MEA Distinguished Lecture Series on India's Foreign Policy
"Role of Technology in India's foreign relations"
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Introduction:

Technology is as old as human civilization. Man has constantly tried to enlarge knowledge, and apply it in diverse ways to meet his needs. This practical application of basic knowledge is what we call technology. Throughout history, the search for knowledge and its application through technology have been important determining factors in the progress of human society. In the competition for dominance and control, societies which forged ahead in mastery of basic knowledge and technology were able to succeed, sometimes far beyond expectations.

This paradigm changing, force multiplying effect of technology has been responsible for major historical changes and relations among societies in the past. Examples are numerous. The discovery of agriculture allowed for the feeding of larger populations, and development of complex societies. The Mongols used a composite bow which was compact and more powerful, and could be used on horseback. Babur used cannons from Turkey to win the battle of Panipat in 1526. The impact of technology on warfare and military balance was particularly striking, allowing relatively smaller forces to prevail because of superior technology. This phenomenon continues even in modern times, when the first atomic bombs caused the immediate surrender of Japan.

Competition among European nations encouraged them to innovate and avoid technological stagnation, which led to the dominance of European powers over the last 500 years. However, dogmatic ideologies which severely limited questioning and enquiry retarded technological progress. This was the case with the inquisition of the Catholic Church in Europe, during the 12 th - 16 th centuries. For example, Giordano Bruno, a leading astronomer, was burned at the stake in 1600 after the Roman Inquisition found him guilty of heresy.

International relations comprise the variety of relationships among states within the international system and complex of global issues, including the interactions between entities governmental and nongovernmental, national or multinational. Power is a key factor in the calculus of international relations. It can be described in terms of control over key resources, capabilities, and influence in international affairs. It is often divided up into the concepts of hard power and soft power, hard power relating primarily to coercive power, such as the use of force, and soft power commonly covering the persuasive domain, such as economics, diplomacy and influencing people. Technology plays a critical role in determining power, both hard and soft.

It is therefore clear that the extent of mastery over basic knowledge and technology are key determinants of a society's military and economic strength, and therefore its ability to participate effectively in the international system. However, such leadership cannot remain indefinitely, since knowledge and technology can be acquired by other competitors, albeit with some time delays. Efforts to control or limit the spread of technology are bound to be temporary at best. Similarly, merely acquiring of technology without the capability to derive it from basic knowledge offers only limited advantages, and may negatively impact genuine

indigenous capability. Therefore remaining ahead in knowledge and technology requires a continuous and sustained effort.

The quest for knowledge and technology requires not merely material resources. Numerous examples highlight the key role played by human resources, especially of innovative thinkers and researchers. There is a distinction between mastering the "content" or "hardware" of knowledge, and being able to "innovate and apply" or the "software" of knowledge. This phenomenon is found in all disciplines. One can distinguish between a technically perfect musician and a musical genius, a technically well trained athlete and a star performer; and a scientist or engineer who knows the content and one who can also innovate and move beyond limits. Both are important – mastery over content as well as ability to innovate.

The pursuit of technology requires innovation and improvisation, the ability to question conventional assumptions and beliefs, and move ahead into uncharted areas. For example in the early 20 th century, the fundamental conventional assumptions of classical physics were challenged and overthrown, and a whole generation of physicists developed quantum mechanics and relativity. This spirit of challenge and enquiry continued in physics, leading to many major advances. A.P.J.Abdul Kalam has called this process the "igniting of minds", by which one can soar beyond the framework of conventional knowledge and explore new horizons.

India in the early years - Nehru's contribution

Even before independence, India had several internationally renowned scientists. These included the mathematical genius Srinivas Ramanajuam, Satyen Bose associated with Bose-Einstein statistics, C.V.Raman for inelastic scattering of light from molecules, and others. In addition, there were outstanding scientists in the Indian diaspora in the US such as S. Chandrasekhar, the astrophysicist.

After independence, Prime Minister Jawaharlal Nehru gave high priority to India achieving excellence in science and technology. He drafted an eminent scientist Dr. Homi J Bhabha to put in place a long term strategic plan for nuclear science and technology. With remarkable foresight, he also promoted major reforms in higher education, science and technology. His tenure witnessed the setting up of the first IIT in Kharagpur in 1951, the Indian Space Research programme in the 1960s, and the strengthening of national research and development capability under the CSIR and various Technical Institutions.

