

Chapter 12
New approaches to harnessing technological progress for children *

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Summary: Recent technological progress (in particular those in drugs and pharmaceutical, in biotechnology and in information and communication technology) has had an important bearing on the welfare of children. This chapter identifies the main issues and problems concerning the technological innovation on these domains, such as the inadequate investment in research for drugs for diseases that are more prevalent in low-income countries, or the high prices and the inadequate access to treatment of poor people, the necessity of caution and regulation in the use of biotechnology, the problem of patent regimes, or the potential positive impact of information and technology on material improvement and child development and the dimension of the digital divide. The main recommendations derived from the analysis insist on a proactive role of the governments in ensuring a wider diffusion of the innovations' benefits, and in regulation and monitoring. As for the availability and access to drug of poor people the authors argue the need of more public investment in R&D relating to specific diseases spread in the developing countries, the taxation of profits of pharmaceutical company to finance this investment, fiscal incentives to encourage this kind of research and the reconsideration of TRIPS.

JEL: D23, G38, I12, O33, O34

*** This study presents the views of its authors and not the official UNICEF position in this field.**

I. The issues

Technological progress has always, and most of all in the past century, provided hope for the improvement of material conditions and for the ability to achieve higher levels of standard of living. In recent years, the accelerated pace of technological change and its far-reaching ramifications have also encouraged hopes that the pace of improvement in human development will also be more rapid. It is certainly true that recent technological change has opened up frontiers, which were earlier not imaginable, and has changed lives across the world. But it is also true that the condition, and also the fate of much of the world's poor children residing in the more populous and less developed parts of the world, remain largely untouched by these possibilities. Since the recent innovations in a range of areas throw up challenges and opportunities which are both complex and multifaceted, there is need for serious analysis and determined and consistent policy responses which would channelise such technological progress specifically towards improving the condition of poor children, across the world.

The ability of technological change to transform the lives of children depends on its ability to affect the basic material and social conditions within which they exist. The critical issues in this regard include: the nutrition of mothers and children; access to quality health and medical facilities of both preventive and curative type; access to quality education, skill development and capacity building in general; access to newly available knowledge and techniques; conditions of housing and shelter; and basic sanitation and water supply. Box 1 lists a number of area of technological developments that have important implications for the wellbeing of children.

here are at least three spheres in which the rate of recent advancement has been truly dramatic. These are changes in biomedical technologies especially relating to drugs and pharmaceutical technology development, biotechnologies relating to agriculture, and in information and communications technologies. In what follows, we consider each of these three areas in somewhat more detail, discussing the options for national and international policy action to direct such technologies towards achieving socially desirable results. In particular, we are concerned with wider access of the poor to "merit goods" resulting from technological advance, such as new drugs that would fight endemic disease, stronger seed breeds that would be more resistant to different kinds of infection and pests, new methods of communication and transmission of information that would serve important developmental and educational purposes, and so on. We also consider some of the possible adverse impacts of the new technologies or the form of their development, ranging from the potential for increased power of MNCs through the patenting process and the possibility of using terminator technology to ensure farmers' continued dependence upon marketed seeds, to the effects of "digital divide" in the new information technologies. We do not consider issues such as the promotion or creation of dependence upon certain brand name or designer drugs, since this does not strictly fall into the area of technological progress.

We do however take up some related issues of investment and production because of the policy implications that we draw from this analysis.

Box 1 : Current areas of technological advance and their implications

Area	Positive effects	Potential problems
Plant biotechnology	Improved seed varieties Greater pest resistance Better quality output Higher productivity of soil	Ecological hazards Health hazards from certain types of GM crops Risks of mono-cropping Reduced autonomy and risk bearing capacity of cultivators Bio-piracy and theft of traditional knowledge
Human biotechnology and genetic research	Control of diseases and medical disorders Better physical quality of life	Unforeseen biological and other consequences Socio-ethical issues relating to life-forms Inadequate access of poor to positive developments
Pharmacological innovation	Control and prevention of disease	Insufficient development and production of drugs of relevance to poor and residents of developing countries Inadequate access to new products, of poor and residents of developing countries Monopoly pricing and other restrictive practices by patent holders
Meteorological and seismological prediction	Better disaster management Prevention of excessive damage through prior action	
Pollution control	Better sanitation Improved health and living conditions, reduced disease	Universal provision constrained by high cost
Information and communications technologies	Wider information access Improved delivery of educational, health and other services, including to remote areas Improved administration and management of developmental concerns New forms of employment	Digital divide between and within countries Skewed investment priorities, leading to neglect of primary education and basic health

II. The pharmaceutical innovations and global public health affordable access to medicine and vaccines for children

One of the most important determinants of conditions of life of children across the world is the availability of and access to decent health care, in both preventive and community health terms as well as in its curative aspect. This is more than an issue of pure welfare, however. The health of young children is a critical factor affecting their subsequent capability as functioning adults. The burden of disease in developing countries not only affects basic living conditions but also means that society in general loses a great deal in terms of potential capabilities foregone as well as has to

spend more on treatment and cure. Thus, sanitation, community health and preventive concerns are especially important in developing countries where they are not already adequately covered. Similarly, universal access to prompt and effective curative health facilities plays a key role in ensuring that human capabilities are retained and developed. This is why, in most of the world, the most important public health concern is actually related to dealing with endemic and contagious diseases such as malaria, tuberculosis, gastro-enteric diseases and HIV-AIDS. This does not mean that other health issues such as cancer treatment and cardiac management are unimportant, but that society needs to put special focus on the first set of diseases because of their greater spread and therefore the greater loss to society. In what follows, therefore, we will be more explicitly concerned with drug development for endemic and contagious diseases.

The health field in general and pharmaceutical markets in particular differ from markets for most other commodities and services. Private drug markets typically suffer from a number of forms of market failure. These include

- (a) informational imbalances - thus, for example, consumers are not in a position to judge the quality and efficacy of drugs, which creates the need for a social monitoring and surveillance system;
- (b) lack of competition created by patent protection, brand loyalty and market segmentation ;
- (c) externalities in the form of substantial social benefits of drug consumption.

Obviously, drugs can play a significant social role in that they are an integral part of the realisation of the right to health. For these reasons, pharmaceutical products could be classified as essential goods, with the understanding that they should be accessible to all people. Note that this is not the same as public goods; in fact, the problem is that such goods, even while they are deemed as essential for human survival or capability, are such that access of them can be limited and the criterion of non-excludability does not apply.

Therefore, there has been a growing international concern that investment in technology relating to drug production, and the subsequent prices and distribution, not only because of the market failures described above, but also since unregulated drug markets tend to create substantial inequity, particularly in terms of access to drugs. Because of its international nature, many aspects of the functioning and spread of the pharmaceutical industry are covered by trade agreements, especially those related to trade-related intellectual property rights. It is also the case that these agreements themselves have been guided more by the effort to encourage global economic growth per se, rather than to promote human development and reduce inequalities in human development. This is why there have been major concerns about the enforcement of the TRIPS agreement particularly with reference to health conditions in developing countries, since the agreement is seen as increasing the power of large corporations who may be in a position to capture patents, vis-à-vis state regulatory authorities. Some of the most frequently expressed concerns have included the following :

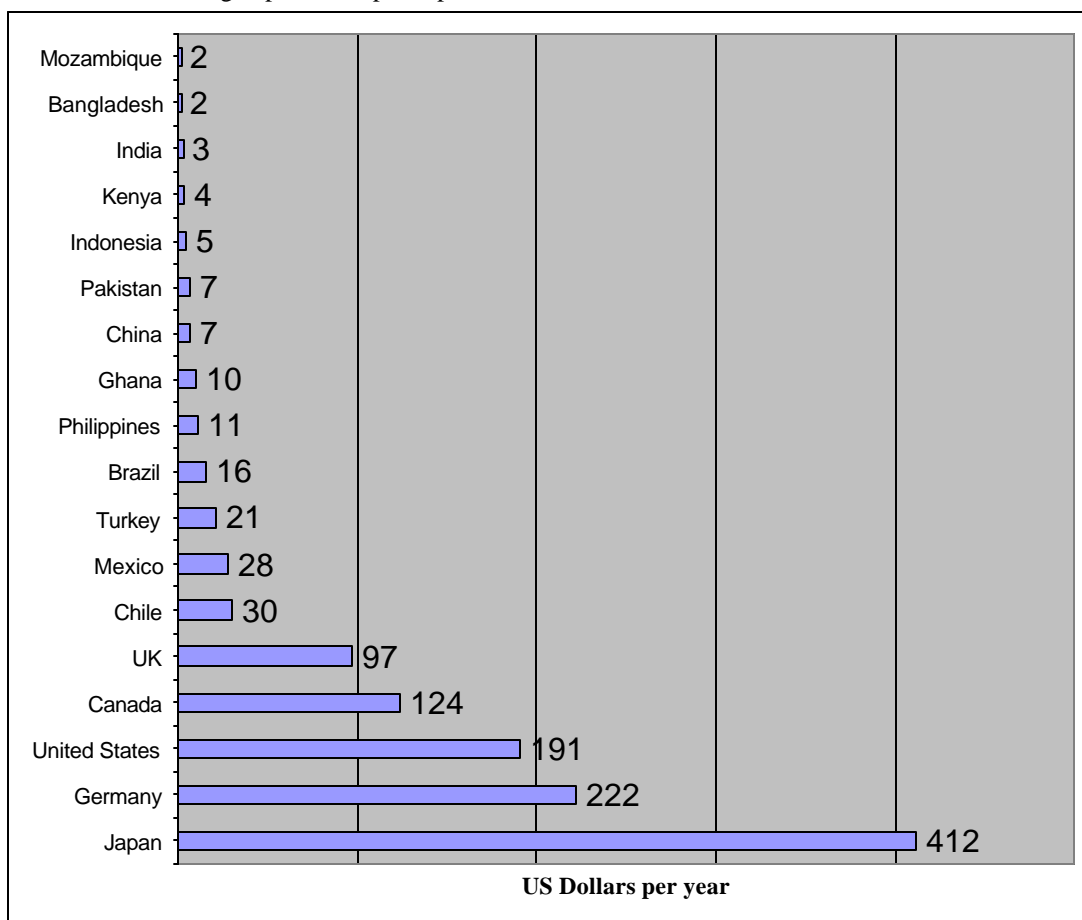
- (i) Patent protection results in high drug prices, while the number of patented drugs of importance from a public-health point of view is likely to increase in the coming years.
- (ii) The access gap between developed and developing countries, and between rich and poor in all countries, will continue to increase as producers in developing countries would have to wait for 20 years before they can have access to innovations.

