The New Age of Biodiplomacy

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One of the most significant public policy developments of the new millennium is the growing recognition of the role of technological innovation in international relations. Critical global objectives such as improvements in human welfare, participation in the global economy, and the transition towards sustainability are no longer possible without the significant use of science, technology, and innovation. In fact, advances in sci ence and technology are shaping the character and content of international relations. Agricultural biotechnology offers an example of how technological innovation and the associated institutional adjustments have the potential to lead to changes in the way nations relate to each other.

Advances in agricultural biotechnology and ensuing public debates will induce changes in relations among countries. These changes are likely to lead to new forms of technology-based international partnerships that will alter the traditional patterns of international cooperation between developing countries. They will also reshape the structure and function of international relations by bringing about greater awareness of the role of science and technology in the practice of diplomacy.

This paper first lays out the links between technological and international relations, using the Green Revolution as an example. The second section examines divergences in the use of emerging biotechnologies. The third part describes the implications of dis continuities in agricultural biotechnology for international cooperation. Finally, I will outline policy and practical directions for development based on new ini tiatives as well as expected trends in international relations.

Biotechnology in International Relations. In the early phases of the Cold War, industrialized countries sought to use their scientific and techni cal knowledge to solve the problems of developing countries, as well as extend their strategic influence. In part to stem the spread of communism, high-yield varieties of wheat and rice were developed and adopted in Mexico, India, and other developing countries.[1] The United States, in cooperation with other industrialized countries, set up and supported the Consultative Group on International Agricultural Research (CGIAR), which remains the most successful effort to mobilize the world's scientific knowledge for solving development problems.[2]

These public efforts helped to raise food productivity in Latin America and Asia, but they also stimulated local eco nomic activities.[3] In addition to meeting local food needs and raising farm incomes, the Green Revolution helped integrate these countries into the global agricultural trade system. The Green Revolution focused on raising agricultural productivity in key staples such as wheat and rice. It simultaneously created a foundation for food safety and demonstrated how countries could use scientific and technical knowledge to solve development challenges. The Green Revolution showed that it was possible to create long-term international technology partnerships aimed at solving local problems.

The capacity to modify living organ isms offers additional tools for raising agricultural productivity, adapting crops to new conditions, reducing the use of chemicals, and designing new produc tion systems that are consistent with ecological principles. These potential bene fits have generated considerable interest among developing countries.[4] Such tech nology makes it possible to address food challenges in regions such as Africa that did not benefit from the Green Revolution.

Although advances in breeding maize helped to extend the scope of food pro duction in many African countries, efforts in other fields showed dismal results. The Cold War concerns that inspired the Green Revolution in Latin America and Asia took on different forms in Africa. Raising food productiv ity was not a strategic way to respond to superpower competition in African countries. The Cold War coincided with the era of decolonization and the upheavals associated with this process of disengagement did not provide sufficient incentives for long-term investment in agricultural research.

Moreover, ecological factors limit the Green Revolution's effects on agricultural production in Africa. Africa's diverse food base and small urban markets did not lend themselves to large-scale crops of maize, wheat, and rice—crops that thrive in most parts of Latin America and Asia. Africa also lacked the institutional foundation for research in these crops. Much of the continent is arid or semi-arid and marked by a high degree of agro-ecological diversity that demands broader farmer participation in research programs.[5] The sheer diversity of crops used in the region and the absence of large markets undermines the feasibility of plant breeding programs. Agricultural research to meet the needs of isolated rural populations was beyond the reach of plant breeding institutions, which focused on a limited number of com mercial crops.

Today's technological capabilities in fields such as genomics make it possible to adapt crops to these diverse ecosystems in ways that are consistent with the principles of sustainable agriculture.[6] Herbicide resistance, disease, stress tolerance, and other traits can be applied to promote sustainable agriculture in regions that do not support agriculture today. It is this technological flexibility and the creation of niche markets that developing countries hope to use to improve their farming methods and reduce pressure on the environment.[7]

In addition, return on investment in pioneer, Green Revolution countries such as India are starting to decline, making it more profitable to invest in African countries such as Uganda.[8] A combination of changes in relative rates of return on investment and advances in agricultural technology make it possible for African countries to make significant advances in food production and related industrial activities.

