Increasing human security through biotechnology

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Abstract: In this paper, we examine the bright and dark, the light and shadow of emerging technologies through the lens of human security. Human security is becoming increasingly debated and discussed in global governance circles, but not yet in relation to emerging technologies. The threats and opportunities to attaining human security in various domains – disease, hunger, environment, poverty and bioterrorism – are discussed. Finally, we explore the implications for actions that follow from this analysis. Two promising possibilities are suggested, the use of networks of leaders from developing and industrialised countries and/or a more effective use of existing instruments of the UN. The key question is whether or not we can come together as a global community to harness significant technological developments and minimise their risks for the betterment of all.

Keywords: human security; biotechnologies; disease; hunger; environment; poverty; bioterrorism.


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1 Introduction

In a recent exhibit entitled Massive Change, visionary designer Bruce Mau asks the question: ‘Now that we can do anything, what will we do?’ His thesis is that in a world facing profound challenges, many brought on by innovation itself, human ingenuity can be harnessed for global prosperity and a sustainable future (Mau, 2004).

The question at the heart of this paper is also what will we do. Recognising the power and promise of emerging technologies, what will this society do? The bright side of emerging technologies is the promise of improvements in some of the most vexing problems of health, hunger and environment. The dark side is the possible enablement of bioterrorism.

In this paper, we examine the bright and dark, the light and shadow of emerging technologies through the lens of human security. We have chosen to focus on biotechnology as it serves as a particularly good model of both bright and dark sides of emerging technology. We have chosen human security as the theoretical lens because it is becoming increasingly debated and discussed in global governance circles, but not yet in relation to emerging technologies. The other advantage of using the human security lens is that it permits a discussion of both bright and dark effects of biotechnology on the same metric. We recognise that a conceptual framework such as human security is only as useful as the additional clarity it provides to a field, which provides a guidance in relation to alternative actions and also motivates action.

Then, our purpose, is to explore the applicability of human security to emerging technologies, examine one specific technology – biotechnology – from this conceptual framework and explore the implications for actions that follow from this analysis. This paper draws from a contribution by Daar and Singer to the Helsinki Process Papers on Human Security (Daar and Singer, 2005).

2 Defining human security

Many years ago, a former Canadian Prime Minister, Lester Pearson, captured the essence of the linkages between science and technology, global knowledge inequities, economic development and human security when he asserted that:

“…there can be no peace, no security, nothing but ultimate disaster, when a few rich countries with a small minority of the world’s people alone have access to the brave, and frightening, new world of technology, science, and of high material living standards, while the large majority live in deprivation and want, shut off from opportunities of full economic development; but with expectations and aspirations aroused far beyond the hope of realizing them:”

1
It is not surprising, then, that Canada played an important role at the UN in pushing for the adoption of human security as a legitimate concern of the Security Council and made a recent commitment to devote at least 5% of its total research and development expenditure to addressing the needs of developing countries.

Definitions of human security abound, but all concern themselves with the individual. The broadest, such as those espoused by the UN Development Programme and the recent Commission on Human Security, aim to safeguard and expand people’s vital freedoms and human dignity, shielding them from threats and empowering them to take charge of their own lives. This is in contrast to national or state security, which traditionally focuses almost exclusively on military threats.

The UN Secretary-General’s Panel on Threats, Challenges and Change recently concluded that development and security are inextricably linked (UN, 2004a,b). Human security is compromised by disease, hunger, poverty, environmental degradation and physical threat. In the case of each of these threats, technology has a potential to ameliorate the condition. The promise of various biotechnologies, nanotechnology, information technology and others has been widely promoted. But through the lens of human security, one can also discern a potential dark side, ways in which the technologies could actually hinder sustainable human development. And while these threats would appear to endanger to a greater extent those in developing countries, none of us is immune.

This paper explores the threats and opportunities attaining to human security by examining just one field of technology – biotechnologies, but our thesis is that human security has applicability to other technologies as well (Barber, 2001).

3 The opportunities of biotechnology

Biotechnology and the life sciences generally, including genomics, helps to illuminate convergences between various domains of threat to human security, including links between poverty and disease, health and economic development, infectious diseases and the environment, and the environment and agricultural productivity. What follows are brief glimpses into each threat domain, providing examples of the promise of biotechnology.

