
The Ambiguous Promise of Biotechnology

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There is currently a great deal of optimism surrounding biotechnological solutions to nature's many diseases and deficiencies. Popular magazines and newspapers herald exciting discoveries emerging in the field of biotechnology, particularly in areas such as AIDS vaccines, cancer treatment, cystic fibrosis, and other infectious diseases. In addition to curing diseases, biotechnology supporters claim that it may solve the global food crisis and eradicate hunger permanently. For developing countries, biotechnology is promoted as the solution to the persistent problems of low productivity, hunger, poverty, and health.

In agriculture, genetic manipulation is on the verge of artificially controlling the ripening of apples, developing frost-resistant citrus fruits, and super-ovulating cattle, as well as producing genetically engineered chocolate, coffee, maize and vanilla. The benefits of these technologies are proffered as a panacea to developing countries which, proponents of biotechnology claim, will be able, finally, to conquer the problems of hunger and disease. Many argue these new technologies of food production are less dependent on petroleum-based agriculture, and will also help to solve the problem of land scarcity because, theoretically, production can be partially moved from the land into laboratories.

Yet the “new world” heralded by the field of biotechnology contains many hidden perils, especially for small-scale farmers. A closer examination of the forces involved in the development of these new technologies for food production reveals many disturbing features which have profound ethical, socio-economic, ecological and cultural implications. This paper examines some of the dominant forces which shape and control the development of biotechnology and which threaten the very existence of small-scale agriculture. Moreover, the threat which biotechnology represents to the future of small-scale agriculture includes issues of growing impoverishment and powerlessness for the world’s majority, increased North-South disparities, and ecological catastrophes. The final section of this paper examines some alternative approaches to biotechnology and the resistance to the current thrust toward global dominance by powerful transnational interests.

Patenting Life’s Processes

The fact that micro-organisms, as distinguished from chemical compounds, are alive is a distinction without large significance (Chief Justice Warren, *Diamond vs. Chakrabarty*, 1980, in Redclift 1987, 193).

The 1980 landmark U. S. Supreme Court case of *Diamond vs. Chakrabarty* is a watershed in the history of biotechnology, allowing biogenetic material and processes to be privately owned. The case involved an application for patenting a bacterium which can literally digest oil slicks. In its decision the Supreme Court broke with its long-standing principles in these matters, i.e., “if it is living, it is not patentable” (Berlan 1989, 24).

In 1985, the U.S. Patent and Trademark Office granted the first patent for a plant. In 1988, a patent was extended for an animal, a mouse, which had been genetically altered to render it susceptible to breast cancer. The real significance of the genetically altered mouse for Harvard University and Monsanto, the corporation to which it licensed the production rights, is that they can collect royalties on the offspring of the original mouse for seventeen years. One need only apply the same process, notes Brewster Kneen, to the cattle or poultry industries to realize the potential profits that lie in store for universities and corporations engaged in this type of research (Kneen 1989, 98). A mere four months after the Supreme Court decision of June 1980, for example, Genentech, one of the first biotechnology firms, offered its stock for sale. Within minutes the stock soared from \$35 to \$89 a share and the company was able to raise \$55 million within a few hours. The company did not, as yet, have a single product on the market (Juma 1989, 110). In early 1990, Swiss pharmaceutical giant Hoffmann-La Roche purchased a controlling

share (60%) of the company for \$2.1 billion (Hobbelink 1991, 30–31).

In 1990, total research and development (R&D) in biotechnology amounted to roughly \$11 billion (Hobbelink, 1991, 32). Between two-thirds and three-quarters of this research is privately funded and increasingly concentrated as multi-national pharmaceutical, chemical and seed companies scramble to buy out each other and the smaller biotechnology firms. Almost all of the previously independent biotechnology companies are currently under the control of the transnational corporations (TNCs) as subsidiaries or through their joint ventures. This consolidation and increased monopolization has taken place alongside an unprecedented explosion of biotech research carried out by universities under contract to TNCs.