(iii) Enforcement of the WTO regulations will have an effect on local manufacturing capacity and remove a source of generic innovative quality drugs on which the poorer countries depend.

(iv) While technology transfer will actually be discouraged, there are few incentives or provisions to ensure that increased revenues will go towards the development of medical technologies relevant for developing countries.

Further, while the TRIPS agreement includes provision for compulsory licensing and parallel imports, it is increasingly difficult to choose these options, which are considered in more detail later. This is because the industrial countries - and the US in particular - have pressurised several developing countries to implement patent and intellectual property legislation that is more restrictive than the minimum requirements of the TRIPS Agreement. The world market for drugs is huge, but it is dominated by only 3 countries - the United States, Japan and Germany - which make up more than two-thirds of total sales. Fifteen per cent of the world' population accounts for 86 per cent of drug spending, while the remaining 85 per cent of the world's population get only 14 per cent share (in part, but obviously not fully or even mainly, because the drugs consumed by the many are cheaper). [Pecoul et al, 1997]. Obviously, this majority is mainly in developing countries. Chart 1 shows the contrast between per capita spending on drugs in several developed and developing countries. Thus Japan shows per capita spending which is several hundred times that of India or Bangladesh.

Chart 1: Annual drug expenditure per capita



This imbalance helps to understand why research and development for diseases found in developing countries has almost disappeared since the 1970s. Between 1975 and 1997, out of 1,223 new chemical entities, only 13 (1%) were for the treatment of tropical diseases. And of these, only 4 were the result of R&D activities of the private pharmaceutical industry. [Pécoul, 1997] This is despite the fact that infectious diseases currently kill 11 million people annually in developing countries, and half of those killed are children.

The importance of purchasing power in affecting not just the development of a drug but even its continued production is dramatically illustrated in the case of eflornithine (Ornidyl) for treating sleeping sickness. This disease, which is transmitted by the tsetse fly, currently kills an estimated 150,000 people every year mainly in Africa of which two-thirds are children. The treatment for this disease was developed by the American firm Merrell Dow in 1985, but the price was so high that it was beyond the reach of those most seriously affected. Therefore the production of the drug was subsequently abandoned. The new post-merger owner of the drug, Aventis, subsequently agreed to transfer marketing rights to the World Health Organisation (WHO). But WHO lacks the resources to manufacture it, and sponsors are still being sought to finance the production of this drug. By contrast, the fastest growing segments of world drug production are non-essential, so-called lifestyle drugs such as Viagra and anti-depressants

The difficulty of ensuring wider access of the poor to life-saving drugs is compounded by the high degree of concentration in the international drug industry. Table 1 describes the situation in 1998, when the top ten companies controlled 36 per cent of the market and the top twenty companies controlled 57 per cent of world sales.

Table 1: Top ten pharmaceutical companies in 1998 *

Company	Sales, US \$ bn	% of global sales	% growth p.a.
Novartis	10.6	4.2	5
Merck	10.6	4.2	8
Glaxo Wellcome	10.5	4.2	8
Pfizer	9.9	3.9	21
Bristol Myers Squibb	9.8	3.9	11
Johnson & Johnson	9	3.6	8
American Home Products	7.8	3.1	1
Roche	7.6	3	6
Lily	7.4	2.9	17
Smith Kline Beecham	7.3	2.9	6
Leading 10 companies	90.5	35.9	8
Leading 20 companies	143.8	57.2	9

*Since then there have been more mega-mergers which have made the industry even more concentrated. Thus, Glaxo Wellcome has merged with SmithKline Beecham, Pfizer merged with Warner Lambert, and the companies Hoechst-Marion, Merrell and Rhone-Poulenc merged to form Aventis. Currently the top ten companies are estimated to control more than half of the world market, and the top twenty companies more than two-thirds of the world market.

The international patents regime

Apart from mergers, drug companies ALSO USE the patent system to establish monopoly control. Often patents are filed for products or chemical substances or now even genes, whose attributes are not fully known, simply to pre-empt the competition and allow for monopoly rents once further research - possibly by others including public agencies - reveals the uses. As Table 2 shows, the top ten filers of patents include 6 drug companies and two companies specialising in genetic research.

Table 2: Top filers of patents 1995-2000

Company/institution	Number
Glaxo Smith Kline plc	747
Incyte Genomics	453
Aventis SA	351
US Government	334
Roche Holding AG	306
Human Genome Science Inc.	286
University of California	262
American Home Products	235
Merck and Co.	222
Chiron Corporation	184

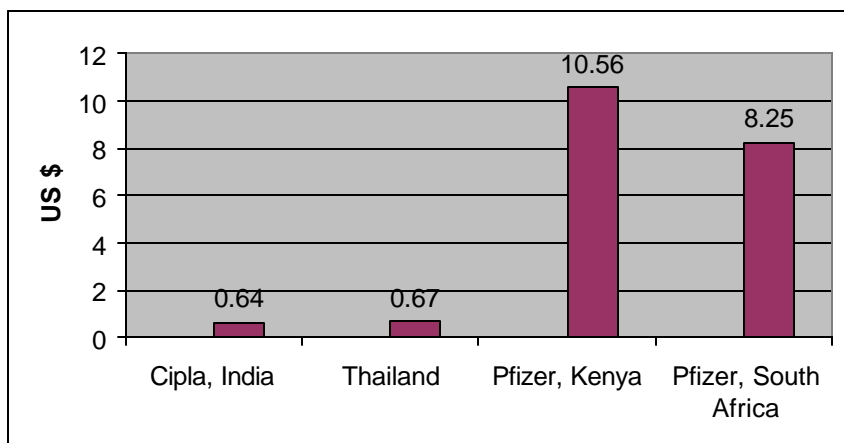
Patents allow drug companies to charge prices which are as high as they feel the market will bear, without reference to or well in excess of the actual costs of R&D that they may have borne. Thus there is wide variation in prices of the same drug charged not only by different companies but even by the same company in different markets. This is clear from Chart 2. The drug fluconazole, which is used both for AIDS treatment and for some forms of meningitis, is available at a substantially lower price in India and Thailand where generic substitutes are produced. But even Pfizer, which holds the patent, charges different prices in Kenya and South Africa.

There is also the question of use of brand names to generate market power and charge higher than warranted prices on many drugs. The issue is especially complicated because of the asymmetric information which characterises the drug market – since consumers do not know the actual composition of the drugs they are taking, often they rely on brand names to ensure quality or homogeneity. This may be warranted where other manufacturers are providing spurious combinations or cheaper substitutes, but this cannot be predetermined or claimed to be true in all cases. As a result, established manufacturers often use the advantage of the brand name to charge much higher prices even when other generic manufacturers are producing the same or equivalent drugs at much cheaper prices. Together, brand names and patents insulate drug companies from price competition.

The experience with the national Drug Policy in Bangladesh in the 1980s and early 1990s provides some indication of just how much brand names play a role in higher drug prices. The Drug Policy came into effect in 1982, specifying a list of 45 essential drugs at the primary health centre level, which were to be manufactured and/or sold under their generic names only. MNCs were prevented from manufacturing simple products like common analgesics, vitamins, antacids, and so on. Prices of finished drugs were controlled. A decade later, the following achievements of such a strategy were evident : essential drugs increased from 30 to 80 per cent of local production;

drug prices not only stabilised but fell in real terms; the proportion of drugs found to be substandard actually declined quite sharply from 36 per cent to only 9 per cent. [Zafrullah Chowdhury 1995]

Chart 2: Prices of Flucanazole



The wide variation in some drug prices results not only from income-determined market segmentation but also from the different patent regimes that are still in operation in some countries but which are threatened by implementation of the TRIPS agreement. Thus, the Indian Patents Act, which currently recognises only process patents in pharmaceuticals, allows for reverse engineering for chemical products, that is working out a process to manufacture using the end-product only. This patent regime has contributed to the major price advantage that Indian companies are able to offer, both because of the ability to engage in reverse engineering and because of the more competitive nature of the domestic industry. This allows for very substantial differences in drug prices between India and even other developing countries, even after deregulation, which has raised drug prices in India over the past decade. Table 3 gives some indication of the vast variation in drug prices between India and Malaysia, where the patent laws did not allow for the emergence of a vibrant domestic drug industry and where there has been greater reliance on multinationals.