3.1 Disease

Perhaps the threat to human security that is most evident and most chronicled is that of disease. The gut-wrenching stories of the impact of HIV/AIDS are read by all of us. More than 1.7 million people die every year from entirely preventable illnesses linked to poor water and sanitation. Incrementally, non-communicable diseases such as heart disease, hypertension, diabetes and cancer are joining the killer infectious diseases in developing countries. The life expectancy of people in developed countries such as Canada is about 80 years and rising, while in some countries in sub-Saharan Africa it is less than 40 years and dropping. So for many, the discourse is really about the survival: individual human security in the most real sense. Health indicators and expenditures reveal a profound pattern of global inequity. Consequently, it is not difficult to make the link to migrations, civil strife and humanitarian emergencies.
Biotechnology, and more specifically genomics, has enormous potential to improve health in the medium and long term. The University of Toronto Joint Centre for Bioethics established a major research and capacity strengthening programme to help reduce knowledge inequities and foster both the health and economic benefits that biotechnology could bring to developing countries, while avoiding the potential risks. Using a Delphi technique with a panel of 29 experts familiar with developing country health needs, the top ten biotechnologies most likely to improve health in the next five to ten years were identified. The consensus list includes: molecular diagnostics; recombinant vaccines; drug and vaccine delivery systems; bioremediation; sequencing pathogen genomes; female-controlled STI protection; bioinformatics; nutritionally enriched genetically modified crops; recombinant drugs and combinatorial chemistry (Daar et al., 2002). These technologies can also promote the UN Millennium Development Goals.

The successes of the 20th century global immunisation programmes have been significant in saving million of lives; they have included the eradication of smallpox and the elimination of poliomyelitis in Europe, the Americas and much of Asia. However, humankind has so far not been able to make effective vaccines against some of the most lethal diseases affecting it, including HIV/AIDS, malaria and tuberculosis. These and many other potentially controllable diseases are amongst those that cause the most amounts of morbidity and mortality in developing countries. Part of the reason that we have been unable to control these diseases is that there are roadblocks that we have yet to overcome and these roadblocks are both in our understanding (science) and in the tools that we need (technology). As illustrated in Box 1, the Bill and Melinda Gates Foundation has come up with an initial $200 million programme to identify these grand challenges and fund their solution (Varmus et al., 2003).

**Box 1** Goals and grand challenges

<table>
<thead>
<tr>
<th>GOAL 1: To improve childhood vaccines:</th>
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<tr>
<td>GC 1: Create effective single-dose vaccines that can be used soon after birth</td>
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<td>GC 2: Prepare vaccines that do not require refrigeration</td>
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<td>GC 3: Develop needle-free delivery systems for vaccines</td>
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<th>GOAL 2: To create new vaccines:</th>
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<td>GC 4: Devise reliable tests in model systems to evaluate live attenuated vaccines</td>
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<td>GC 5: Solve how to design antigens for effective, protective immunity</td>
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<td>GC 6: Learn which immunological responses provide protective immunity</td>
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<th>GOAL 3: To control insects that transmit agents of disease:</th>
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<td>GC 7: Develop a genetic strategy to deplete or incapacitate a disease-transmitting insect population</td>
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<td>GC 8: Develop a chemical strategy to deplete or incapacitate a disease-transmitting insect population</td>
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<th>GOAL 4: To improve nutrition to promote health:</th>
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<td>GC 9: Create a full range of optimal bioavailable nutrients in a single staple plant species</td>
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Box 1  
Goals and grand challenges (continued)

**GOAL 5: To improve drug treatment of infectious diseases:**
- GC 10: Discover drugs and delivery systems that minimise the likelihood of drug-resistant microorganisms

**GOAL 6: To cure latent and chronic infections:**
- GC 11: Create therapies that can cure latent infections
- GC 12: Create immunological methods that can cure chronic infections

**GOAL 7: To measure disease and health status accurately and economically in poor countries:**
- GC 13: Develop technologies that permit quantitative assessment of population health status
- GC 14: Develop technologies that allow assessment of individuals for multiple conditions or pathogens at point-of-care

The SARS story is really quite instructive to our discussion of biotechnology and human security. It is believed to have started when people became infected by the virus from animals they had contact within the marketplace environments in southern China in 2002. It arrived in Canada by February 2003 and was identified very quickly as being due to infection by a new type of coronavirus. It caused enormous hardship in many countries. In Asia alone the economic cost of SARS has been estimated at $60 billion. Nevertheless, diagnostic tests were developed before the summer and by the summer of 2003 the genome of the SARS virus had been sequenced and now there are vaccines already being tested in human beings. There has never been such a rapid understanding and translation of knowledge with such a global infectious disease outbreak – and all this is because of the powerful biotechnological tools that we now possess. The interconnectedness of health and security is coming under closer scrutiny as evidenced by a recent book by Chen et al. (2003).