The Appropriation of Creation

I think that the world seed trade figure is probably something like 30 billion dollars annually. And this number, if you stop to think about it, simply represents a heck of a lot of DNA, the primary genetic input into the agricultural sector. Numero Uno. Not exactly a discretionary item. No agriculture without seeds. (David Padwa, Agrigenetics Corporation, 1982, in Kloppenburg 1988, 191).

The global economic forces that are shaping biotech innovations are often ignored in the literature on biotechnology. A more comprehensive evaluation of this technology considers biotechnology not merely as an innovation, but as a revolution in the very way the processes of life itself are understood, appropriated and marketed. Unlike the Green Revolution, which had only limited application, the Bio-revolution has the capacity to transform radically every aspect of food production as well as the international structures involved in determining the production, processing and distribution of these products.

What also distinguishes the Bio-revolution from the Green Revolution is the thrust toward privatization which is geared to guarantee the private profitability of biotechnology research. Biotechnology is oriented toward privatized research driven by TNCs which are aided by the patent protection of their products. This process has occurred alongside the rapid accumulation in recent years of seed companies by transnationals largely involved in the chemical and pharmaceutical industries. This movement toward vertical integration ensures that these multi-nationals have virtual control over every stage in the production of food, including the type of seed developed and the types of fertilizers and pesticides to which a particular crop will respond.

The recently completed Uruguay Round of the General Agreement on Trade and Tariffs (GATT) clearly demonstrated the aggressive stance of Northern corporate interests in controlling all aspects of the Bio-revolution. TNCs engaged in a very intense lobbying campaign during the negotiations and pressured countries to accept the validity of intellectual property rights. This turned into a "moral crusade" with recalcitrant countries being charged with the theft and piracy of valuable R&D. TNCs consequently threatened these countries with trade sanctions if they did not comply.

The control over the means of food production right down to the level of the gene has profound implications for local producers. Not only is this technology beyond the reach of local producers, it threatens to undermine their ability to benefit from nature's own self-reproduction of seeds. As John Kloppenburg notes, biotechnological processes function "to uncouple agricultural producers from the autonomous reconstitution of their own means of production" (Kloppenburg 1988, 281).

From the perspective of local producers, there are three features of biotechnology which threaten not only their increasing marginalization and dependency, but also ecological diversity, the traditional bulwark against diseases and pests. These three features of the Bio-revolution are: (1) privatization of biogenetic property; (2) increasing privatization of research and development; and (3) socialization of plant genetic resources. All three of these features are products of a context where powerful interests manipulate and create institutions which define ownership, private property and the "legitimate" operation of the market.

The Privatization of Biogenetic Property

Allowing the manipulation of life's processes to fall under the absolute control of the private sphere has profound ramifications for our conception of nature's processes and for our understanding of life itself. The very information encoded in DNA is falling under private control (Kloppenburg 1988, 97). In biotechnology, it is not the production of a particular gene or process that holds the greatest potential for profit, but the ownership of the genetically altered product that makes it so lucrative (Kenney 1986, 241). Through its court decisions, the U.S. set in motion a global trend toward the "discovery" and subsequent patenting of any of life's processes with profit potential. Kneen's wry comment on this development captures the arrogant presumption that lies behind the patenting of life: "In other words, everything in the world—creation itself—is private property waiting to be discovered, to be owned. The Creator God, then, will have to argue the case in patent court" (1989, 99).

The prospect of establishing monetary value at the most basic level

of life's processes is luring investors into the biotechnology industry and is one of the driving forces behind the explosion of corporate take-overs in recent years. In the process, the role of labour in food production is being transformed. Powerful corporations, through the private ownership of manipulated biological processes, are able to control every aspect of food production. Poorer countries will increasingly become dependent on technologies developed in the North, for which they will be forced to pay annual royalties.