This thrust in science and technology continued during Indira Gandhi's premiership, including the Pokhran I series of nuclear explosions in 1974. India became host to one of the two centres of the International Centres for Genetic Engineering and Biotechnology (ICGEB). Prime Minster Rajiv Gandhi also gave strong political support to science and technology, including information technology and telecommunications.

The driving force behind India's science and technology came from government initiatives such as those in atomic energy, space, and biotechnology. However, in later years, the private sector was the driver in areas such as information technology. In the area of scientific and technical manpower, the IITs proved to be a successful model, recognized in the west. However, there is room for further improvement of overall quality of India's scientific institutions including those engaged in scientific and technical education. The recent higher education reform proposals may help in this direction.

India's foreign relations

The principles of India's foreign relations were to a large extent formulated by Nehru. These included non-alignment with either of the two blocs in the Cold War, peaceful coexistence and constructive collaboration with all countries irrespective of their internal governance systems, and securing largest possible space for India's indigenous economic, scientific and technological development considered vital for removal of poverty. The Cold War has faded away, and in its wake there are multiple poles of power – the US, China, EU and Russia. But the global situation is marked by instability, growing competition and lack of collaboration, requiring continuous and sophisticated adaptation of our foreign policy.

Technology and international relations

In the post World war II era, the advent of nuclear weapons, together with the rivalry between two power blocs posed a challenge to the international system. While the basic science behind nuclear weapons was fairly simple, in practice the construction of nuclear weapons required formidable technical efforts in enrichment of Uranium, and weapons design expertise. The nuclear weapons arms race resulted in numerous tests, and the rise of USSR, UK, France, and China as nuclear weapons states.

For these reasons, the area of arms control was the first where technology impacted international relations in a big way. The various arms control negotiations such as the NPT, the Nuclear Test Ban treaties, Chemical and Biological weapons, etc, involved technology related issues, especially in the verification and compliance aspects. Negotiators had to have a good grasp of technology to be effective, and close cooperation between the diplomats and the technologists became necessary.

In the 1970s international debate focused on the North-South divide, with the developing countries under the umbrella of the G-77 demanding fundamental changes in the international order. The status quo was represented by the Group B or industrialized market economy countries, while the socialist bloc supported the G-77 on most issues more with a political motive than with conviction. One key area of discussion was the question of access to technology on fair and equitable terms. Efforts were made under UNCTAD to draft a legally binding code on transfer of technology but these were blocked by the group B countries. Even a non binding code of conduct could not be agreed upon. Multinational corporations which had the technology would only grant access to it on their terms, which often included restrictive business practices that went against the competition laws of their own countries.

In this context, India's diplomatic efforts had to take into account the growing role of technology related issues in international relations. Some of the important areas where technology has impacted India's external relations are discussed below.

Nuclear technology and India's foreign relations

The area of nuclear technology is probably the most significant challenge in India's foreign relations. After the end of World War II, shocked by the horrors of Hiroshima and Nagasaki, there was a strong demand for the complete abolition of nuclear weapons, articulated forcefully but pragmatically by Nehru. However, the nuclear weapons states US, USSR, Britain and France obviously preferred a regime in which such weapons could remain in their

hands. While Britain benefited from the US in terms of access to nuclear weapons technology, China derived similar support from the USSR. The Cold War rivalry which reached its most dangerous manifestation in the Cuban Missile crisis of October 1962, and China's nuclear tests in 1964 set the stage for moving ahead with the Nuclear Non-Proliferation Treaty (NPT). This unequal and unbalanced treaty legitimized the possession of nuclear weapons in the hands of five states, while placing numerous restrictions and controls on access to and application of nuclear technology by other states, coupled with only lip service to reduction in nuclear arsenals. India rightly rejected this unequal treaty, along with several other countries. This implied that India would face difficulties and restrictions in the area of nuclear technology.