### 3.2 Hunger

Today, as many as 800 million people in the developing world and at least 24 million in developed and transition economies do not have enough food. The primary problem is thought to be a lack of entitlement and access. However, we grow by 77 million souls a year. In 2050 population is projected to be 8.9 billion. To ensure food security, agricultural productivity will have to increase significantly. Ninety-six percent of the arable land in the world is already under cultivation and water is becoming scarce where it is needed most. And the spectre of long-term climate change looms large.

We cannot afford to ignore the potential role of biotechnology in meeting the food needs of the poor. During the Green Revolution, which largely bypassed Africa but which had an enormous impact elsewhere, agricultural technology in the form of improved varieties was disseminated internationally. This benefited particularly those countries with sufficient research capacity to adapt and adopt the high-yielding varieties. The seeds and knowledge were given freely and treated as global public goods. This does not seem to be happening during the Gene Revolution. The controversy surrounding possible risks and the significant regulatory and market barriers including intellectual property licenses are causing paralysis in the developing world. What is needed if
biotechnology is to have any relevance for developing countries is for native crops that are the main staples to be studied using biotechnology techniques to see if they can be improved, with or without genetic modification.

Some question whether genetically modified crops are safe to consume and environmentally safe to grow and release (Daar et al., in press). A recent report from the UK by the GM Science Review Panel concludes that recent attempts to create public anxiety have been ignoring the scientific evidence. The World Health Organization also maintains that genetically modified foods presently on the international market are safe to eat. And one of the voices from the developing world, Hassan Adamu, Nigeria’s former Minister of Agriculture and Rural Development, has noted “To deny desperate, hungry people the means to control their lives by presuming to know what is best for them is not only paternalistic but morally wrong” (Hassan, 2000). Nevertheless, the UK Panel suggests that it is necessary to develop safety assessment technologies and effective surveillance, monitoring and labelling systems to appropriately deal with the risks that may occur.

Golden rice, which has been genetically engineered to contain elevated levels of pro-Vitamin A (β-carotene) and iron, could inexpensively touch the lives of more than three million children below the age of five who suffer eye damage. In India, vegetarians often suffer from malnutrition due to crops with low protein and essential amino acid content. A new potato containing a gene from the South America amaranth plant that codes for the protein albumin is awaiting regulatory approval. A new field of smart breeding is developing. In smart breeding, the knowledge of the genomes of plants is being used to speed up the same traditional breeding techniques that humankind has used for millennia. One focus is to activate healthy genes (e.g. pest resistance). No genes from any other plants are introduced. In other words, there is no ‘transgenesis’ – instead these are ‘super-organic’ techniques, which really have the potential to improve agriculture enormously without the debilitating controversy surrounding genetically modified crops.

3.3 Environment

Suffice it to say that on the environmental front, any assessment concludes that there is no room for complacency. Virtually every indicator – on air, water or land, shows signs of a world in disequilibrium. Never before we have been so aware of the link between our economic and social security and the health of the environment.

While the population of the world has increased fourfold in the past century, economic activity per person has increased at least four and a half-fold. The effects on our global ecosystem can be felt through the extinction of species, pressures on the environment, global warming, unstable water supplies and depletion of fertile lands. Yet, those who are threatened most, the poor people in developing countries, are not the main culprits, they are not the ones whose economic activities and environmental footprints are the largest: they are simply the ones who are the least capable of responding to these existential challenges.

Bioremediation is one of the processes that holds a great promise to improve the environment. Simply put, bacteria and plants can be engineered to chew up oil spills and remove organic waste and heavy metals, such as lead, mercury and cadmium from drinking water. Bioremediation was part of strategy to clean up the Alaskan shoreline after the Exxon Valdez oil spill in 1989. In the developing world, China is already using plants to clean up fouled waterways. Scientists in the USA discovered that a fern, Pteris...
vittata, can accumulate arsenic in extremely high concentrations without harming itself. It can be cultivated in arsenic-contaminated water and acts as a natural arsenic filter. Researchers are seeking to identify and splice the fern’s arsenic-metabolising genes into other plants.