The Privatization of Research: The University-Industrial Complex

Biotechnologies are making the hitherto hidden convergences between knowledge, power and profits explicit....No more will the separation of science and profits work as a patriarchal fiction because the universities, the modern intellectual 'commons,' are being totally 'corporatised' and privatized. Companies are buying up scientists and entire departments and programmes with multi-million dollar, multi-year contracts (Shiva 1988, 135-36).

The high cost of research and development in biotechnology, and the increased capital-intensive nature of this kind of research, has led to an ever-increasing association between universities and biotechnology firms. The major sources of investments in biotechnology come from venture capitalists who are behind large companies like Genentech, Genex, Biogen, and Cetus, which have turned to the skilled scientific sector in universities, offering high salaries and multi-year contracts to carry out applied research. The biotechnology firms also have looked for linkages with the large multi-nationals in search of particular products or research. Multi-nationals like Ciba-Geigy, Monsanto, Dupont, Sandoz, Hoechst, fresh from their acquisition of major seed companies, are banking on their ability to transfer quickly to the global market the fruits of any marketable discoveries made in university laboratories (Buttel and Kenney 1985, 63-65). It is estimated that by the year 2000 between ten and twenty TNCs will control the entire global seed market (Hobbelink 1991, 45).

Not only do the prohibitive start-up costs preclude developing countries from conducting this type of research, but also public agricultural research institutions in developing countries are either rapidly being squeezed out of performing basic research or being privatized with the support and urging of the World Bank. That leaves a very small group of research institutions and universities funded by corporate sources to spearhead and control research and development in biotechnology. This

growing link between universities and corporations raises a number of disturbing issues regarding the future direction of scientific research. These trends indicate that basic research geared toward the public good or for the benefit of smallholder agriculture is being abandoned increasingly in favor of research dictated by the availability of corporate funding. Scientists and researchers have recognized that the primary goal of biotechnology research is profit and not public interest (Kenney 1986, 113).

Research conducted on malaria vaccines, for example, illustrates the implications of this more explicit link between universities and corporations. Research by scientists at New York University to develop a malaria vaccine is geared primarily toward meeting the high income market of tourists and military personnel, and not toward the general populations of developing countries (Juma 1989, 126). Genentech refused to release the vaccine for more general use in the Third World because the World Health Organization has refused to give it an exclusive license—something which would enable Genentech to collect monopoly rights on the production of the malaria vaccine (Buttel, Kenney and Kloppenburg 1985, 50).

Moreover, in agriculture, biotechnology research is not primarily geared toward developing pest-resistant or disease-resistant strains of crops. Instead, it is directed toward injecting herbicide-resistant genes into crops. For instance, researchers at Calgene, a major biotechnology firm, have implanted a gene into cotton that is resistant to Roundup, a herbicide which it also markets. Hence, the trend of biotechnological research is toward developing crops that will tolerate increased applications of herbicides and pesticides.

The ecological implications of this chemical assault on the land are not taken into consideration when evaluating the consequences of these “new” techniques (Buttel and Kenney 1985, 67). In fact, the \$2 million cost of developing a herbicide-resistant crop is a good investment considering the \$40 million estimated cost of developing a new herbicide. The same is true in the case of pesticides. Developing chemical-adaptable plants will increase sales considerably and is currently the route seed and biotechnology firms are vigorously pursuing (Juma 1989, 113; Hobbelink 1991, 61).

University researchers are also increasingly compelled to keep their research findings secret. Not only does corporate rivalry render exchange between colleagues increasingly rare, students and faculty from foreign countries, more often than not, find themselves completely excluded from this kind of research. The thrust toward research to develop marketable products in the universities is leading to greater fragmentation,

increasing secrecy and the stifling of creative interaction among departments. Universities are increasingly finding their agenda being dictated from outside sources. Martin Kenney notes the disturbing implications for the university, given its increasing collaboration with the biotechnology industry:

As the university is bought and parceled out, basic science in the university will increasingly suffer. The speculative, non-commercial scholar will be at a disadvantage, and the intellectual commons...will be eroded and polluted. Industry will then discover that by being congenitally unable to control itself and having no restraints placed on it by the public sector, it has polluted its own reservoir (Kenney 1986, 246).