Table 3: Price of drug in India and Malaysia (price per 100 tablets in US\$ equivalent)

Drug	India	Malaysia
Captopril	2	43
Ceftriaone sodium 1G vial	277	2342
Dioclofenac 25 mg	1	12
Omeprazole 20 mg	4	180
Simvastine 10 mg	11	105

Therefore, the use of market segmentation to earn monopoly profits is obviously constrained by the possibility of undercutting by competitors producing generic substitutes. This possibility, and the opposition of multinational drug companies to allowing it, is dramatically illustrated by the recent battle between the Indian drug company Cipla and major MNC players over providing cheaper drugs for AIDS patients in Africa (see Box 2).

BOX 2 : The battle over providing cheaper AIDS drugs to Sub-Saharan Africa

The controversy involves a Mumbai-based Indian drug company, Cipla Limited and the multinational drug giant Glaxo Wellcome plc. Cipla has become one of the world's major producers of generic AIDS medicines, based on the company's ability to produce drugs through reverse engineering. This in turn is possible because the Indian patent laws still recognise only process patents in the pharmaceutical sector.

Late last year, Glaxo attempted to block access to cheaper versions of its top-selling AIDS medicine which were being distributed in Sub-Saharan Africa by Cipla. In early 2000, Healthcare Ltd., a pharmaceutical distributor in Accra, Ghana, purchased a small consignment of Duovir, Cipla's version of Glaxo's anti-AIDS drug Combivir. Cipla was providing these at a small fraction of the cost charged by Glaxo. Soon afterward, Glaxo sent letters to Cipla and Healthcare charging that "importation of Duovir into Ghana by Cipla or its affiliates represents an infringement of our company's exclusive patent rights" and threatening legal action if they were continued. As a result, Cipla stopped selling Duovir in Ghana. Healthcare, the Ghana distributor, said boxes of Duovir remain unopened in its offices and that no patients have received any of the drug.

Currently, the cocktail of three drugs that are used to treat AIDS patients is provided by the major MNC drug companies to developed country users at a price of around \$10,000 a year. An amount which is obviously outside the reach of most Africans. Yet it is estimated that of the total of 36 million people in the world currently infected with AIDS, as many as 25 million are in Sub-Saharan Africa. Cipla, which manufactures generic versions of these drugs, has offered them for sale to several South African countries at just above \$ 300 a year. Cipla has been cutting prices of these drugs continuously over the past year, citing in-house technological advances as the cause.

Over the past year, five major drug makers - Glaxo, Bristol-Myers Squibb Co., Merck & Co., Boehringer Ingelheim GmbH of Germany and Roche Holding Ltd. of Switzerland - have agreed to substantially slash prices of their AIDS drugs in Africa, even though they are still much above the price of the generic substitutes. This offer to discount prices is largely because of the fear that African nations will begin buying generic copies of their drugs produced by Cipla in India and by other companies in Thailand and Brazil.

In a recent twist, Cipla has offered to pay a royalty of 5 per cent of sales to the five drug companies, a move, which has met with tepid response. Instead, the MNCs have argued that all this condones the violation of the companies' patents and the TRIPS agreement. They have asked western governments to put more pressure on India, Brazil and other countries to speedily adjust their patent laws so as to conform to TRIPS and prevent such production of cheaper generic drugs, in other words to regain their monopoly and ability to charge higher prices.

This story brings into stark relief the nature of possible conflicts between the international pharmaceutical industry and the public interest, as well as the implications of the TRIPS agreement for public health. Conversely, the multinational pharmaceutical companies argue that without intellectual-property protection they would have no incentive to invest the millions required to discover and develop new drugs. The irony in this case is that the costs of developing the two chemicals (AZT and 3TC) used in Glaxo's Combivir were actually borne by the public sector - through work done earlier by researchers funded by the US Government's National Institute of Health. Glaxo purchased the drug before its efficacy in AIDS treatment became obvious, and once again relied on public research to establish this efficacy. However, once it was known, the company promptly took out a patent on this drug and has since been reaping monopoly profits from its sale.

A postscript to this story is that the group of 37 MNC drug companies which had taken the South African government to court over its compulsory licensing laws, withdrew the case on 19 April 2001. This was partly the result of tremendous public pressure, including from major NGO players like Medecins sans Frontieres, OXFAM and others, but it also was a recognition of the multinational drug industry's inability to present a coherent case for maintaining very high prices for life-saving drugs such as those for treating HIV-AIDS.

Research and Development

It is now much more widely recognised that there is no correlation between socially desirable and necessary R&D in drug development, and a tight patent regime which is supposed to encourage innovation by offering pecuniary rewards.. Indeed, much of the major research in pharmaceuticals and medicine, both in the past and currently, is under the aegis of publicly funded institutions across the. In many western countries, pharmaceutical products remained unpatentable until the 1980s or even the 1990s, with no adverse implications for research. [Chang, 2000].

TRIPS requires all WTO Member States to grant patents for pharmaceutical products or process inventions for a minimum of 20 years. It leaves Member States a certain amount of freedom in modifying their regulations. For example, the terms *invention* and *discovery* are not defined in the Agreement, yet how they are defined could have important implications, especially in the biotechnological field. The Agreement says that Member States may provide limited exceptions to the patent holder's exclusive rights in their laws. National public authorities may be allowed, within special conditions laid down in the Agreement, to issue compulsory licences against the patent owner's will when justified by the public interest. The Agreement does not prohibit parallel imports. These restore price competition for patented products by allowing the importation (without the holder's consent) of identical patented products which have been manufactured for a lower price in another country.

Table 4 : Explanation of Article 27.1 of TRIPS

Article 27.1 - Patentable subject matter	Comments
<i>patents shall be available for any inventions, whether products or processes,</i>	Some countries only made available process patents for pharmaceutical inventions. Under TRIPS, product patents must also be available; the protection of rights on a product is much broader in scope.
<i>in all fields of technology</i>	Some countries, unable to invest in R&D, have been excluding pharmaceuticals from patentability so as to allow the possibility for copies of patented drugs to be produced locally or imported - from other countries which also do not respect pharmaceutical patents - without the authorization of the company that invented the drug.
<i>provided that they are new, involve an inventive step and are capable of industrial application.</i>	Usual definition of the conditions of patentability of an invention.
<i>patents shall be available and patent rights enjoyable without discrimination as to the place of invention</i>	No discrimination between national and foreign inventions, or between foreign inventions
<i>the field of technology</i>	No discrimination between types of products - pharmaceutical or other.
<i>provided that they are new, involve an inventive step and are capable of industrial application.</i>	Usual definition of the conditions of patentability of an invention.
<i>and whether products are imported or locally produced</i>	Some countries have been issuing compulsory licences for lack of exploitation of patents. This type of obligation was intended to require foreign companies to set up on the national territory in order to exploit their patents, with resultant transfers of technology. The Agreement would here appear to allow these companies to import their patented product without having to transfer the related technology.

Source : Germán Velásquez and Pascale Boulet, Globalization and access to drugs: Implications of the WTO/TRIPS Agreement, WHO Geneva, 1999

Thus, compulsory licensing and parallel importing policies are two policy tools which can still play an important role in helping developing country governments make essential medicines more affordable to their citizens, although their use is being sought to be restricted by drug MNCs and their home country governments.

Compulsory licensing

Compulsory licensing may occur as follows : when reasons of general interest justify it, national public authorities may allow the exploitation of a patent by a third person without the owner's consent. This involves a government giving a manufacturer - which could be a company, government agency, or other party - a licence to produce a drug for which another company holds a patent, in exchange for the payment of a reasonable royalty to the patent holder. The effect is to introduce generic competition and drive prices down, as has occurred in India. Compulsory licensing can lower the price of medicines by 75% or more. Zimbabwe, for example, could issue a license to a local company for an HIV/AIDS drug manufactured by Bristol-Myers Squibb. The Zimbabwean firm would manufacture the drug for sale in Zimbabwe under a generic name and pay a reasonable royalty to Bristol-Myers Squibb on each sale.

Five kinds of use without authorisation of the right holder are expressly envisaged by the Agreement [Correa 1999a, 2000] : (1) licences for public non-commercial use by the Government; (2) licences granted to third parties authorised by the Government for public non-commercial use; (3) licences granted in conditions of emergency or extreme urgency; (4) licences granted to remedy a practice determined after administrative or judicial process to be anti-competitive; and (5) licences arising from a dependent patent.

In addition, since the Agreement does not state that these are the only cases authorised, Member States are not limited in regard to the grounds on which they may decide to grant a licence without the authorisation of the patent holder. They are in practice only limited in regard to the procedure and conditions to be followed. Thus, in principle, compulsory licences can be issued for considerations of public health as well as to prevent anti-competitive practices and possible uses connected with monopoly.

Parallel imports

Another strategy for lowering drug prices is by parallel imports. Parallel importing involves a government or another importer shopping in the world market for the lowest priced version of a drug rather than accept the price at which it is sold in their country. In the pharmaceutical market, as has been shown, prices tend to vary dramatically. Thus, one study found that the retail prices in USD of 100 tablets of a commonly used anti-ulcer drug ranitidine marketed in its brand name 'Zantac' by the multinational drug company Glaxo in 15 developing and developed countries of Asia Pacific varied from US \$ 3 to 183. Australia and New Zealand, two advanced affluent countries, recorded prices higher than eight developing countries. Mongolia, a least developed country with the lowest per capita GNP, recorded a price almost nine times that of Australia and New Zealand. [Details in Ghosh, 2000] Since parallel

imports involve imports of a product from one country and resale, without authorisation of the original seller, in another, thereby allowing the buyer to search for the lowest world price, they also can be a tool to enable developing countries to lower prices for consumers.