According to the World Health Organization, up to 50 million people are exposed to arsenic poisoning in Bangladesh. It is estimated that arsenic in drinking water from deep wells will cause 200,000–270,000 deaths from cancer. Experts believe that this contamination results from bacteria that live in the water and as part of their normal metabolism they convert insoluble arsenic from the walls of the aquifer into soluble arsenic that then enters the well and is consumed in a form that is poisonous to human beings. Currently, Australian, Canadian, Bangladeshi and US scientists are studying the genomes of bacteria in the hope that a better understanding of these organisms will lead to some solutions that are more effective than the current techniques, mainly filtration, all of which have not been able to solve this public health and human security catastrophe. The sequencing of the genomes will be done in Canada and one of the laboratories involved is the one that successfully sequenced the SARS virus.

Biodiversity resources are crucial to long-term sustainable development. They impact, directly or indirectly, poverty and its alleviation, our health, the survival of indigenous communities and of course, the environment we live in. Biodiversity is thus intimately linked to human security, and we need not only to preserve this important human resource but also to learn how best to make use of it sustainably.

Biodiversity in the sense of the genetic endowment resident in plants and animals is no stranger to controversy. Issues of ‘biopiracy’, intellectual property rights and indigenous knowledge are common. There are famous examples such as that of a US company patenting the neem tree; the attempt to patent turmeric and the attempts to patent even names such as basmati rice and jasmine rice. Many developing countries are beginning to restrict the export of their plant and animal DNA and tissue. India and China, for example, require a special license. Other countries such as Costa Rica have entered into long-term agreements with companies to exploit their biodiversity and have signed benefit-sharing agreements.

The devastation of HIV/AIDS on sub-Saharan Africa is almost unimaginable to those who do not experience it at first hand. But what is little known is the effect on the environment of the AIDS epidemic. The Africa Biodiversity Collaborative Group has funded research that demonstrates how HIV/AIDS is complicating conservation and natural resource management efforts. Timber and medicinal plants appear to be particularly at risk. Mourning rituals in much of rural Africa require that fires be kept burning for up to five days for both warmth and food. And the number of trees felled to make coffins has increased dramatically. In some areas, medicinal plants and wildlife, such as turtle eggs, are being overharvested in the belief that they can cure AIDS. Traditional knowledge is also at risk, as people are dying before they pass it onto the next generation.

3.4 Poverty

One-fifth of the world’s people (1.2 billion) experience income poverty and live on less than $1 per day; 2.8 billion live in a chronic state of poverty. When people’s livelihoods are deeply compromised it is not only their physical security, but also their psychological security that is at risk. Poverty means lack of adequate housing, unsafe
environments, the absence of effective healthcare facilities, grossly inadequate human resources for health and all these contribute to avoidable deaths in poor developing countries.

In his budget speech in February 2000, Paul Martin, who is now the Prime Minister of Canada, said:

“Today, the strength of a nation is measured not by the weapons it wields, but by the patents it produces; not by the territory it controls, but by the ideas it advances; not only by the wealth of its resources, but by the resourcefulness of its people. In such a world, successful nations will only be those that foster a culture of innovation. They will be those that create new knowledge and bring the product of that knowledge quickly to market. Our goal as a nation must be to lead the way.”

In January 2000, the World Health Organization’s Commission on Macroeconomics and Health highlighted that effective investments in health are crucially important to human development, economic growth and therefore poverty reduction. The commission estimated that in the poorer developing countries, better health services, including a few specific interventions against infectious diseases and better nutrition could save up to 8 million lives per year by 2010. It provides arguments that clearly lead to the conclusion that there will be huge economic returns on this investment in health.

From the case studies of health biotechnology innovation systems, we know that countries such as China, India, South Africa, Brazil and Mexico are investing seriously in biotechnology. It serves to address their health problems but importantly also, it results in ‘leap-froging’ and creating new industries that will create jobs and reduce poverty. Cuba, for example, is a notable success story in biotechnology. It has consistently invested in biotechnology, has world-class research and development infrastructure and a working national system of innovation centred on health biotechnology (Thorsteinsdóttir et al., 2004). It holds a number of international patents and has a respectable record of publications; it is also the only country in the world that has so far managed to make a vaccine against meningitis B.

In agriculture as well, the economic benefits of investing in biotechnology have been significant. In reviewing the cases of transgenic crops in Argentina, China, India, Mexico, South Africa and the USA, the 2004 FAO edition of The State of Food and Agriculture (SOFA) identified systemic factors contributing to such success, such as access to national research capacities, a regulatory setting with clear biosafety protocols and a wide distribution of benefits.