The Socialization of Genetic Resources

It is estimated that over ninety-five percent of plant genetic resources are located in the world's poorest countries (Mooney 1983, 26; Juma 1989, 21). It comes as no surprise, then, that genetic resources are perhaps the only aspect of biotechnology where the trend is toward socialization rather than privatization (Meagher 1990, 15). Plant genetic resources are the raw materials for biogenetic manipulation, and it is precisely for this reason that the institutions and corporations in the North are eager to ensure that they continue to be considered as the "common heritage" of humankind. Such an arrangement gives biotechnology firms unlimited and, for the most part, free access to the labour and research which is devoted to collecting, screening and maintaining the huge range of plant species. This work is carried out by the International Board of Plant Genetic Resources (IBPGR) which was established in 1974 to collect, maintain and exchange plant genetic resources.

Moreover, the maintenance of these resources has proven to be a very useful in light of misguided agricultural practices in the North. Examples abound of situations where strains or germplasm from developing countries have rescued crops in the North from serious diseases. Pat Roy Mooney notes the profound reality that often escapes notice in the North: "...the so-called 'breadbasket' nations may be grain-rich but they are gene-poor and wholly dependent upon the Third World for the long-term survival of Western agriculture" (Mooney 1989, 11).

In effect, the IBPGR performs a vital service for biotechnology firms by facilitating their access both to the germplasm and labour power of developing countries. The plants and germplasms, turned over to the North, are manipulated and patented, to be sold back to the South where exorbitant prices are paid for what in effect belongs to them—and without any hope of their ever gaining access to the technology and skills by which these "improved" varieties are developed. Indeed, the potential

profitability of this arrangement is staggering: estimates of the potential global sales of biotechnology-based agricultural inputs range between \$50–100 billion *per annum* (Buttel and Kenney 1985, 66). What J. Kloppenburg predicted in 1984 is already occurring with alarming rapidity:

The gene revolution in the Third World will probably involve the extraction of genetic resources from the LDCs [Least Developed Countries], their incorporation into commercial plant and animal varieties in the corporate laboratories of the advanced industrial nations, and the re-introduction of these improved varieties into the LDCs via an expanding factor market. Once again, biotechnology may well reflect the historical experience of hybrid corn by generating not a reduction in regional disparities, but the intensification of existing inequalities (1984, 318).

The World Bank's Vision for Biotechnology

The World Bank is keen to spread the “good news” of biotechnology to developing countries. In a major report published in 1988 applauding the success of the Green Revolution, the World Bank points to the future rewards promised by biotechnology (World Bank *et al.* 1988). The World Bank, in particular, sees great opportunities for African countries in the field of biotechnological innovation. According to one of its reports, greater productivity, drought and disease-resistant crops are only a few of the benefits that lie in store for African farmers. One World Bank report suggests an exciting set of new marketing opportunities in this field:

A flexible African response to these competitive dynamics must be based on a close monitoring of biotechnological trends, more joint research and development partnerships with Western companies, and the development of substitute products (World Bank 1989, 31).

More recently, during the United Nations Conference on Environment and Development (UNCED), the World Bank actively promoted the granting of Intellectual Property Rights (IPRs) to international agricultural research centres. Such a move would enable these centres to enter into joint ventures with TNCs which could gain access to the centres' stocks of germplasm and subsequently apply for control over the genetic manipulation of these public resources. The World Bank also played a key role in transforming the UNCED treaty on biodiversity into a tract supporting the basic principles of biotechnology.