Both the promotion and the transfer of technology, as well as public health or nutrition could justify derogation of the patentee's exclusive rights. Scrutiny of the exceptions existing in much national legislation gives an idea of the different possibilities [Correa, 1999b]: (1) parallel importation of the protected product; (2) acts carried out on a private basis and for non-commercial purposes; (3) scientific research and experiments involving the patented invention; (4) preparation of drugs by unit and on medical prescription in pharmacy dispensaries; (5) a person being, in good faith, already in possession of the invention covered by the patent; and (6) tests carried out before the expiry of the patent to establish the bio-equivalence of a generic drug.¹

Compulsory licensing and parallel imports are currently permitted under the TRIPS rules. But the US and other developed country governments have put pressure on countries - such as South Africa, Argentina, Brazil, Thailand, and India - that have or had intellectual property rules such as compulsory licensing and parallel imports, that are designed to make essential medicines more affordable to their citizens. The existence of such pressures needs to be formally recognised, and there is scope for an international protocol which would ideally prevent the governments which are home to powerful multinational drug companies from engaging in such pressure which directly affects the health of citizens, including children, in the developing world.

In addition to these measures, as pointed by Correa [2000] there is scope within the TRIPS Agreement (under Article 30) for a number of exceptions to exclusive patent rights. Such exceptions must of course meet certain conditions, that is they must be limited, they should not unreasonably conflict with the normal exploitation of the patent, and exceptions should not unreasonably prejudice the legitimate interests of the patent owner. Given these conditions, there is a wide range of exceptions that can be provided that are within the scope of Article 30, such as : (1) acts done privately and/or on a non-commercial scale, or for a non-commercial purpose (2) use of the invention for research (3) use of the invention for teaching purposes (4) experimentation for teaching purposes (5) preparation of medicines under individual prescriptions (6) experiments made for the purpose of seeking regulatory approval for marketing of a product after the expiry of a patent (7) use of the invention by a third party that had used it bona fide before the date of application of the patent.

As can be seen, even though the TRIPS provisions are restrictive, government that are anxious to ensure drug development for public health purposes may still endeavour to push for more flexible patent regimes, if they are not prevented from doing so by other forces. The recent withdrawal of the case against the South African government by 37 multinational drug companies (see Box 2) on the issue of compulsory licensing, is an indication that such pressures can be resisted.

¹This last exception is at present the subject of consultations under the WTO dispute settlement system between the European Union and Canada, as Canadian legislation allows generics manufacturers to carry out experiments and tests required to obtain marketing approval, and also to manufacture and stockpile copies of patented products, before the relevant patents expire.

Problems and policy options

The chief problems that therefore arise in ensuring that technological change in pharmaceuticals is harnessed towards ensuring the access of poor children (particularly in the developing world) are as follows :

1. Inadequate investment in preventive and curative treatment of a range of endemic diseases that are more widely prevalent in low-income developing countries.
2. Even when technology exists, inadequate production of drugs, even life-saving drugs, that are used by dominantly poor populations.
3. High prices, market segmentation and monopoly control, partly but not only related to the existing patent regimes and to the TRIPS agreement.
4. Even in the absence of monopoly prices, inadequate access to life-saving drugs because of absolute poverty.
5. Inadequate information among the public and those affected, about various drugs and their alternatives.

There are various levels of policy engagement which are required to confront these problems :

1. At the national level, it is necessary for governments to be made more aware of the actual possibilities for exceptions and for avoidance of monopoly even within the current TRIPS regime. There must be more systematic and comprehensive dissemination of the available possibilities for exceptions to exclusive patent rights, as well as of compulsory licensing and parallel imports.
2. As noted above, often the constraints on developing country governments have come not from the WTO so much as from developed country governments and multinational drug companies, who have used their clout to prevent countries from using these exceptions and methods OF access to encourage the production of even life-saving drugs. There is need for an international protocol which would prevent such undesirable practices and allow for a more flexible interpretation of TRIPS especially under public health considerations.
3. The basic problem of inadequate investment in R&D relating to tropical diseases and diseases afflicting the poor can only be addressed through more public investment. Thus, both nationally and internationally there is need to encourage more public expenditure directed towards this end. There are several possibilities for funding such research, quite apart from the general use of the state exchequer. Thus, a tax could be levied on the pharmaceuticals companies' profits, the proceeds of which would go into a fund to pay for research into tropical diseases and the production of essential medicines. Such a tax could be administered at the national level by all countries, and then go into research sponsored, for example, by the WHO.
4. Similarly, there could be fiscal incentives that encourage more such socially desirable research and investment in crucial drugs, in the form of differential taxation and differential treatment of different types of pharmaceutical research.
5. It is obvious that the possibilities of alternatives such as parallel imports themselves depend upon the generic production of drugs somewhere in the world which allows their lower prices, and this possibility itself will be negated once all countries are forced to move to a stricter patent regime which insists on product patents in pharmaceuticals. At the multilateral level, therefore, there is definitely a case for a reconsideration of the TRIPS agreement, especially with respect to process versus product patents in pharmaceuticals. Since there have already been calls for

renegotiating Article 27.3 of TRIPS relating to the patenting of life-forms, there is a case for combining such a demand with the demand for reconsidering this item as well.

6. One important problem remains, that of poverty and lack of access of many poor people across the world to even life-saving drugs, and certainly those drugs that affect the well-being and development of children. Here a case may be made for an international fund to support the production and distribution of such drugs to those in need, and a special case may be made for a fund devoted specifically to meeting the health needs of children and women in the reproductive age group.

7. It is also worth noting that in many developing countries distribution systems are inadequate or incapable of ensuring access of the needy to many essential drugs. Therefore even before insisting on such distribution, it is necessary to have in place a network of primary health centres or health practitioners who would identify the sick and their illnesses, prescribe the required medicines and provide an overall assessment of the amount of different medicines required. This requires public investment and continuing expenditure at the national level that must exist before any international assistance can be usefully utilised.

8. Among the public-private partnerships that are possible, a special role can be played by partnerships between governments and major national and international NGOs. Some NGOs have already been very significant in identifying and highlighting abuses by commercial players, spreading information and raising broader consciousness, creating pressure groups. They have also shown how it is possible to combine in coalitions successfully, as for anti-HIV drugs in Africa, and many developing country governments may wish to work along with some such groups to push for international strategies to provide wider access to essential drugs.

III. New technologies for food and agriculture

Biotechnological innovation in cultivation practices

Hundreds of millions of children still go to bed hungry every night, and an even greater number are affected throughout life by the nutritional deficiencies experienced by their mothers during pregnancy and lactation, and by themselves in the formative early period of their lives. There is little doubt that the one single factor affecting the basic conditions of well-being of most children in the world is access to adequate, balanced nutritional diet. Although the proportion of the world population in a chronic state of undernourishment has declined from 37 to 18 percent in the last 30 years, the actual number of undernourished people declined only from 960 million to 826 million in developing countries. At the same time, there are 34 million hungry and undernourished in the industrialised countries, according to FAO.

The depth of hunger, or food deficit, is measured by comparing the average amount of dietary energy that undernourished people get from the foods they eat with the minimum amount of dietary energy they need to maintain body weight and undertake light activity. The diets of most of the 850 million chronically hungry people lack 100-400 kilocalories per day. In terms of sheer numbers, there are more chronically hungry people in Asia and the Pacific, but the depth of hunger is clearly the greatest

in sub-Saharan Africa. There, in 46 percent of the countries, the undernourished have an average deficit of more than 300 kilocalories per person per day. By contrast, in only 16 percent of the countries in Asia and the Pacific do the undernourished suffer from food deficits this high. [FAO 2000]

If there is one area where current technological advance tends to hold out much promise, it is in the crucial area of increasing food availability and nutritional access for the world's children through advances in biotechnology. It should be noted that previous quantum expansions in food production in the last thirty years, as exemplified in Green Revolution type seed development, have been significantly aided by important public-private initiatives like the Consultative Group on International Agricultural Research (CGIAR). The CGIAR is an association of public and private members that supports a system of 16 research centres working in more than 100 countries. It has focussed on research affecting agriculture in developing countries, such as higher yielding food crops, livestock, fish and trees, and improved farming systems that are environmentally benign. What is important is that all benefits and knowledge obtained by CGIAR research are kept in the public domain, freely available to everyone.

Modern biotechnology, especially the creation of Genetically Modified Organisms (GMOs) is often presented as a magic solution, or universal panacea for the problems of poverty, inadequate food access and nutrition, and even environmental degradation in the world. The reality, of course, is far more complex. Even today, total food production is adequate to feed the world; the problem is rather of unequal distribution, which deprives a large part of the population of even their minimal nutritional requirements. Similarly, farmers, especially in developing countries, face many problems which biotechnology does not address, much less solve: lack of infrastructure, poor or unstable market access, volatile input and output prices, and so on. And of course, recent problems with the effects of new methods of livestock rearing in European agriculture in particular have underlined the problems that many of the technologies utilized in agriculture can have unforeseen consequences, and their safety and future viability are far from secure.

