan was implicitly disaggregating a largish, indeed continental, entity we call “India” into constituent interests and suggesting that the vector sum effect of reducing labor via herbicide-resistant crops was not good policy. This is a plausible claim. The largest class of absolute poor is the rural landless who must find daily employment to maintain themselves. Reducing aggregate demand for labor under those agrarian conditions either destroys livelihoods directly or puts downward pressure on wage rates or both, in either event deepening poverty if no other systemic parameters change simultaneously. Worse, the rural poor who engage in weeding labor for a livelihood are frequently those cumulatively disadvantaged along other dimensions of social stratification: women, depressed castes, ethnic minorities. In those circumstances, even if herbicide-resistant crops would be desirable on other grounds—to encourage soil conservation, for example—a pro-poor approach would necessarily

¹A very useful overview is Winston (2003); see also Dawkins (1997), McHughen (2000), Shiva (2000), Shiva *et al.* (2000), Altieri (2001), Charles (2001) and Paarlberg (2001).

begin discussion of land reforms, rural public works, food subsidies, and other mechanisms to avoid making the poor pay for others' profits (e.g. Herring, 2003a).

But the story is surely more complicated than Dr. Swaminathan suggested. Where farm labor is either scarce or mostly supplied by farmers who own their own land, ability to control weeds may enhance yields, returns for labor, and opportunities to take on more land for cultivation when available. All these outcomes could be pro-poor, depending on the net effect on costs and returns to direct producers. This view has been long advocated as correct for African conditions, and was advocated from the plenary floor by Florence Wambugu. There are rural poor in both India and Africa, but their objective interests in herbicide-resistant technology may well diverge. Moreover, even in India, demand for rural labor is highly uneven temporally: an aggregate surplus of labor, indicated by insecurity and poverty among landless workers, does not mean that acute labor shortages do not occur in times of peak demand. Farmers will frequently tell investigators that labor is in short supply. This observation may occasionally be literally true, but often means only that they cannot hire labor in discrete bundles at times separated by enforced idleness at a wage that gives them a decent profit. This farmer-profit wage may well leave the laborer below a pitiful poverty line over the course of a year, as labor demand is seasonal (Herring and Edwards, 1983). Agrarian structure matters fundamentally.

Because disaggregation produces complex analytics that require significant empirical research, the serious literature on transgenic crops and poverty is in its infancy. There is little doubt that development of affordable, scale-neutral technologies for reducing biotic and abiotic stresses on crops of special importance to marginal farmers would be important to global poverty reduction, assuming reasonable seed prices. Indeed, the great promise of recombinant DNA technology is that the specific problems of poor farmers can in principle be addressed in new and efficient ways (Lipton, 2000). The poor often face special agronomic difficulties because they are driven to the margins of agrarian systems; the best land, water, drainage, locations, credit connections, knowledge are not in their hands. Their crops do not attract the attention of the best-funded research institutions. Drought- or salinity-resistant crops are of special importance to the poorest farmers, but the technical problems in these traits exceed those of single-gene solutions such as insect resistance through *Bacillus thuringiensis*. There is thus both need and promise for transgenics developed specifically to alleviate the obstacles faced by poor farmers; but the distance between promise and delivery is long, and made longer by the political controversy surrounding biosafety and regulation, as discussed below.

The implication of this promise is that directed research and development become necessary. Critiques of biotechnology as a force for poverty alleviation thus target the incentives for and record of current research and development. Most of the currently available technology was developed for crops and agrarian conditions of wealthier farmers and countries as opposed to crops widely grown by

poor farmers in poor countries [for representative data on global distribution of crops, see James (2003)]. This critique would be more powerful were the technology not so young and were there not so many new potential players at the national and global levels. Moreover, the *Bt* approach to insect control seems to be widely applicable to a common agricultural problem, regardless of size of holding. Nevertheless, the point about research and development concentration has some validity as a generalization. The political economy of this outcome, even if overstated, is very clear: unlike the international research and distribution regime of the “green revolution,” most of the research in genetic engineering is in the hands of for-profit firms, rather than international public-sector and national research institutions. There is little private incentive to produce for small markets of poor people, especially when the political climate for acceptability of transgenic crops in poor countries is so uncertain or even hostile (Potrykus, 2004). Orphan crops join orphan drugs as instances of market failure. At its best, development policy is ideally suited to address such market failures. Getting the institutions right—public, private, national, global—for biotechnology is a necessary condition for purposive pursuit of poverty-reducing outcomes (Cohen *et al.*, 2003).