Technological Divergence. The use of biotechnology has evolved with a focus on markets in industrialized countries and temperate regions. This is partly due to the accumulation of knowledge in areas with previous investments in technology and research institutions. Developing countries that need biotech nology most are often the ones that are least involved in its development.[9]

The use of transgenic crops has been expanding rapidly, but disproportionately in temperate regions. In 2002, transgenic crops covered over 67.7 million estimated hectares in eighteen countries. The bulk of this was in the United States with 63 percent, Argentina accounting for 21 percent, Canada 6 percent, China 4 percent, Brazil 4 percent, and South Africa 1 percent.[10] Most of these crops are on large farms where genetic modification has been used to introduce incremental changes in existing crops. These incremental crop adjustments explain why transgenic crop distribution is limited to geographical areas with similar ecological conditions.

Transgenic applications are currently limited to soybean, corn, canola, and cotton. Biotechnology's promise to meet the needs of low-income families in the developing world still remains a distant dream, although some new agricultural trials are underway in a number of developing countries.[11]

There are several key reasons why the promise is yet to be realized. First, crop development for low-income families has traditionally been carried out by the public sector. Advances in biotechnology have arisen from within the private sec tor, and the private sector lacks the incentives to invest in crops for low-income families.[12] Second, official devel opment assistance for agricultural

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As a result, little investment has gone into developing crops for low-income families.[13] It is unlikely that this situation will change without a redirection of existing research priorities in private enterprises through the provision of appropriate incentives; a significant increase in public sector funding for agricultural research; and the creation of new forms of partnerships.[14] In addition, institutional arrangements will need to be created to facilitate closer cooperation between private and public sector institutions.

Technological divergence is likely to be reinforced by three factors. First, the continuing uncertainty over market access for genetically modified products in Europe could reduce the pace of technological innovations in products intended for international markets. Considerable uncertainty over the impact of public opinion on investment decisions could influence investment firms to err on the side of caution.[15]

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Second, developing countries are likely to redirect their biotechnology efforts towards meeting local needs. Indeed, many of the products being created in developing countries are destined for local consumption, partly because of urgency to meet such needs and partly because of uncertainty in international markets.

Third, a number of biotechnology firms in the industrialized world are willing to share their technology on the condition that it is used to address local food needs rather than export crops, and that they are not held liable for damages arising from the use of their inventions. This is one of the challenges faced by new institutions such as the African Agricultural Research Foundation, which was created with the help of the Rockefeller Foundation to pool patents relevant to tropical agriculture.

Biotechnology Debates. Debates over divergence in technological priorities parallel international controversies over the role of genetically modified (GM) foods in the global economy. Much of this debate has focused on the environmental and health impacts of the products. Governments have used the United Nations as a forum for resolving their differences. In fact, initial attempts to resolve the growing concerns through the 1992 UN Convention on Biological Diversity (CBD) dealt largely with environmental aspects of living modified organisms (LMOs).[16]

International negotiations over biotechnology in the late 1990s focused largely on potential applications to meet the needs of developing countries. Governments negotiated and signed the CBD based on detailed consideration of the potential role of biotechnology in development. Indeed, developing countries argued that they could use biological resources to create new industries via this emerging technology. It was agreed that biotechnology "promises to make a significant contribution in enabling the development of, for example, better health care, enhanced food security through sustainable agricultural practices, improved supplies of potable water, more efficient industrial development processes for transforming raw materials, support for sustainable methods of afforestation and reforestation, and detoxification of hazardous wastes. Biotechnology also offers new opportu nities for global partnerships, especially between the countries rich in biological resources (which include genetic resources) but lacking expertise and investment."[17]

Subsequent negotiations led to the adoption of the Cartagena Protocol on Biosafety to the Convention on Biological Diversity on 20 January 2000. The pro tocol came into force in November 2001, making it the first major treaty to codify the "precautionary principle" in international law. The United States argued that the application of the precautionary principle would endanger international trade, while the European Union and its devel oping country partners stressed the need for countries to have the option to ban imports, even if there was no conclusive evidence that the products were harmful.[18]

Nevertheless, the protocol states: "In accordance with the precautionary approach…the objective of this Protocol is to contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustain able use of biological diversity, taking also into account risks to human health, and specifically focusing on trans-boundary movements."

Biotechnology has increasingly been defined in terms of its risks, and little consideration has been devoted thus far to finding mechanisms that offer a bal anced assessment of its potential in developing countries. Enterprises in developed countries have in turn been slow to engage in technological partner ships in developing countries because of concern over the lack of a policy envi ronment that supports the use of emerg ing technologies.

Trade in Transgenic Foods. Consumers in industrialized countries continue to express skepticism toward transgenic foods. They question the need to use new technologies to make incremental changes in their foods without offering tangible benefits, especially those that help to improve human well-being. Indeed, industrialized countries already face challenges associated with excessive production of food. Corresponding institutional reforms that combine agricultural, environmental, and consumer protection ministries illustrate a change in policy focus and public outlook.