It is true that transgenic plants offer a range of benefits which are above and beyond those which emerged from more traditional innovations in cultivation. Thus, it is argued that such new technology offers more effective pest resistance of seeds and crops through genetic control mechanisms, which also reduces the need for pesticide use; leads to improved yield; improves tolerance to biotic and abiotic stress; and also offers nutritional benefits in areas where traditional breeding methods have been unsuccessful. All this also means that such technology can have reduced environmental impact, by producing crops that tolerate cultivation in stressful conditions, introducing GM traits that control disease (especially root disease) and allow farmers to cultivate where reduced tillage is essential. [Cohen, 2000]

A fundamental question, of course, is whether the new GM technology is safe, and this is clearly absolutely crucial especially for children who will be exposed to the products of such cultivation technology from a very early age. The jury is still out on this matter, and the controversy is unlikely to be resolved quickly. [Burrill, 2000] On the pro-GM side, it is argued that this is a valuable technology for all the reasons outlined above, and is essentially an extension of traditional breeding methods which

encouraged the combination of desirable traits within species. It is further argued that all GMOs have been tested and demonstrated safe prior to reaching markets and final consumption, and that they have been consumed for some years now in the United States without any evidence to indicate that they are harmful. The opponents of this technology argue that in any new technology, it is always possible that harmful side effects may occur, and therefore there need to be long term tests on health and environment before its implementation. Similarly, unlike traditional plant breeding methods, the new technology uses artificial laboratory techniques to combine genes that would never occur in nature, which really means altering genetic patterns that have developed over millions of years. Similarly, the pre-testing of GMOs has generally been on laboratory animals rather than human beings, and the effects may be quite different, especially over time. It is pointed out the effects of BSE on beef consumption and its implications for human health also appeared after a very long time lag and was not something that would have been evident through short term laboratory tests, and therefore that great caution needs to be exercised in this matter.

One issue that is of special significance for children in developing countries is that most governments in developing countries have relatively low food and beverage regulatory standards, and public systems for monitoring and surveillance of such items are poor or non-existent. This leaves them open for entry and even dumping of a range of agricultural products of the new technology which may not pass regulatory standards in the more developed countries. Currently the international systems for ensuring some degree of uniformity in this do not exist. Thus there is a possibility that citizens of poor developing countries will be more exposed to new food products which are inadequately tested or for whom the fuller long term health implications are not known. This is obviously a problem that is even more significant for children for whom the effects may work out over the longer life span, and it must be balanced against the potential nutritional and health benefits that may accrue from such technology.

There are also problems of sustainability for farmers in developing and tropical countries which may arise from the newer lab-based technologies. As Rosset [2000] has pointed out, in developing country agricultures, there is greater need to tailor agricultural technologies to their variable but unique circumstances, in terms of local climate, topography, soils, biodiversity, cropping systems, market insertion, resources, and so on. For this reason, farmers have over millennia evolved complex farming and livelihood systems which balance risks -- of drought, of market failure, of pests, etc. -- with factors such as labor needs versus availability, investment needed, nutritional needs, seasonal variability, etc. Typically their cropping systems involve multiple annual and perennial crops, animals, fodder, even fish, and a variety of foraged wild products...When transgenic varieties, carrying Bt insect resistance, for example, are "forced" into such cropping systems, the risks are much greater than in green revolution, large, wealthy farmer systems, or farming systems in Northern countries. For example, in developing countries there will typically be more sexually compatible wild relatives of crops present, making pollen transfer to weed populations of insecticidal properties, virus resistance, and other genetically traits more likely, with possible food chain and super-weed consequences. Such farmers are unlikely to plant refuges, making resistance evolution by insects more likely. Horizontal transfer of genetic material is also highly risky in such circumstances."

For these reasons, it has been argued that rather than concentrate on genetic engineering as the solution for developing country agriculture, it may be more important to focus on technologies which have pro-poor diseconomies of scale, like agroecology, and organisation into social movements capable of exerting sufficient political pressure to reverse fairly typical policy biases against small holder agriculture.

Plant Varieties Protection

Until very recently, the possibility of intellectual property rights over living organisms was not recognised by any country in the world. However, first the hybrid seed industry and, later, the biotechnology-driven life sciences industry, helped to make plant breeding highly profitable and encouraged the more active participation of large corporations which have campaigned extensively for patent protection. As a result, the notion of plant variety protection (PVP) was constructed – effectively by corporate representatives – as an alternative to patenting that would guarantee breeders a commercial monopoly on the use of their varieties while leaving loopholes open for farmers and other breeders. This protects “ownership” of the genetic makeup of a specific plant variety. The criteria for protection are different from that of standard patent protection, emphasising novelty, distinctness, uniformity, and stability. PVP laws can provide exemptions for breeders, allowing them to use protected varieties for further breeding, and for farmers, allowing them to save seeds from their harvest. However, over time, such loopholes have been progressively closed.

Currently the seed industry is promoting the Union for the Protection of New Varieties of Plants (UPOV) as the appropriate system of *sui generis* protection. UPOV is a small intergovernmental organization (with mainly industrialised country members) that administers common rules for the recognition and protection of PVP internationally. UPOV is an interesting organisation, that is plurilateral in terms of accepting all those governments who agree to sign the Convention, and while it is an intergovernmental organisation, it tends to propound positions similar to those of large multinational seed companies. Through successive revisions of the 1991 UPOV Convention, the rights granted to breeders have become more and more similar to those granted under the patent system. “While breeders get exclusive commercial control over the reproductive material of their varieties and the right to enforce licenses, farmers planting PVP-protected varieties are prohibited from saving seeds for replanting except under highly restricted conditions. And increasingly in many countries practicing PVP, the right of the breeder extends to the farmers’ harvest and the direct products of that harvest.” [Kuyek, 2001] An extreme example of the kind of control over cultivators that could result from such an orientation is when the major company Monsanto hired the detective agency Pinkertons to report on farmers’ seed use and cultivation practices in the United States, and farmers were forced to allow these detectives access to their fields.

There is currently tremendous pressure on developing countries to sign this Convention or to introduce PVP broadly in consonance with the fairly stringent requirements of UPOV. Since PVP is not explicitly covered by a WTO trade agreement, and the application of TRIPS is not possible since the wording of the

TRIPS agreement is ambiguous in this area, multinational seed companies and their political lobbies have been exerting pressure on developing countries to sign this Convention or to introduce PVP broadly in consonance with the fairly stringent requirements of UPOV.

Just as with patent protection, there is very little or no substantive evidence to suggest that PVP is necessary to encourage the development of newer and better seed varieties in developing countries. In fact, in most of the developing world, such research is dominantly supported by governments. Unlike in the US where 70 per cent of the financial resources in agricultural biotechnology research came from the private sector, a study looking at five developing countries (Mexico, Colombia, Kenya, Zimbabwe, Indonesia) found that 60–80 per cent of the total research expenditure in this area was funded by the government and carried out by public research institutes or public universities. [Cohen, 2000] Nor do UPOV-type systems increase the quality or diversity of plant varieties released by the private sector. One study found that commercial varieties are genetically quite similar since they are typically based on parental lines or strains based on research provided by public institutions. In fact, much of commercial breeding is directed at "cosmetic differences" to serve market strategies, [Rangnekar, 2000] which suggests that forces similar to those which are important for brand names in the drug industry may be operating.

Hybrid and terminator seeds

In the absence of PVP, a crucial form of protection for the seed industry is that which is actually concocted biologically, through the development of seeds in which a certain quality collapses or cannot be transmitted through natural reproduction. The most widespread example of biological protection is hybridization. The yield factor of F1 hybrids deteriorates in subsequent generations, forcing farmers to buy fresh seed from the company every year or two. Earlier, not many crops could be hybridized in an economically feasible way, but this is changing with the new biotechnology. It is estimated that to date, over 60 patents have been awarded worldwide related to hybrid seed production using genetically engineered cytoplasmic male sterility.

Another related development in biological protection is Genetic Use Restriction Technology, more popularly known as "terminator" seeds. These prevent farmers from saving seeds since the genetically engineered plants will not germinate in subsequent generations or will not express a particular trait (such as herbicide resistance) unless sprayed with specific chemicals that activate the right gene. After widespread public outcry when such seeds were introduced in several developing countries, several major companies have insisted in public that they will not pursue the technology. Nevertheless, a recent report by coalition of groups in Europe identified 60 patents on such terminator technology – 25 of them held by a single seed company, Syngenta of Switzerland – and reported that laboratory and field tests of plants transformed with this technology have already taken place in the US and UK. [Kuyek, 2001].

This is an example of the increasingly important role played by NGOS in creating awareness, uncovering and disseminating information, and forming crucial social pressure groups which can counterbalance the tendencies for corporatisation in

agricultural production. Just as in the issue of patenting in pharmaceutical production, NGOs have been crucial in creating wider public awareness, filing public interest litigation which fights for the socio-economic rights of citizens, and campaigning for greater access for the poor to food and nutrition.

It should be remembered that farmers constitute by far the largest sector of seed breeders in every developing country, and generate the diversity on which commercial plant breeding is based. Despite this, and despite the greater role of public institutions in funding and carrying out agricultural research, transnational corporations dominate applications for PVP and patents in developing countries. Over half the current biotech patents on rice are owned by a handful of mostly Western chemical conglomerates, which implies greater seed costs and greater monopoly control over basic food production through this means. Even public research tends to become more oriented towards the needs of industry. More open access to new seed development is obviously important in providing cultivators with the freedom and unrestricted access to available plant varieties which has historically been the basis of all cultivation and contributed more to sustainable agriculture over the centuries than any amount of laboratory research. It is also important in ensuring the welfare of children in farming communities. And it can be crucial in ensuring the biodiversity which is essential for sustainable life on the planet, as the discussion below suggests.