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REASONING FROM THE BOTTOM UP

The spirit of pro-poor transgenic policy must begin reasoning from the needs of the poor, rather than from potentials of the technology. This is explicitly a comparative enterprise: the question is always, implicitly, under what conditions do particular dynamics obtain? Though the poor are obviously a heterogeneous category, some primary desiderata can be posited universally:

- The poor need opportunities to improve incomes, which by definition would reduce poverty. Net employment and wage effects (shadowing productivity gains) relative to food prices are most important for the most vulnerable poor, whose main—often only—saleable asset is labor power.
- The poor need more affordable and more nutritious food to improve their health and to live longer and more productive lives. Affordable food is obviously important for the poor; yet the poor consumer’s gain can be the poor farmer’s loss when over-production causes prices to fall. Poor producers will be harmed by surpluses unless total factor productivity on farm rises and no new extractions of intermediaries—seed merchants, moneylenders—siphon off additional farmer income.

- The poor need environmental protection. This is true both because more often than for the rich, their livelihoods depend on ecological integrity, and because environmental degradation affects most quickly and seriously those with the least flexibility in life choices.

This simple accounting does not exhaust the needs of the poor; one thinks of land, shelter, political access, cultural acceptance, and personal security among other conditions. Nor should consideration of transgenics obscure the major levers through which poverty might be alleviated. The international regime of subsidies and protectionism in rich countries, for example, has a much larger impact on incomes of the rural poor than any transgenic yet developed. These macro and structural determinants of poverty and its effects must be bracketed for a discussion of biotechnology *per se*, but must not be forgotten.

Income

The easiest question concerns farmers who own their own land: what is the evidence that genetic engineering allows scale-neutral deployment with substantial benefits for very small and marginal farmers? In the narrative of proponents of transgenic crops, scale-neutral technical change can lower the size threshold of a viable farm, rescuing smallholders from the problem of having too small a farm to be viable—an increasingly troubling phenomenon. In the narrative of opponents, poor farmers in particular lack the power, autonomy or knowledge to avoid victimization by powerful purveyors of an alien and dangerous technology.

This is no place for a literature review, but the evidence seems to be squarely in favor of the scale-neutral interpretation. That is, new technology embodied in seeds does not face the lumpy investment hurdle of such innovations as tractors or tube wells that favor wealthy farmers over poorer farmers. The clearest evidence is probably from *Bt* cotton, where small farmers have increased their net income through two mechanisms: less cash expenditure on insecticides and better protection from pests, increasing production per acre (*e.g.* James, 2002; Lipton, 2003; Pray and Naseem, 2003; Zilberman *et al.*, 2003; Herring, 2005). The evidence that small farmers can take advantage of *Bt* technology to avoid debts for inputs such as pesticides and provide some insurance against crop failure and raise production has led to endorsements by global organizations such as the United Nations Development Program (UNDP, 2001)—certainly no corporate shill—and the Food and Agriculture Organization (FAO, 2004).

The most obdurate problem of poverty is, however, in many settings that of the landless poor who must seek wage employment on whatever crops need labor. More an Asian than an African problem, as suggested above, the rural landless are everywhere especially disadvantaged in economies that generate too few jobs and experience urban bias in social support services. Labor-displacing (“saving” in the discourse of maximizing managers) transgenics then come under special scrutiny. Insect- or herbicide-resistant crops, by reducing the labor needed for applying insecticides or weeding, may reduce hired farm labor, thereby affecting the de-

mand for labor from the most vulnerable class. At the same time, increased income for farmers could generate more rural employment: the familiar trickle-down dynamic (typically assumed by those who do not have to wait for trickles for their well-being, but live rather farther upstream). The dynamic of lower labor applications on transgenic crops would be attenuated under conditions of smallholder self-cultivation: so, for example, less prevalent in *Bt* cotton in China, in theory, than in India, where cotton holdings, though small, are larger than those in China [data from James (2002)]. On yet another hand, work opportunities lost in chemical applications may be compensated by more harvest labor, less polluted ground water and less exposure to toxins. This scenario could present a difficult trade-off for the very poor, but may not be inevitable. For example, in *Bt* cotton in India, if wages are based on weight harvested—rather than a daily basis—income would increase with yield and with density of viable bolls of cotton. The inverse is that there is no income for the landless at all in harvesting crops destroyed by bollworms. To the extent transgenics reduce risk of crop failure, they serve as a macro-insurance policy for the landless poor, as they do for farmers.²