India's nuclear explosion in 1974, declared as being for peaceful purposes, led to severe restrictions on India's access to nuclear technology, materials and equipment. The Nuclear Suppliers Group was set up to enforce a technology denial regime. This led to a massive indigenous effort under BARC and DAE to develop India's strategic and civil nuclear programmes. India's foreign policy in this sphere had to counter the efforts in the international community to isolate and strangle India's nuclear programme. The main thrust of our policy was – to continue to develop our nuclear programme, reject the NPT as an unequal and unbalanced treaty, to call for the total abolition of nuclear weapons, and support confidence building measures such as ban on first use of nuclear weapons, measures to reduce false alerts and alarms, etc.

In May 1998, India conducted a series of five nuclear weapons tests, including one thermonuclear device. Earlier moves to conduct tests had been thwarted by the US administration. This time the tests came as a surprise even to the US. These tests were followed by a series of tests conducted by Pakistan in the Chagai Hills. International reaction was severe, and prospects of a nuclear war between India and Pakistan were widely discussed. The nuclear embargo on India was tightened, including economic pressures aimed at curbing India's purely indigenous nuclear programme. In contrast Pakistan which had developed its nuclear weapons through the clandestine A.Q.Khan's nuclear smuggling enterprise, plus weapon designs and political support from China, was relatively unfettered.

India's response to international pressure has been carefully calibrated. We continue to support the total abolition of nuclear weapons, a goal which the US had initially described as "unrealistic", but which now finds some support under President Obama. India has declared a unilateral moratorium on nuclear testing but continues to stay out of the CTBT which it regards as a part of the unequal NPT regime. India supports a no first use policy on nuclear weapons, despite the existence of troubled relations with two of its neaighbours -China and Pakistan. If it were possible, India would be ready to sign the NPT but as a nuclear weapons state. Nevertheless, India has declared it will respect the "principles" contained in the NPT, while not signing it.

Persistent efforts by India yielded positive results with the July 2005 Manmohan Singh-Bush joint statement on separation of India's civil and strategic nuclear programmes, the former to be placed under international safeguards, and in exchange benefit from full civil nuclear cooperation,. Over the next three years intensive negotiations and discussions with internal constituents in both countries led to amendment of U.S. domestic law, a civil-military nuclear Separation Plan in India, an India-IAEA safeguards (inspections) agreement and the grant of an exemption for India by the Nuclear Suppliers Group. Once the IAEA India specific

safeguards agreement enters into force, some 35 Indian nuclear installations will come under safeguards, in a phased manner.

The joint effort by India and the US to get a waiver from the nuclear Suppliers group, in the face of opposition from several countries, must be seen as a landmark in Indo-US diplomatic cooperation. The 45-nation NSG granted the waiver to India on September 6, 2008 allowing it to access civilian nuclear technology and fuel from other countries. The implementation of this waiver makes India the only known country with nuclear weapons which is not a party to the Non Proliferation Treaty (NPT) but is still allowed to carry out nuclear commerce with the rest of the world. India's responsible stewardship of nuclear technology and its declaration on nuclear testing helped this process.

Pakistan, with Chinese support, has lobbied strenuously for the same status from the NSG, but with little success, perhaps due to its involvement in nuclear smuggling. A China-Pakistan nuclear deal, on the lines of the Indo-US is unlikely to gain acceptance from the NSG. The recent notice to the IAEA by China of supply of two new civilian nuclear reactors to Pakistan on the basis that this deal is part of an earlier agreement that antedates China's entry into the NSG is certain to cause disputes and weaken the NSG.

Israel, the other undeclared nuclear weapons state with a formidable arsenal, has its own strategic imperatives. The case of North Korea and Iran is quite different, as both these have signed the NPT. North Korea has withdrawn from the NPT and tested a nuclear device. Iran continues to pursue Uranium enrichment and a heavy water reactor, ostensibly for peaceful purposes, but these also give it a nuclear weapons option. Meanwhile the NPT review conference of 2010 did not break any new ground and failed to meet Arab concerns over the problem of Israeli nuclear weapons.

India will continue to face challenges in the field of nuclear policy. It is under pressure to sign and ratify the Comprehensive Test Ban Treaty (CTBT). Moves to negotiate a Fissile Material Cutoff Treaty (FMCT) gained momentum after the Obama administration recently changed the US stance on verification, but Pakistan has blocked progress. The FMCT would seek to prohibit the further production of fissile material for nuclear weapons or other explosive devices. This treaty would be difficult to accept unless the goal of a credible nuclear deterrent is achieved. In the future the FMCT negotiations could pose a challenge for India.