Loss of biodiversity

It is now recognized that loss of biodiversity, especially because of new cultivation practices, can have very negative implications for the future sustainability of agriculture, and therefore amounts to a crime against future generations. There is also recognition that the rate of decline of diverse biological species has accelerated in recent times. There are several reasons for this. One significant factor has been the rapid expansion of industrial and Green Revolution agriculture, intensive livestock production, industrial fisheries and aquaculture that cultivate relatively few crop varieties in monocultures, rear a limited number of domestic animal breeds, or fish for, or cultivate, few aquatic species. Production systems using GMOs only accelerate this trend. Also, the process of globalisation of the food system and marketing, and the extension of industrial patenting and other intellectual property systems to living organisms have led to the widespread cultivation and rearing of fewer varieties and breeds for a more uniform, less diverse but more competitive global market.

While there is a range of international conventions in place to protect the interests of current private investors, there is currently no *enforceable* treaty or agreement that seeks to ensure the protection of biodiversity for our children and for the future. Instead, the current tendency is precisely to encourage the opposite. As mentioned above, the typical UPOV criteria for plant variety protection – distinctiveness, uniformity, stability, and novelty – encourage breeding for monoculture production systems and are irrelevant to farmers who do their own breeding to produce genetically diverse seeds. Thus they contribute to accelerated loss of biodiversity. In order to avoid this, instead of allowing IPR on plant varieties, developing countries should urgently establish mechanisms to protect and encourage farmers' rights and community innovation.

One coalition of farmers' and indigenous people's groups has called upon governments to "develop and enforce a code of conduct for the regulation of all so-called life-science transnational corporations, with a view to protect the rights, livelihoods and food security of their people," and to "ensure accountability of the public research institutions for the protection of the interests of the poor farmers, and for sustainable agriculture, bio-diversity and the rights of the communities over their knowledge, technology, practice and genetic resources including all plants, plant-forms, and animals." ["Indigenous Peoples' Statement on the Trade-Related Aspects of Intellectual Property Rights of the WTO Agreement," signed at the United Nations, Geneva, Switzerland, on 25 July 1999.] This once again highlights the major role that is now being played even at the international level by NGOs and social movements. Instead of such progress, international talks intended to keep the world's plant resources in common ownership collapsed in 2000.. These talks were the culmination of six years of negotiations to produce an International Undertaking on Plant Genetic Resources for Food and Agriculture, which promised a historic compromise between the plant breeders of the industrialised world and farmers from developing countries who have nurtured their traditional strains of crop plants over the generations. These crop varieties that contain most of the genetic raw materials from which breeders work. The deal would have guaranteed scientists free access to the seed varieties, while ensuring that a levy on any resulting commercial breeds gave the farmers some financial return. The agreement was vetoed by the United States, Canada, Australia and New Zealand, which unfortunately suggests that future attempts to carve out deals along similar lines may well meet with similar fates.

Policy Options

Once again, there are issues to be deal with at both national and multilateral levels.

1. At the national level, there is crucial need to ensure that proper systems of flexible regulation , monitoring, surveillance and discipline are set up in developing countries to regulate new technologies for cultivation and food production which may have health and nutrition implications.
2. Similarly, there is special need to monitor and regulate the agricultural biotechnology which may have unforeseen implications in the specific and more complex conditions of developing country agriculture.
3. Public funding of relevant technologies must continue and be increased, but the danger that such public research becomes a tool for transfer to private monopoly through the effective sale of patents to large corporations, must be guarded against.
4. UPOV type plant variety protection should be avoided and replaced with more open, flexible and democratic systems of farmer access which are also important to ensure biodiversity.
5. There is need for joint international action to promote an International Undertaking on Plant Genetic Resources for Food and Agriculture.
6. As in the case of pharmaceutical patents, WTO needs to develop and adopt measures which would allow developing countries access to such merit goods without having to deal with monopolistic practices or other forms of pressure from industry.

IV. ICT: The Perceived Opportunity

The Potential

Developments in information and communication technologies during the last quarter of the 20th century are widely seen as having heralded an information age in which economic and social activity has been widened, deepened and transformed. Optimistic projections would have it that a computerised and networked world would not only change work practices, attitudes to leisure and access to facilities that enhance the quality of life, but also allow for a more widespread and rapid growth of employment, productivity and output. That is, these technologies are seen as having both the potential to advance human development as well as spread the capabilities to benefit from that potential.

For children the promise that ICT offers stems from two sources: First, its role as a delivery mechanism, to even poor and remote locations, of a wide variety of services varying from improved education and health facilities to the enhanced capacity to deal with and mitigate the consequences of natural disasters. Second, its potential use as a mechanism to improve the transparency and efficiency of governance, which would reduce leakages from and improve the reach and delivery of publicly provided social services and thereby contribute to an advance on the human development front. Thus, there is an important democratizing element in the new communications technologies. However, it is also worth remembering that given the structure of investment and ownership in this sphere, it is likely that web space of corporations selling goods and services will dominate over more public knowledge oriented sites.

A typical example of the use of ICT for advancing health status is the still nascent field of *telemedicine*, which promises to deliver the best medical advice and treatment to patients irrespective of their location.² Besides advice based on standardised symptoms, work is on in delivering higher-end medical care via satellite to remote rural sites or in response to disasters, like earthquakes. At the moment the real constraint is the access to and cost of the higher bandwidth needed to transmit real physiological data and complex medical images.

At the core of this perceived opportunity offered by ICT lies the dramatic increase in computing power ensured by the emergence and rapid evolution of microprocessor technology. In the three decades starting 1971 the number of transistors on a chip increased from 2,300 on the 4004 to 26 million on the Pentium III processor ; the cost of a Mhz of computing power has fallen from \$760 in 1970 to 17 cents in 1999.³ This has helped PC makers and those incorporating computer chips into their products deliver far more powerful systems at the same or declining prices.

The growth in computing power has triggered a veritable race at developing digital devices that can exploit that power and offering peripherals that extend that capability. These devices acquire, record, organise, retrieve, display, manipulate and

² See for example, "The online doctor is in", *The Economist*, London, March 22, 2001.

³ Refer information available at <http://www.intel.com/pressroom/kits/bios/moore.htm> and Federal Reserve Bank of Dallas, *Annual Report 1999*.

disseminate information. Here too technological change has reduced costs substantially. The cost of a megabit of storage has fallen from \$5257 in 1970 to 17 cents in 1999.

Computing devices also help to manipulate and modify stored information, by searching through the data, displaying them in a chosen format, performing simple and complex scientific and engineering calculations and solving a range of non-numerical problems. The power that this offers is considerably enhanced by the growing possibility of linking computing devices and allowing them to communicate with each other based on some common protocol. This process has been aided by improvements in communication technology that have reduced the cost of transmitting a trillion bits of information from \$150,000 to 12 cents over the last three decades.⁴ This allows for the distribution of the benefits flowing from computing power, since individuals, organisations and corporations are able to secure a presence on the web as well as easily traverse cyberspace. This creates the basis for establishing links between individuals, individuals and government agencies, individuals and business, business and government and business and business. The full consequences of this *compacting of economic and social space* resulting from the internet's transformation from a channel of communication between few scientists to a web linking economic and social agents of different kinds are even now only being absorbed and analysed.

ICT's potential contribution to human development

Seen in these terms the ICT revolution, besides promising increases in income and employment, could contribute directly to human development. As developing countries build their capabilities to exploit the new technologies and as these technologies become more accessible in these countries, the argument goes, they can be put to use in a more direct manner to empower people, improve social service provision and alleviate poverty. There are many ways in which these possibilities are being currently experimented with. To start with, a system of networked and interactive computers providing constantly updated information is seen as conducive to better decision-making as well as to a more citizen-friendly mode of governance. There are a number of micro-level experiments underway, aiming to realise this potential of ICT. This is the objective underlying the talk about 'e-governance' in many developing country environments.

A case in point is the disaster management project, developed as part of the Maharashtra Emergency Earthquake Rehabilitation Project (MEERP), being implemented in the State of Maharashtra, India, aimed at minimising the adverse effects of natural disasters.⁵ Complete with a disaster management centre located at the Yashwantrao Chavan Academy of Development Administration (YASHADA), computerised control rooms across the state, a VSAT- and VHF-based communication network and area-specific, Geographical Information System (GIS)-

⁴ For a descriptive survey of computing and information technology refer various references at www.brittanica.com.

⁵ Refer Krishna S. Vatsa, "Technological Challenges of the Disaster Management Plan for the State of Maharashtra", in Subhash Bhatnagar and Robert Schware (eds.), *Information and Communication Technology in Development; Cases from India*, New Delhi: Sage Publications, 2000, pp. 50-62.

based, disaster-management plans, the system provides critical support for the disaster management functions of the administration. It would help plan exit and evacuation activities in case of natural or man-made disasters, locate resources that could be easily and quickly deployed in the affected areas, identify potential disaster management facilities in case of need and help access international medical and managerial support. Supported by the World Bank, the DFID and the UNDP, the project is now reportedly complete in all districts across the state.