Poverty implications for farmers and states seeking hard currency through agricultural export earnings are complicated by segmentation of global markets; segmentation in turn is a function not of poverty concerns but of differential interpretation of the science on issues of risk and uncertainty. Here European consumers have proved disproportionately powerful. Though there seems to be some softening of official European hostility to transgenics, it is still not clear how *identification and labeling of transgenic products in the global market will affect opportunities for poor farmers. The example of Japan's banning of transgenic papayas underscores the vulnerability of small farmers to discrimination against transgenic crops—ironically in this case to the benefit of a multinational firm dominating the market (Lee et al., 2003).*

Finally, income effects are difficult to specify with limited data and unanswered questions about the regime of property rights and mix of public/private investment in new technologies. It is becoming clear that the burden of patents, property claims and consequent fees has been exaggerated by opponents of transgenics. Activists in India said that Monsanto would crush the peasants, for example, but a) seed costs are typically only 7–10% of the cost of cultivation, b) most farmers who use the very expensive Bollgard® seeds seem to find that net income goes up, and c) farmers who wish to avoid the high costs of officially sanctioned seeds have many gray-market unapproved *Bt* cultivars as options, some of which are

²*Bt* cotton in India has been in the field for too short a time, and with too few independent and credible studies, for there to be firm conclusions on this point. See Herring (2005) for some sources and evidence. It is clear that the storm-generating claims on positive yield effects of the Qaim and Zilberman (2003) piece in *Science* were based on an unusually devastating bollworm infestation and represent not a typical outcome but a limiting case, as the authors recognized. Nevertheless, such catastrophes do occur from time to time, and *Bt* crops survived when others failed.

quite inexpensive and some of which are held superior to the Monsanto version by some farmers (Herring, 2005). The monopoly powers of political rhetoric and TRIPS negotiations prove difficult if not impossible to enforce on the ground, whether in Southern Brazil (soy) or Western India (cotton). It is certainly true that Monsanto has been quite vigorous and somewhat successful in demanding enforcement of its property claims in North America, and comes down very hard on farmers to set examples, but it is equally clear that such strong interpretations of intellectual property are anomalous on a global scale. Moreover, it is the public sector that seems to be supplying more and more of the transgenic research and products in the low-income countries (Cohen, 2005).

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Health

Most of the world's poor are not farmers at all. The overwhelming fact of poverty is insecurity and restricted options: food comes first, and consumes a larger share of expenditures the poorer one is. Moreover, food expenditures of the poor tend to be weighted towards staples rather than fruits, vegetables and animal protein. For the poor family, there is not enough food and it is not adequate nutritionally. As deadly as protein-calorie malnutrition is, it is increasingly recognized that micronutrient deficiencies generated by excessive reliance on staples in an unvaried diet may be equally or more debilitating. The potential of bio-fortification of food crops—of which pro-vitamin A rich “golden” rice is the poster plant—figures heavily in claims for the life-saving potential of transgenics. The model is clear: having plants make nutrients that will be bioavailable in staples for those who cannot afford the varied diets recommended by nutritionists seems superior both in terms of cost and sustainability to alternatives such as supplementation or fortification of processed foods (Bouis, 2003).

This topic was treated well in plenary by Suzanne Harris and mentioned in passing by others. It is hard to imagine that this contribution of biotechnology is not the most significant for the poor; cash can be lost, crops can be destroyed by natural catastrophe, recessions can dry up wage labor opportunities, but as long as adequate entitlements to food staples can be maintained for the poor, nutritional enhancement of those staples contributes to health in the most direct way. What is not known is how practical nutritional enhancements are in different agronomic regions and crops, how consumers will accept transgenic foods, whether farmers will grow bio-fortified varieties, and whether or not there are dangers in over-dosage of specific micronutrients for specific people.