3.5 Bioterrorism

As terrorism has entered our vocabulary in recent years, there is certainly a perception that we are living in an unsafe world. Enter the dark side of biotechnology – bioterrorism. Bioterrorism involves the use of harmful, possibly lethal, biological material such as viruses, bacteria or their toxins. History reveals stories of biowarfare in the past – from the use of poisoned arrows in the Trojan War to the embedding of the smallpox virus blankets given as gift to North American Indians; from the German use of sheep infected with anthrax in the world war to the forcible infection of prisoners in Nazi concentration camps with a wide variety of bacteria, protozoa and even a virus, Hepatitis A. More recently the Aum Shinrikyo attack on the Tokyo subway with a nerve gas (sarin) and anthrax scares in the USA in March of 1995 dominated the media.
Biological weapons theoretically can be used not just against humans but also against animals and plants. It is possible that some biological weapons are a bigger threat to human security, and are therefore more lethal terrorist weapons than either chemical or ‘dirty’ nuclear weapons (which are more of a psychological threat as they are unlikely to kill large numbers of people but will cause panic because of environmental contamination and the association with the term ‘nuclear’). This is because living weaponised organisms, by causing an infection in the victims, can multiply and spread in the population uncontrollably, while chemical weapons to be effective would have to be in large volumes and be administered repeatedly. Furthermore, because of the incubation period before symptoms appear, which can be up to 60 days with some agents, it may not be possible to contain the spread early and it will take a long time even to recognise that a bioterrorist event has occurred.

In a 2003 report, “Biotechnology Research in an Age of Terrorism: Confronting the ‘Dual Use’ Dilemma”, the US National Academy of Sciences (NAS) articulates the dilemma society now faces – biotechnology for health and other useful purposes on the one hand, and the potential to create biological weapons on the other. The report recognised that because the USA is only one of many countries pursuing advanced biotechnology research, America’s own national-security interests and scientific progress could be impeded without progress towards building international consensus and crafting guidelines for overseeing such research. The NAS will shortly be releasing a new report on advances in technology and next generation threat.

On the positive side, biotechnology can also be used to enhance physical safety. Many detection (diagnostic) methods depend on biotechnological techniques, which include isolation by culture, enzyme immunoassays, animal inoculation, detection of antibodies in the victims and detection of metabolic products or toxins in specimens such as blood or urine of the victims. Newer genetics-based techniques include the Polymerase Chain Reaction (PCR) to detect and identify the DNA or RNA of the organism itself. Very sensitive sensors are now being developed that will identify extremely small quantities of bioweapons very quickly, almost in real time, to try to cope with such threats to human security.

It has now become common to identify criminals through their DNA left at the scene of the crime, say in semen left on the victims of rape or cells found on a cigarette butt used by the criminal and subsequently matched with specimens either stored tissue banks or DNA data stored in databanks or specimens obtained from suspects. Some countries have started to use individual, stored DNA samples or even DNA information stored in databanks as security measures – to track and identify criminals and terrorists. While the police find these applications very useful and are pushing for their adoption opponents cite human rights concerns. Both impact human security. Genetic finger printing has been crucial in identifying the human remains of terrorists and other victims, including those killed by state terror, as in Argentina.

4 Approaches to action

Thus, how can one reconcile the dark side (bioterrorism) and the bright side (development in relation to disease, hunger, environment and poverty) of biotechnology? How can the potential of these technologies be realised in a search for an improved quality of life for more of the world’s people while ensuring they are not misused?
These are not entirely new questions. In 1953, President Eisenhower addressed the UN General Assembly on the subject of atomic warfare. In that remarkable Atoms for Peace speech, he addressed the global nature of the threat and proposed an avenue of peace – an international atomic energy agency under the aegis of the UN. Recognising that peaceful power from atomic energy could be a boon for the benefit of humankind, he said:

“...the United States pledges before you, and therefore before the world, its determination to help solve the fearful atomic dilemma – to devote its entire heart and mind to finding the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life.”

Some 50 years later that goal remains elusive. Nuclear power provides 16% of the world’s electricity. Nuclear technology has applications in medicine, agriculture, industry, environmental protection and public safety with concomitant economic impact. But, some 50 years later the legacy of nuclear technology is most evident in anxiety about non-proliferation and discussion at the UN continues. Clearly, there are mixed views about the balance of successes and failures in human security.