Another example is the computerisation of the *Mandal* Revenue Offices (MROs) in the State of Andhra Pradesh. As part of the project all the MROs (totalling 1124), the revenue divisional offices (78), the collectorates (23), the office of the commissioner of land revenue, and the directorate of economics and statistics at Hyderabad are to be computerised. This involves data collection, development and implementation of appropriate databases and developing human resources through intensive training. The system sits on the Andhra Pradesh Statewide Area Network (APSWAN), which uses a 2MBPS optic fibre link to connect the state secretariat with 23 district headquarters. Here too, a substantial part of the funding comes from a World Bank Hazard Mitigation and Emergency Cyclone Recovery Project, “which supports the government’s efforts to improve data collection and communication of relevant hazard and vulnerability reduction information from the district and mandal level to citizens.”⁶ The system is expected to automate and facilitate the maintenance of statistical information on population, landholding, cropping patterns, livestock, irrigation facilities, housing, health and a range of other economic information needed for design and management of development schemes. The storage of a wide range of information, including documents relating to property rights in computerised databases and providing public access to these databases is seen as promoting transparency of a kind that strengthens democracy, empowers people and speeds up decision-making when compared with a situation where information was sealed into files locked with red tape that were accessible only to a bureaucracy sworn to secrecy on all matters.

A more decentralised, village level project aimed at carrying computers to the rural and semi-urban areas is the model, “wired village” project implemented around Warana Nagar in the Kolhapur and Sangli districts of Maharashtra.⁷ It was designed as a pilot project aimed at demonstrating the contribution an IT infrastructure can make to the socio-economic development of a cluster of 70 contiguous villages. The project aims to provide agricultural, medical and educational information to villagers at facilitation booths in their villages, provide villagers access to the Internet via the National Informatics Centre Network, and provide distance education facilities to both primary and higher educational institutes.

The Warana project is jointly implemented by the National Informatics Centre (acting on behalf of the central government), the Government of Maharashtra and the Warana

⁶ Refer Asok Kumar, “Computerisation of *Mandal* Revenue Offices in Andhra Pradesh: Integrated Certificate Application”, in Subhash Bhatnagar and Robert Schware (eds.), *Information and Communication Technology in Development; Cases from India*, New Delhi: Sage Publications, 2000, pp. 105-112.

⁷ N. Vijayaditya, “A Wired Village: The Warana Experiment”, in Subhash Bhatnagar and Robert Schware (eds.), *Information and Communication Technology in Development; Cases from India*, New Delhi: Sage Publications, 2000, pp. 132-140.

Vibhag Shikshan Mandal under the educational department. The estimated cost of the project of around \$600,000 (Rs.2.6 crores) was also jointly financed by the central government (50 per cent), the Government of Maharashtra (40 per cent) and the *Warana Vibhag Shikshan Mandal* (10 per cent).

The potential gains from wired environments like these is illustrated by a second set of experiments which seek to increase the efficacy of social service delivery through the use of ICT. A remarkable pilot project along these lines was the Indian Healthcare Project begun in 1994 as a collaborative project involving the Government of India, Apple Computer Inc. and CMC Ltd in the state of Rajasthan.⁸ It targeted the Auxiliary Nurse Midwives (ANMs) who were healthcare workers responsible for 5000 persons distributed over several villages. The ANM is expected to call on each household under her charge once a month to collect demographic data, administer immunisation facilities, and provide counselling on family and child welfare and mother-child health programmes.

The project sought to combine the use of an IT device, the personal digital assistant (PDA) and relevant support tools to reduce time spent doing paperwork by ANMs, increase the accuracy of the data collated and supplied by the ANMs, ensure availability of village level healthcare data in an electronic form, and provide the ANM with information that helps her provide more effective services. The pilot project team designed a system based on the Newton handheld computing platform and at the end of the research phase turned over the results to CMC Lt for further development. Though Apple has dropped the Newton from its profile of products, the availability of new, cheap and extremely powerful PDAs makes it possible to build on the experienced gained from the pilot project.

Finally, experiments are on to provide computer access at the village level, which facilitates not merely extension services on technical matters relating to best agricultural practices or combating pest attacks, but also provides ready access to information on market conditions, opportunities and prices and means to combat illnesses and deal with emergencies. In Embalam, in the state of Pondicherry, India, “a two-street where 130 out of 210 families struggle below the poverty line”, the village elders have allowed the M.S. Swaminathan Foundation access to one side of the temple to house two solar-powered computers that are used to give villagers a wealth of data, varying from the price of rice to weather conditions for fishermen and medical information for the sick. Embalam is one of four villages in which the M.S. Swaminathan Foundation is implementing the “information village” project. The project aims to use “science and technology to tackle poverty, with a \$120,000 grant from the Canadian government.”⁹

It is indeed true that all of these, with a very few exceptions, are still in the nature of pilot projects. But they do demonstrate the potential of ICT to help improve governance, make the state more citizen-friendly, empower the poor and ensure the better delivery of improved social services to India’s poor. If these experiments can be

⁸ Refer Naresh Kumar Reddy and Mike Graves, “Electronic Support for Rural Healthcare Workers”, in Subhash Bhatnagar and Robert Schware (eds.), *Information and Communication Technology in Development; Cases from India*, New Delhi: Sage Publications, 2000, pp. 35-49.

⁹ K. Venugopal, “Computers in farm land”, *Business Line*, Chennai, 22 February 2000.

replicated in other developing country environments, ICT can indeed contribute to the reduction of income poverty and an improvement in human development indicators.
Potential for developing countries

In sum, from the point of view of developing countries searching for ways to improve extremely poor quality of life indicators, the human development-advancing potential of ICT is an obvious attraction. The real question is whether the ICT revolution would diffuse its way into the less developed world. Protagonists argue that it will, because there are many factors favouring the diffusion of ICT, even though the major innovations underlying that revolution have thus far occurred in the developed economies. Principally, *unlike the 'routinised' technologies which dominated development during the immediate post-World War II years, the new 'entrepreneurial' technologies driving the IT sector are seen as being characterised by a knowledge-base for innovation that is more rapidly transmitted across the globe, and levels of investment that are much lower and often easily afforded by even private investors in developing countries.* This substantially reduces barriers to entry and facilitates the presence of small players from developing countries in a rapidly expanding segment of the global economy.¹⁰

This optimism has been strengthened by the evidence of the success of some countries in the export of ICT and ICT-enabled services. These services are delivered via telecommunication or data networks, and are either *outsourced* or organised by agents in the country of origin of the service to whom the provision of these services are contracted out or *outlocated* by subsidiaries of corporations from the country of delivery of certain services. Countries like India have been extremely successful in exploiting the new opportunity.

Based on this success, there have been extremely optimistic projections made of growth in the IT sector. According to a study undertaken by McKinsey for NASSCOM¹¹, India has the potential of raising export revenues from software and IT-enabled services from its 1999-00 level of \$4 billion to \$50 billion in 2008. This would take the size of the industry from \$3.3 billion in 1998 to \$87 billion in 2008, along a trajectory involving a compound annual rate of growth of 40 per cent. As a result, the IT sector's contribution to GDP growth is expected to touch 7.5 per cent and its share in India's exports to reach 30 per cent as compared with around 5 per cent currently.

¹⁰ For example, the 1999 *Annual Report* of the Federal Reserve Bank of Dallas argues as follows: "What's different about the New Economy? There's an unbridled dynamism, flowing from an entrepreneurial capitalism. A novel idea and a little money can spark a billion dollar business overnight. Yesterday's economy was dominated by establishment capitalism, with high barriers to entry that disadvantaged newcomers and new products. Economic change occurred at a slower pace." Interestingly, the same authors go on to say that "Increasing returns to scale pervade the New Economy," making the argument about easy entry a bit difficult to swallow. For a more academic analysis in the Indian context refer, Hans-Peter Brunner, *Closing the Technology Gap: Technological Change in India's Computer Industry*, New Delhi: Sage Publications, 1995.

¹¹ Refer *Highlights of the NASSCOM-McKinsey Study Report 1999* at www.nasscom.org.

The constraints

The optimism generated by these opportunities that ICT provides has to be tempered with caution because of the innumerable constraints that operate on the realisation of this potential. Among the constraints are the following:

- Limits to physical access to the new technology and the high costs of ensuring such access to the less well endowed
- Foreclosure of access because of the insufficient capabilities of large sections of the population in both developed and developing countries, especially the latter.

These constraints are the basis for the argument that, rather than help to improve social service delivery and address poverty, the ICT revolution is likely to generate a new “digital divide”. The international digital divide between the developed and developing countries is obvious. Twenty of the world’s largest developing nations contribute only about 27 per cent to the global information technology market of \$750 billion. Less than 5 per cent of the world’s population participates in the internet revolution, involving 330 million users and 1.8 billion web pages, which are increasing at the rate of 150,000 users and 2 million pages every day.¹²

However, the real threat of a digital divide is, of course, within developing countries themselves. This arises from a number of sources. First, the fact that an overwhelming majority of the population is likely to remain excluded from the benefits of the new technology. Second, that even to the extent that access is available, inadequate education would ensure that the majority would not have the competence and the confidence to participate in the transformation that the technology is likely to effect in the work practices and lifestyles of the urban and rural elite. Finally, even as access grows, the rapid changes in ICT and its use would result in many with initial access falling behind in their ability to continue to use the benefits of the technology.