Environmental Integrity

The poor are the first victims of environmental degradation. They depend on the environment more and have fewer options in comparison to the rich. There are dichotomous positions on the environmental consequences of transgenics. Proponents argue for substitution of destructive agro-chemical inputs in ways that improve environments. Synthetic chemicals in agriculture are among the most toxic substances in circulation; the poor are especially vulnerable. If someone is going to put on a backpack sprayer and walk unprotected and often half-naked through fields spewing toxins, the probability that it will be a rich male is close to zero. If anyone is going to drink contaminated surface water, or water from shallow wells, that person is most likely to be found at the bottom of the social hierarchy. Here the claim of *Bt* technology, especially in cotton, is very powerful. The evidence from China on farmer health in *Bt*-protected fields as opposed to sprayed fields is clear (Huang *et al.*, 2002; James, 2002; Pray *et al.*, 2002). Reduction of pesticide spraying can be expected to conserve water as well, and reduce the destruction of beneficial insects in the fields and wildlife that depends on agro-ecological niches.

Against this clear benefit is the prospect of uncertainty—not risk, yet, for no probability distributions are known—but an uncertainty about possible ecological dangers. The magnitude of the uncertainty is not known. Pitting certain benefits against uncertain dangers presents a difficult public-choice situation. It is not helpful to say, as techno-optimists sometimes do, that science should decide; there is no scientific means of placing values on uncertain outcomes. Rather, there are widely varying distributions of risk aversion and risk acceptance (Douglas and Wildavsky, 1982). This is true for societies as for individuals. Most North Americans consume transgenic foods with little thought of allergenicity; Europeans—and some African and Asian societies—take a much more risk-averse position. Risk aversions are not subject to refutation; some people fear airplanes, others fear statistically uncommon crimes, others fear rare diseases; no data will settle the issue of their preferences or relative risk aversion. The only solution to this public choice problem is some interaction between democratic processes and biosafety institutions. The poor are the least likely to be heard in these forums under existing institutional arrangements.³

INSTITUTIONS: BIOSAFETY, REGULATION AND PROPERTY

There is always one institutional caveat in the standard narrative of transgenics and the poor: the assumption that an effective regulatory regime can be put in place. On this point both proponents and opponents agree. There are three huge

³For results from a major project testing the conceptual and empirical dimensions of this issue, see *Democratizing Biotechnology: Genetically Modified Crops in Developing Countries*, Institute for Development Studies, University of Sussex, Brighton, UK (www.ids.ac.uk/biotech).

issues: how much regulation? will regulation work? is the result worth the cost? Joel Cohen confidently said in plenary, “Risk assessment will happen,” but later added somewhat more ominously, “Farmers will find a way.”

Seeds are not only divisible as working capital—contributing the scale-neutral characteristic of at least some transgenic crops, and hence their contribution to raising poor-farmer income—but largely invisible to regulators (Herring, 2003b). Seeds are also highly portable; the very idea of borders becomes as problematic in the genomics revolution as it has proved to be for drugs, arms, people and information. The contemporary conflict over genetically modified (GM) soy in Brazil underscores the point: the federal state is less a means of enforcing Brazilian law than a forum in which struggles take place over regularization of a transgenic crop that farmers clearly want. “GM-free” zones declared by governmental institutions are a fantasy.⁴ Likewise, underground, unauthorized *Bt* cotton seeds spread without the knowledge of either Monsanto’s Indian partner Mahyco or the nodal federal authority for enforcement of Cartagena provisions, the Genetic Engineering Approval Committee in Delhi. As a result of farmer stealth and underground seeds, a kind of genetic anarchy evolved in India’s cotton regions. Farmer-generated *Bt* crosses, F2 seeds of earlier crosses, unauthorized transgenic varieties produced by small companies, and the three officially approved Monsanto Bollgard® varieties approved by the biosafety regime, were all competing for space in the fields at different price points. In the face of farmer political power, regulators basically retreated (Herring, 2003b, 2005). Gene police will be hard to come by in the villages.