Consequences for Local-Level Agriculture

The extent to which small-scale agriculture will be transformed owing to the Bio-revolution is difficult to predict. Existing trends, however, reflect some disturbing characteristics. In many respects, biotechnology augurs

the death of smallholder agriculture which, primarily carried out by women, is already considered a passive residual left behind by the Green Revolution (Goodman *et al.*, 1987, 162ff). The fruits of the Bio-revolution are completely out of reach of the smallholder namely because the new technology requires a massive reorganization of agriculture into large units. Vandana Shiva warns that biotechnology will dramatically intensify the disparities first wrought by the Green Revolution:

While the Green Revolution and the Bio-revolution differ in scope and impact of control, they share the logic of commoditization and demanded growth in agriculture...If the package is technologically and financially beyond the access of the ordinary cultivator and people by its research and resource intensity, biotechnologies will breed new inequalities and new ecological hazards (Shiva 1991, 215).

The shift toward large-scale farming estates is already taking place in many developing countries. The debt crisis and the implementation of harsh austerity programmes known as Structural Adjustment Programmes (SAPs) are facilitating this transformation. Developing countries are scrambling to restructure their economies to meet International Monetary Fund (IMF) and World Bank demands which are rapidly eliminating what little support they gave to small farmers and abolishing marketing boards. (The completion of the lengthy Uruguay GATT Round in December 1993, for example, effectively sealed the demise of marketing boards and supply-management systems). In a forthcoming book entitled *The End of Work*, social analyst Jeremy Rifkin warns that developments in biotechnology could lead to a world without farmers, with unimaginable consequences for 2.4 billion people who depend on agriculture for a living (Khor 1994).

Ecological and Health Implications

The ecological effects of biotechnology are only now being critically examined in the North. It is farming groups in the South that have warned of the potential effects of introducing new life forms into the environment. For instance, the newly introduced herbicide-resistant crops can easily hybridize with their wild relatives which, as weeds, will then carry the herbicide-resistant gene. The consequences of spreading foreign genes into new lineages (for the purpose of marketing a particular herbicide more effectively) will certainly be enormous, if not catastrophic (Juma 1989, 131; Shiva 1991, 207). Although biotechnology may herald the development of pest-resistant plants, the current drive is to produce pesticide and herbicide-resistant plant varieties. This is already resulting in an even greater chemical assault on the environment, as TNCs rush to

develop seeds that are resistant to their own pesticides and herbicides.

The haste with which biotechnological firms are getting approval to develop and market synthetic genes (particularly those which increase food production) has many critics worried about potential long-term health effects. In February 1994, for example, the U.S. Food and Drug Administration approved the use of recombinant bovine somatotrophin (rBST), a genetically-engineered growth hormone that promises to increase milk production by up to 20 percent. The Canadian Federal Health Department is also in the final stages of approving its use.

Monsanto (the company which has developed the hormone) officials claim that there is absolutely no difference between rBST and the naturally occurring hormone BST and that its approval can only be seen as a "win-win" situation for farmers. Monsanto's independent studies into the effects of this hormone have so far convinced health officials in the U.S. of its safety. A number of prominent health experts, however, have warned of the dangers of rBST. According to Samuel Epstein, professor of occupational and environmental medicine at the University of Illinois School of Public Health, rBST may increase the risk of breast cancer in pre-menopausal women as well as causing premature breast enlargement in young children (Memon 1994, 21). The hormone rBST has also been positively linked to severe cases of udder infections, or mastitis, in cows.

What is particularly alarming about this development is that consumers may not even have a choice about drinking milk that is free of rBST. Monsanto is currently suing dairy companies in the U.S. who are labeling their milk "rBST-free." In Canada, because milk is pooled before being sold to dairies, all milk would *de facto* be tainted with rBST if its use is approved. There are numerous other examples of synthetic hormones being approved whose long-term health and environmental effects are unknown. Many of the studies which purport to prove their benign effects are suspect because this research is carried out by the very companies who stand to profit from their approval and use.