The prospect is disturbing when we begin to examine the figures. Even in a successful IT “power” like India, according to official sources, in 1998-99, the penetration of PCs was only 3 per thousand and the number of fixed telephone lines to connect to the world wide web through an ISP only 22 per thousand. By that time half the US population had access to PCs and the worldwide average penetration was 60 per thousand in the case of computers and 125 per thousand in the case of telephone lines.¹³

Much of even this extremely limited access is concentrated in urban India. Trying to accelerate penetration through schemes like the Warana “wired village” project, which the government’s IT Task Force has recommended should be replicated across India’s villages, would of course be impossibly expensive. As mentioned earlier, the Warana project, which connected and computerised a cluster of 70 villages, was estimated to have cost \$600,000. There are around 550,000 villages across India. If costs of replicating the experiment across these villages remains the same, the total

¹² “Third World contributes 27% to \$750 billion IT market”, *Economic Times*, Delhi, 21 July 2000.

¹³ Government of India, Ministry of Information Technology, *Annual Report 2000*, New Delhi: MIT, 2000.

cost would amount to around \$4.7 billion. This amounts to close to 12.5 per cent of India's GDP in 1998-99. This compares with the fact that public expenditure on education as a proportion of GNP stood at 3.2 per cent in 1995-96 and on elementary education at just 1.5 per cent, and that even the Indian government's unimplemented commitment in this area is to raise the expenditure on education to just 6 per cent of GDP.

This difference in actual expenditure on education and the required expenditure on wiring India's villages is not without significance when we look at literacy and educational outcomes. Even as late as 1997, NSS data revealed that literacy among the population above 7 years of age was just 62 per cent. The literacy requirement is set so low that in most cases being literate would be inadequate to be competent enough to become digitally literate. A minimum of school education would be a prerequisite beyond a point. Here the picture is dismal. To quote the Public Report on Basic Education in India¹⁴, "at the time of the 1991 Census and the National Family Health Survey (1992):

- Half of the country's population (61 per cent of women and 36 per cent of men, aged 7 and above) was unable to read and write.
- Less than 30 per cent of all adults had completed eight years of schooling.
- One-third of all children aged 6-14 years (about 23 million boys and 36 million girls) were out of school."

What these figures suggest is that building capacity to exploit the benefits of ICT requires investment in schooling and in developing literacy and skills among those beyond the school-going age, who would be the ones immediately affected by the structural transformation that IT effects. This creates a dilemma. Not investing in ICT is to forego what happens to be the leading opportunity in modern economies. But excessive emphasis on IT could result in the diversion of resources away from the much more crucial expenditures on literacy and primary education, which are not just development goals in themselves but a must if the digital divide is not to widen rapidly.

Finally, given its sources, the information economy transacts principally in the English language. This also means that much of the software needed to be a digital citizen requires, as of now, familiarity with English. This implies that non-English speaking countries should invest either in the generation of software in the vernacular or in developing English language skills, or both. This makes the costs of "catching up" all the greater. A large part of this investment must be undertaken by the State, since the market is unlikely to service these needs.

Policy conclusions

In brief, this analysis of the constraints to the realisation of the potential of ICT, especially from the perspective of unleashing its potential for human development, suggests the following:

¹⁴ The Probe Team, *Public Report on Basic Education in India*, New Delhi: Oxford University Press, 1999, p. 9.

1. Despite its rapid growth, the information technology sector in developing countries, like India, is small and the fall-out of its growth on the rest of the economy is limited.
2. The limited presence is all the more crucial when we examine the prospect of a sharply widening digital divide within the economy. Even beginning to provide access to the new technology to the overwhelming majority who cannot access it for technological reasons would impose a large financial burden. But the more difficult task is to prepare the disconnected to develop the competence to participate, however marginally, in the emerging digital economy. This alters priorities completely. With literacy and schooling achievements still at indefensibly low levels in many developing countries, the first task of the government would be to rapidly advance the pathetic reach of literacy and school education in the country.
3. In terms of priority this should be placed above the target of providing a minimum degree of access to ICT to those who are completely disconnected. However, the nature of the challenge of overcoming backwardness is such that a degree of syncopation is inevitable, necessitating large resources that in part must come from the surpluses being garnered by the rapidly growing and highly profitable IT services sector. Thus any dilution of the State's role in the growth in the IT sector could aggravate the tendency to widen the 'digital divide' between India and the developed industrial countries, especially the US, and within India itself to persist and even widen. This strengthens the argument that the buoyant and highly profitable private IT sector has to be treated on par with the "brick-and-mortar" economy and taxed to generate the resources for such expenditures.
4. Support from developed country governments and multilateral agencies would be crucial if capabilities are to be built in this area in order to preempt an increase in international and national inequality that may not even be easily quantified.

V. Summary of Issues and Main Policy Conclusions

The paper has dealt with three types of recent technological changes that have a particular bearing on the welfare of children : in innovations in drugs and pharmaceuticals; in biotechnology especially relating to food and agriculture; and in information and communications technology.

In the case of drugs and pharmaceuticals innovation, the chief problems were identified as follows: There is inadequate investment in preventive and curative treatment of a range of diseases that are more widely prevalent in low-income developing countries. Even when technology exists, there is inadequate production of drugs, even life-saving drugs, that are used by dominantly poor populations. High prices, market segmentation and monopoly control all affect the access of poor people and citizens of developing countries. This is partly but not only related to the existing patent regimes and to the TRIPS agreement. Even in the absence of monopoly prices and when the drugs are produced, there is inadequate access to life-saving drugs because of absolute poverty. There is inadequate information among the public and those affected, about various drugs and their alternatives.

In the case of biotechnology relating to food and agriculture, the main issues were identified as follows : GMO technologies may have revolutionary effects on

productivity of cultivation, but they are still very nascent in terms of use and application. Given that many of the short-term by-products and short-term effects of the new GMO technology are still unknown, it is important for all countries to exercise caution and regulation in determining the use of such technologies. However, many developing countries do not have the capacity for effective regulation, and the possibility of “technological dumping” and effectively using developing country agriculture as an enormous testing laboratory for such new products is therefore high. In addition, there is pressure on developing countries to adopt highly restrictive UPOV-type protection of plant varieties which enhances the bargaining power of MNCs vis-à-vis ordinary citizens.

Information and communications technology is seen as a major source of potential for material improvement and child development. However, despite its rapid growth, the information technology sector in developing countries (even in a country which is more prominent in this area like India) is small and marginal and the fall-out of its growth on the rest of the economy is limited. There are signs that barriers to entry outside the realm of production in both the hardware and software segments are substantial, and the digital divide is real. Therefore governments need to play a more proactive role to ensure that the benefits of this new technology are more widely dispersed.

This analysis leads to the following policy recommendations :

1. At the national level, it is necessary for governments to be made more aware of the actual possibilities for exceptions and for avoidance of monopoly even within the current TRIPS regime (such as compulsory licensing and parallel imports), as well as the need for regulation with respect to new forms of biotechnology and its products. International institutions can play an important role in such dissemination.
2. There is need for an international protocol which would prevent undesirable practices such as developed country governments and MNCs using their clout to prevent countries from using these exceptions and methods to access to encourage the production of even life-saving drugs. Similarly there should be a clear international rejection of attempts to force developing countries into joining UPOV.
3. The basic problem of inadequate investment in R&D relating to tropical diseases and diseases afflicting the poor can only be addressed through more public investment. Thus, both nationally and internationally there is need to encourage more public expenditure directed towards this end. There are several possibilities for funding such research, quite apart from the general use of the state exchequer. Thus, a tax could be levied on the pharmaceuticals companies' profits, the proceeds of which would go into a fund to pay for research into tropical diseases and the production of essential medicines. Such a tax could be administered at the national level by all countries, and then go into research sponsored, for example, by the WHO. Similarly there could be a tax on MNC companies sponsoring and taking patents on biotechnological research, to be used for infrastructure development for developing country agriculture. It is also important to tax the new ICT industries which are often given special fiscal incentives despite high profits. For example, e-commerce should be taxed and attempts to block such taxation at the international level should be resisted.

4. Similarly, there could be fiscal incentives that encourage more such socially desirable research and investment in crucial drugs as well as in biomedical research, in the form of differential taxation and differential treatment of different types of pharmaceutical and biomedical research.

5. It is obvious that the possibilities of alternatives such as parallel imports themselves depend upon the generic production of drugs somewhere in the world which allows their lower prices, and this possibility itself will be negated once all countries are forced to move to a stricter patent regime which insists on product patents in pharmaceuticals. At the multilateral level, therefore, there is definitely a case for a reconsideration of the TRIPS agreement, especially with respect to process versus product patents in pharmaceuticals. Since there have already been calls for renegotiating Article 27.3 of TRIPS relating to the patenting of life-forms, there is a case for combining such a demand with the demand for reconsidering this item as well.

6. The problem remains of poverty and lack of access of many poor people across the world to even life-saving drugs, and certainly those drugs that affect the well-being and development of children. Here a case may be made for an international fund to support the production and distribution of such drugs to those in need, and a special case may be made for a fund devoted specifically to meeting the health needs of children and women in the reproductive age group.

7. At the national level, there is crucial need to ensure that proper systems of regulation, monitoring, surveillance and discipline are set up in developing countries to regulate new technologies for cultivation and food production which may have health and nutrition implications. Similarly, there is special need to monitor and regulate the agricultural biotechnology which may have unforeseen implications in the specific and more complex conditions of developing country agriculture.

8. There is need for joint international action to promote an International Undertaking on Plant Genetic Resources for Food and Agriculture.

9. To enhance the spread of ICT and its benefits, it is necessary for governments to increase the necessary infrastructure investment and access to it. With literacy and schooling achievements still at indefensibly low levels in many developing countries, the first task of the government would be to rapidly advance the still pathetic reach of literacy and school education in developing countries.

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