Ironically, the same forces that preclude effective biosafety surveillance also preclude enforcement of property rights that both firms and opposing NGOs assume. The concern for the poor is quite straightforward. For poor producers, the shift from public-sector dominance of intellectual property in the “green revolution” to private-sector dominance in the transgenic revolution could deepen market-determined disadvantages. The worst-case scenario for poor farmers would be one in which technology fees were prohibitively expensive, yields were dramatically improved on the farms of early adopters of new transgenic crops, and the poor were caught in a backwash of lower output prices because of increased yields on adopter-farms, but with no reduction in input costs or increases in yields on their own farms. Technical change in this scenario would accelerate agglomeration of ownership and the ruin of small farmers.

⁴See for example, *Seed Quest*, Brazil Introduces Bill to Regulate GM Crops, Rio de Janeiro, Brazil, October 30, 2003. The national state sought first to limit underground transgenic soy to one state, Rio Grande do Sul, where farmers have been growing seeds smuggled in from neighboring countries for some time. The neighboring state of Parana then banned the crop and seized shipments from the port of Paranagua, but part of this shipment was grown in Paraguay, not Brazil, raising an international dimension to the conflict. The establishment of a biosafety regime at the national level led to significant political conflict, within and outside the government (Poddar, 2004).

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As the transgenic cropping revolution unfolds, though, it seems that, to date, property rights have been much more fluid, contingent and variable than opponents of the technology had feared. China's public-sector *Bt* cotton seems to be quite successful and is likely to travel to India via a partnership with Nath Seeds. In India itself, public-sector research is picking up, though still is far behind that of China (Pray and Anwar, 2003). Private-property claims also turn out to be quite negotiable. The "golden rice" property claims have been sorted out to segment the market in a way friendly to poor producers; this outcome may serve as a model for future humanitarian transfers of technology. The analogy to pharmaceuticals seems clear: market-driven distribution with strong property rights is inappropriate for serving the needs of the poor. When the Indian firm Cipla entered the African market, multinationals with prohibitively priced AIDS drugs had either to write off the market or adapt with competitive pricing. Of course the possibility remains that just as "orphan drugs" are abandoned for lack of markets because only poor people get the disease in question, there may well continue to be orphan crops, as the poor lack both economic and political power.

If some of the most pessimistic projections of the effects of strong intellectual property rights in transgenics seem exaggerated, there remains much that is uncertain. It is still true that high upfront technology fees will disadvantage poor farmers. To the extent that transgenics require more upfront cash than alternatives, they will reinforce the advantages of deep-pocket farmers over poor farmers. The poor are excluded from or disadvantaged by credit institutions and, by definition, are less likely to be able to afford cash payments from savings. They often pay more for credit. Black farmers in the United States won a massive settlement from the Department of Agriculture in 1999 to compensate for credit discrimination and loss of farms historically. Precisely the same probabilities of lower ranking in the social hierarchy that make poor farm laborers especially vulnerable to ravages of income insecurity and nutritional crisis afflict small farmers in stratified agrarian systems (Herring, 1977). More creative credit institutions are in general of special importance to the poor, and especially under conditions of technical change. By the same token, to the extent that transgenics substitute for upfront cash costs of inputs, they are of special benefit to the poorest farmers; in the case of *Bt* cotton in India, debts at usurious rates to pesticide firms have been a significant source of farmer financial crisis and the widely publicized farmer suicides of 1998 (Centre for Environmental Studies Warangal, 1998; Department of Agriculture and Cooperation, 1998). It is now clear that the CryIAC protein in practice substitutes for sprayed pesticides in a very cost-effective way, more so when technology fees are avoided than when they are paid (Roy, 2003; Herring, 2005).

These observations on underground seeds raise a serious concern about the feasibility of biosafety regimes. The discourse of Cartagena could well be more symbolic politics than real barrier to gene flow. If the benefits of introduction of transgenics are captured by a subset of farmers and seed companies, but the costs are spread to society generally, the case for transgenics is proportionately weaker on developmental grounds.

The first ethical dictum of development policy is to do no harm. The history of development is one of innovation, accepting risks to achieve gains. As always, the question of social justice is: who bears the risk, who is likely to gain, at whose expense? There is no dispute, for example, that the regulatory regime for genetically engineered organisms mandated by the Cartagena Protocol on Biosafety of the Convention on Biological Diversity will be costly and difficult to implement—particularly in the poorest countries—and perhaps ineffective. The opportunity costs of implementing this regime are high in terms of brain-power, skills and funds. Confronting these costs in the calculation of potential benefits of transgenics is a challenging but necessary task, one typically dodged in the standard discourse on biotechnology.