The situation in many developing countries is different, especially in Africa. Low-income families in these countries face a wide range of challenges that include malnutrition, hunger, and related illnesses. Addressing these challenges requires the deployment of all available technological options. The poor often rely on a limited range of food sources, and as ecological degradation continues, the capacity to meet the needs of the poor diminishes. Therefore, promoting sustainable land use is crucial.

Responding to these challenges

requires investment in technologies that are appropriate to the needs of low-income communities in diverse ecological zones, often located in areas that major markets do not serve. Agricultural production in these areas will need to be equally diverse and reflect local needs and preferences. Genetic modification and emerging genomics techniques offer the possibility of designing farming systems that are decentralized, responsive to local needs, and that reflect sustainability requirements through greater productivity.

The regulatory divergence between the United States and the EU led to a decision by the European Commission in 1999 to impose a moratorium on the importation of GM foods that have not been approved in the EU. A series of bilateral consultative efforts to resolve the differences failed to yield any significant results. As a result, potential trade wars regarding GM products have emerged as a new source of trans-Atlantic friction.[19]

In response, the United States, Canada, and Argentina have decided to challenge the moratorium in the World Trade Organization (WTO), arguing that it constitutes a trade barrier. Until the matter is resolved, developing countries will be reluctant to accept policies that might put them in conflict with any of the warring parties. This is particularly important because their membership to the Cartagena Protocol requires that they implement its provisions at a time when there are faced with a dominant regulatory model applied in the United States.[20] The trade dilemma could also affect investment in biotechnology research. The outcome could be a delay in the adoption of biotechnology, even in situations where such products are for domestic use only.[21]

Food Aid. The introduction of GM foods to the global economy has coincided with intensified concerns over the impact of food aid on developing countries.[22] As a result, constituencies that were previously opposed to food aid *per se* now express their disenchantment through opposition to GM foods. In other words, the advent of GM foods provides a new basis for questioning the effects of food aid while focusing on ecological and health concerns. Civil society organizations have long questioned the impact of food aid on recipient countries and have even sought to promote ethical standards for food distribution.

Southern Africa dramatically exemplifies the diplomatic ramifications of GM food aid. A number of Southern African countries, notably Zimbabwe, Zambia, and Angola, have at some point rejected GM food aid, citing a variety of arguments related to trade, the environment, and human health. The more widely publicized case of Zambia illustrates the possible diplomatic ruptures that can arise from conflicts over biotechnology.

In 2001, the Zambian government publicly declined food aid, claiming that they could not guarantee its safety. They also feared that genetic contamination could undermine the export of their agricultural products to their traditional markets in the European Union. Zambia, like many other African countries, aspired to develop its agriculture sector and was already doing so with little assistance from the international agricultural aid community. While the Zambian government maintained a strong public position against GM foods, its senior officials privately pointed out that they were interested in being part of the biotechnology revolution. Indeed, the country has since adopted a biotechnolo gy development policy despite its popular image as a strong opponent of genetic engineering.

Biotechnology Cooperation. The current debates and evolution of biotechnology affect international cooperation in agricultural biotechnology in myriad ways. First, the shift from public to private sector funding has resulted in discontinuities in international cooperation, especially through the introduction of new institutional practices such as stricter intellectual property protection mea sures. International agricultural research institutes have been slow to adapt to this new culture and, as a result, they have not been able to make effective use of new technologies held by the private sector. The main response by these institutions has been to argue for an open access regime that would guarantee their freedom to operate.

These discontinuities are also associated with the shift of funding from con ventional plant breeding to modern genomic techniques. Budgetary changes that have forced scientists at the International Maize and Wheat Improvement Center (CIMMYT) in Mexico to curtail their breeding activities illustrate this point.[23] The reduction in CIMMYT's funding is part of a broader reduction in funding to the international agricultural research center, but it underscores the importance of technological discontinuities. Such shifts in research missions also affect partnerships between international and national plant breeding programs.

Even more fundamental is the past inability of leading international devel opment agencies, such as the World Bank, to establish clear agricultural policies. This is mainly because the gover nance of such institutions is dominated by members of the United States and the EU who do not share a common view on the role of biotechnology in internation al development. Such policy uncertainty affects non-governmental international development agencies working on food aid or agricultural issues.

Biodiplomacy's Future. The future of biotechnology and diplomacy could follow a number of possible scenarios. The first is that the current debates between the United States and the EU will continue for some time and, as a result of this uncertainty, many of the efforts underway in developing countries will dissipate. This is a plausible scenario, but its impact on countries will depend on their stages of development; more advanced countries are less likely to experience adverse effects and current players in the biotechnology field will seek new markets and adapt to emerging regulatory regimes.