What we know is that through genuine dialogue, we must continue to seek clarity about the future and negotiate a way forward that optimises the benefits of emerging technologies while eliminating or minimising the risks. While our visions and preferences for the future may differ, whether we be technological optimists or pessimists, a meaningful conversation is essential.

Such a conversation has implications regarding the participants, the agenda and the mechanism. It would have to be a conversation that includes all relevant actors. The benefits to developing countries are readily apparent and the dangers of misuse are inherently transnational and demand an international response. Similarly, the private and public sectors each have a role to play. In particular, there is increasing appreciation of the potentially constructive role that the private sector can play in science and technology development. This is one of the major conclusions of the UN Commission on Private Sector and Development, Unleashing Entrepreneurship: Making Business Work for the Poor (UN, 2004a,b). A project of the Chemical and Biological Arms Control Institute and the International Institute for Strategic Studies is premised on the idea that the life sciences industry must become more involved in the safety and security agenda (Taylor and Moodie, 2004).

As for the agenda, the first priority should be to enable decisive and timely action in order that genome-related biotechnologies can be harnessed to benefit human security in developing countries. Kellman suggests that synthesising a global bargain of biosecurity would require: a policy commitment to the global spread of legitimate biological science as a social good; recognition that countering bioterrorism must be a facet of a broad international commitment; and, an obligation to promulgate biosecurity standards as a prerequisite of global biosecurity guardianship (Kellman, 2005).

A commitment has already been made through the UN Millennium Development Goals. Targets and indicators to measure them have been set. Progress has been slow. The examination of policy options to mobilise action on priority biotechnologies for improving global health underscored the desirability of moving towards a more open and collaborative system of science (Daar et al., 2002). We suggest that a five-point strategy could include research and access to knowledge, capacity strengthening for innovation and the development of appropriate legal and market regimes, consensus
building among indigenous and local communities, public engagement and investment (Daar et al., 2002).

Concurrently, the language of human security can facilitate an honest examination of potential for next generation threats – bioterrorism. The elements of a credible collective security system have been proposed (UN, 2004a,b). A global dialogue that would raise awareness, perhaps build consensus and trust and set the agenda for action is essential. This is a public policy issue that is not limited to an individual country or culture. It is a matter, which is not only about scientific fact, but also about society’s understanding, acceptance and management of risk. Dozens of international institutions have some relevant responsibilities, from the World Health Organization to the International Center for Genetic Engineering and Biotechnology, and, indeed, both have activities in this area. However, this interconnected world requires creative institutional arrangements that enhance collaboration and coordination leaving no one behind. There is an opportunity to put the politics of polarisation aside and be architects of a participatory process worthy of the importance of the issue.

Notwithstanding a number of worthwhile initiatives, a champion has not yet emerged to mobilise action with an appropriate sense of urgency. Two possibilities are promising.

Anne-Marie Slaughter notes that a key feature of world order in the 21st century is the network. Increasingly government networks, whether of police investigators, financial regulators or judges, are exchanging information and coordinating activities with the speed and flexibility necessary to function effectively in an information age (Slaughter, 2004). The idea of a network of leaders from both the developed and developing world – the L-20 – is the subject of a current project at the Centre for Global Studies at the University of Victoria (Carin and Smith, 2004). It is proposing that the intractable, complex and challenging global problems from trade inequities to climate change that we face could benefit from the intervention of leaders making common cause. Increasing human security through biotechnology could well be one of their first agenda items.

Another possibility would be to use more effectively the instruments of the UN. The Weapons of Mass Destruction Commission, launched by the Government of Sweden in late 2003, is developing proposals for the reduction of the dangers from weapons of mass destruction, including biological weapons. They are assessing threats, raising public awareness and stimulating thinking. They have assessed the bioterrorism threat, examined how to manage the biological weapons problem and the global governance of ‘contentious’ science. One specific focus is how to strengthen legally binding measures such as the Biological and Toxin Weapons Convention. The establishment of an organization for the Prohibition of Biological Weapons modelled after the IAEA could well provide the platform for a global bargain of making technology available for development while protecting its misuse. While some experts would prefer a model that emphasises risk assessment and risk management such as the Biosafety Protocol, experiences from other fields warrant further examination.

Which of these paths is chosen may well depend on the imagination and collective will of both the private and public sectors. There is an urgency to come together as a global community to harness significant technological developments, minimise their risks and build global trust in technology to advance human security. The Canadian Program on Genomics and Global Health at the Joint Centre for Bioethics, University of Toronto will take up the challenge of catalysing discussion about the way forward and will welcome all expressions of interest.
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