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poverty alleviation must rank highly.*

THE GOLDILOCKS PARADOX

Poverty has been important, at least rhetorically, in the globally contentious politics surrounding transgenics. Supporters and opponents of transgenics have a poverty story to tell. This essay has argued that among the common international goals for biotechnology, poverty alleviation must rank highly. Conceptually, and to some extent experientially, this goal seems realistic, but is no easy mark.

The standard narrative of transgenics and the poor produces a Goldilocks outcome: societal well-being requires not too much regulation, nor too little regulation, but rather, an amount that is just right. Though reassuring for mass publics and policy analysts, the “just-right” parameters in real agro-ecologies in real social systems are extremely difficult to specify with anything approaching scientific rigor. We quickly enter the realm of Donald Rumsfeld’s “unknown unknowns.” In the social choice matrix into which transgenic policy must be inserted, the most complex question is then about the marginal dollar of development expenditure: where does genetic engineering lie in relation to alternatives? Every policy choice curtails or preempts others. There are, for example, a number of innovations in the area broadly known as “agroecology” that might be considered, possibly as complements, possibly as alternatives, to transgenics (Uphoff, 2003). Where should the marginal dollar of scarce development funding go? More difficult still is the

question of regulation and biosafety regimes. These expenditures entail an enormous burden for low-income countries: the opportunity costs are high. The worst-case scenario is one in which biosafety costs are high, born by poor countries at the expense of pro-poor alternatives, and prove to be ineffective in practice. The evidence from *Bt* cotton in India confirms Joel Cohen's observation: "Farmers will find a way."

Though often posed as a matter of societal choice, in fact technical change typically produces differentiated costs and benefits and is driven by particular interests. Conflicts over new technologies have a long history in development studies. Ned Ludd contributed his name to one hostile characterization of opponents of technical change, yet his program was what economists tell us is the natural human condition: pursuit of individual interest. The critical developmental question for technical change is always: at whose cost, to whose benefit? To make a gross but fairly accurate generalization, capital prefers freedom to operate, labor prefers social protection – a reflection of their relative power in market society (Polanyi, 1944/1957). Because the poor are unlikely to win when dollars are criteria for power, the political system and resultant policies become critical for pro-poor outcomes.

Adoption of pro-poor strategies then presupposes political feasibility. "Finding common international goals" works better as conference theme than as political program. NGOs speaking on behalf of the poor have intermittently blocked even field trials of transgenic crops designed to find out whether or not there is environmental threat (Shiva *et al.*, 1999). This disagreement indicates the absence of even the most basic epistemological and methodological grounds for resolution of the politics. Those social forces that could form the base of a pro-poor coalition—public intellectuals, public-spirited NGOs, progressive political parties, social movements mobilizing the poor—are to date those most likely to be hostile to transgenics in poor countries. The discussion of developmental trade-offs above indicates a reasonable basis for opposition: not that transgenics make frankenfoods, but that the opportunity costs in terms of research, development, testing, monitoring, and regulation are too high. If these are the grounds of objections, there are grounds for negotiation. If the grounds of disagreement are more fundamentally epistemological, or have to do with irreducible conflicts over approaches to uncertainty and risk, there is less prospect for settlement. Democratic mediation has a Goldilocks character as well; dissent needs to fall within an elastic band: not too much, not too little, but sufficient distance for societal resolution through democratic means. There is much at stake in these politics: wrong conclusions on either side of the argument could have adverse consequences for the poor. If the critics are correct but proponents persist, the lives of the poor could be made even worse than they are now. If proponents of biotechnology are correct but critics prevail, the poor would be denied significant opportunities for improving their lives.

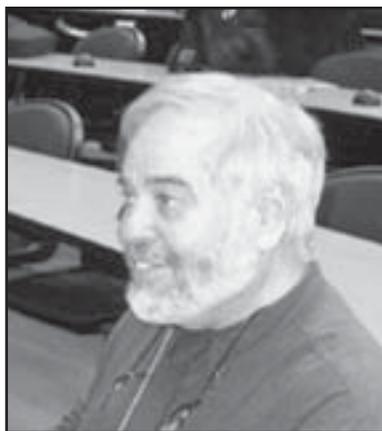
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