The second possible scenario is the rapid resolution of differences between the opposing camps, with agreement on common elements in their regulatory practices. Such agreements could possibly follow the outcomes of the WTO dispute on GM products. This scenario is obviously contingent on the capacity of European enterprises to play an immedi ate role in global biotechnology mar kets,[24] This picture seems unlikely in the near future.

A third scenario could involve a strategic push by one or both of the trading parties toward broad partnerships promoting the use of biotechnology in agriculture as well as in other fields such human health, industrial production, and environmental management. Such a scenario could unfold as major, developing country biotechnology players such as China, India, and Brazil start to expand their partnerships with other developing countries.

Regardless of future diplomatic decisions, the innovations of allied countries will depend on the degree to which they define and manage access to biotechnology as a strategic input to the development process and the extent to which they seek to build technology alliances.

Science and Technology Policy. Poor alignment between development goals and government structures hampers technological innovation in developing countries. Alleviating this will require a strategic vision for the country or regional integration organization that focuses on the role of technological innovation in economic transformation. For most countries, the most obvious starting point for formulating a strategic vision is to focus on reducing dependence on raw materials and shifting attention to greater application of knowledge in the economic process.

Such a strategic vision will demand an increase in the application of technical knowledge in decision making. Moreover, the rapid rate at which knowledge is changing will require leadership that is informed on the best available scientific and technical knowledge.

Technological innovation is a long process that often does not show immediate results, so technology policies must be part of a long-term development vision. In many cases, this vision necessitates political consensus. Where there is no political consensus, science and technology policy strategies may not last long enough to show viable results. The long-term perspective also requires continuous adjustments of the policies and institutions in light of global changes and new opportunities.

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Long-term policies are likely to succeed when they focus on specific issues or categories of products that confer a certain degree of competitive advantage to a country or region. Investment in technical education, for example, offers the flexibility that a country needs to adapt to emerging global conditions.[25]

The role of science and technology advice in offices of presidents and prime ministers becomes particularly important in these regards. Science and technology advice must help guide international relations, and policymakers will need to equip themselves with the capacity to use scientific and technical knowledge in decision making.

Overall, nations should base the design of policies and institutions upon identified technological goals and not upon generic terms. A focus on agricultural biotechnology and biomedical research, for example, would offer the necessary focus for rethinking existing policies and institutions. In addition, these entities should consider such policies and institutions in the context of the configuration of resources needed to deliver products.

In the case of agricultural biotechnology and biomedical research, such policies and institutions will need to consider the importance of strategic alliances and global partnerships

New Technology Alliances. One of the most widely accepted approaches to technology cooperation is to promote South-South cooperation, promoting technological development among developing coun tries. Several countries have made such efforts, especially through the United Nations, and there are considerable opportunities for promoting regional technology cooperation among developing countries. Additional opportunities now exist in countries such as China, Brazil, Mexico, India, and Malaysia that could play important roles as technology mentors for their less developed coun terparts. However, these countries should base such alliances upon techno logical needs and capabilities rather than upon ideological grounds similar to those characterized by the Cold War era.

Indeed, science ministers from India, Brazil, and South Africa have been working together to identify areas for trilateral cooperation that include nanotechnology and efforts to prevent and treat HIV/AIDS. Their first meeting was held in October 2004 as part of the India-Brazil-South Africa (IBSA) trilateral commission. The meeting followed a 2003 event of the three nations' foreign ministers in Brasilia, Brazil that identified science and technology as one of the key areas for trilateral cooperation.

The emergence of such alliances could become the basis for forging new biotechnology partnerships among developing countries. It is conceivable, for example, that India, Brazil, and China will use their growing technologi cal strength as a foundation for forging partnerships with other developing countries. Such a move would not only take advantage of the traditional affinity among developing countries, but could create new mechanisms for promoting technological cooperation.

Divergences in the use of biotechnol ogy are influencing international relations. While biotechnology is only one of many innovations at the center of diplomatic controversies, its pervasive and transformative nature makes it a special case. In this regard, we are likely to see the emergence of new interna tional partnerships designed to specifi cally use advances in the life sciences in general, and agricultural biotechnology in particular, to improve human wel fare. These changes will be part of a growing movement to reinvent foreign policies and diplomatic practices that reflect the growing importance of science and technology in human welfare and international relations.

Author's note: This article is based on a chapter from the author's forthcoming book, *Taming the Gene: Biotechnology in the Global Economy.*

NOTES

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