The Counter Bio-revolution

It is through the research and networking efforts of non-governmental organizations (NGOs) that public awareness has been raised regarding the implications of the Bio-revolution. Having established international links, these groups have succeeded in influencing policy-makers and in forcing governments in the North and South to take a close look at international trade agreements such as the GATT. The NGOs also have supported groups resisting the repeal of laws protecting local seed and pharmaceutical industries in countries like India, Sri Lanka, Brazil, Nigeria and Canada. This is being complemented with efforts carried out by a

variety of NGOs to support and encourage the reintroduction of local plant varieties and genetic diversity into agricultural practice.

Southern countries also are beginning to assert their proprietary claims over genetic resources. Recently, attempts have been made to assert Farmer's Rights. Countering attempts to usurp control of global genetic resources, coalitions from developing nations are putting forward proposals that recognize the centuries of informal innovation by farmers that have gone into producing present-day plant cultures. P. R. Mooney, of the Ottawa-based Rural Advancement Foundation International, observes that one of the features of this informal approach is that these innovations are not produced in laboratories but "arise from informal, (often cooperative) efforts which are [as] purposeful and creative as any similar efforts in more formal or 'Western' models of innovation" (Mooney 1989, 7). Groups proclaiming Farmer's Rights are pressing for conventions which would impose a tax on all internationally traded biological products originating from the South and grant automatic licensing rights to all Third World countries for any patents based on genetic material derived from the South. Mooney has estimated what a hypothetical royalty payment back to the South might be for the appropriation of biological germplasm: "If Third World guardians of biodiversity were remunerated at royalty rates similar to those claimed by chemical and pharmaceutical companies, then the original stewards of precious biological resources would collect \$302 million a year from global seed vendors and \$45 billion a year from world pharmaceutical sales" (ECEJ 1993, 46). In addition, Vandana Shiva reminds us of the crucial role that women play both in the conservation of resources and also in organizing to resist against efforts to usurp control:

Because of the fact that the germplasm of the world lies in the forests and the fields of the Third World...the conservation of genetic resources lies in the hands of Third World women, tribals and peasants. As in all other attempts to protect the sources of life and to conserve the feminine principle, women peasants will probably again take the lead in the politics of seeds (Shiva 1988, 140).

NGOs, in the North and South, are active in movements and coalitions that are forming to speak out against the injustices of the current global economic order predicated on debt and unjust trading relations. These dynamics have produced struggles throughout the South which focus on the democratization of control over resources. Filipino farmers are rejecting the Green Revolution seeds that indebted them to the pesticide and fertilizer companies and, instead, are planting traditional rice varieties that do not require chemical inputs. In October 1993, over 500,000

farmers rallied in India to protest against the GATT and the patenting of seeds. Women in both Kenya and Mozambique have organized greenbelt movements to reclaim parts of cities for vegetable gardens and to experiment with sustainable agroforestry techniques. Other alternatives include the promotion of South-South and regional trade arrangements.

Many NGOs are also involved in the provision of capital goods and technology within their development projects in the Third World, either through very soft loans, or more frequently, through grants. In these situations, the NGOs themselves are able to get supplier credits for their purchases and on terms which benefit the recipients, particularly if they involve sales which might otherwise have been handled under commercial terms (Thomson 1984). These initiatives demonstrate that there are a variety of alternatives to the export-oriented trade model. Already being practiced successfully, these alternatives are based on sustainable long-term models and should be pursued and supported by governments and multilateral organizations.

This paper has examined some of the dominant forces that are controlling biotechnology and has argued for a multi-disciplinary approach to understanding the way that these forces not only threaten the livelihood of millions of farmers worldwide, but also pose innumerable threats to the well-being of people and the environment. It challenges ethicists, political scientists, environmentalists, women's groups and farmers in the North and South to join together and mobilize for alternatives to the current biotechnological agenda and to promote small-scale agriculture, diversity and sustainability.

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