In the area of civil nuclear cooperation, India is now able to import Uranium fuel for its civilian reactors, which have been run at low output due to fuel shortages. Some countries such as Australia, still insist that India should join the NPT before they can do business with India in this sector. The Nuclear Liability Bill recently approved by Parliament is a step forward in facilitating civil nuclear commerce, especially with the USA, although some changes are being called for in the legislation. But nuclear power sector in India remains restricted to the government sector, and the question is whether this model will be able to manage the financial and technical resources for implementing India's ambitious nuclear power programme.

Space and Missile programme

India's space programme started under the Department of Atomic Energy in 1950, with strong support from Nehru. It gained momentum under the Indian National Committee for

Space Research (INCOSPAR) founded in 1962 with Vikram Sarabhai as its chairman. The Indian Space Research Organization in its modern form was created by Vikram Sarabhai in 1969. The development of launch vehicles which has both civil and military applications involved critical and closely guarded technology subject to restrictions. The USSR was a strong partner in India's programme. ISRO went in for a long-term strategic plan of indigenous launch vehicle capability. Over the years, this approach resulted in successful development of increasingly powerful launch vehicles, such as SLV, ASLV, PSLV and finally the GSLV.

The GSLV-I has a Russian-made cryogenic third stage, which is to be replaced with an identical Indian-built one for the GSLV-II. The solid first and liquid second stages are carried over from the PSLV. In July 1993, under US pressure, Russia went back on its agreement to transfer cryogenic technology to India on the grounds that it would violate Missile Technology Control Regime (MTCR). In lieu of cryogenic technology, Russia agreed to sell two additional cryogenic stages to India. Following Russia's refusal, India had to develop cryogenic technology it on its own, which is a formidable feat. The first launch of the rocket with the Indian made cryogenic engine in April 2010 was a failure. The next launch is likely to take place within a year.

To restrict the spread of missile technology, the Missile Technology Control Regime (MTCR) was established in April 1987 by Canada, France, Germany, Italy, Japan, Great Britain, and the United States and now includes 34 countries The MTCR was created in order to curb the spread of unmanned delivery systems for nuclear weapons, specifically delivery systems that could carry a minimum payload of 500 kg to a distance of over 300 km. In October 1994, in order to make the enforcement of MTCR Guidelines more uniform, the member states established a "no undercut" policy, meaning if one member denies the sale of some technology to another country, then all members must adhere.

Faced with a technology denial regime, India had to develop its indigenous missile capability. This programme over 1980-2007 has successfully developed short and intermediate range missiles for various defence applications. Notable is the intermediate range ballistic missile Agni III (range 3500 km) to be followed by Agni V with a longer range. India and Russia have collaborated in developing the world's only supersonic cruise missile the Brahmos, with a range of 290 km (below the MTCR threshold) and speed of Mach 2.8. A hypersonic Mach 8 version Brahmos II is under development.

Thus in the defence field, India has to contend with a number of technology denial and restrictive regimes, while meeting its requirements of defence equipment.

The Wassenaar Arrangement

The Wassenaar Arrangement is a multilateral technology export control regime (MECR) with 40 participating states. The list of restricted technologies includes a "Munitions List", a Sensitive List and a Very Sensitive List. The Very Sensitive List includes materials for stealth technology, equipment that can be used for submarine detection, advanced radar, and jet engine technologies. India is not a party to this arrangement, which is a successor to the COCOM, as group set up during the Cold War to prevent leakage of technology from the West to the East bloc.

US technology control regime

The US, a leading country in terms of technology development, has put in place a system of controls to prevent sensitive technology from leaking into the hands of hostile entities. The Bureau of Industry and Security (BIS) of the Department of Commerce deals with issues involving national security and high technology. It regulates the export of sensitive goods and dual-use technologies; enforces export control, anti-boycott, and public safety laws; cooperates with and assists other countries on export control and strategic trade issues; assists U.S. industry to comply with international arms control agreements. Many sensitive goods and technologies (for example, encryption software) require a permit from the Department of Commerce before they can be exported. Recently, India and the US signed an end user verification agreement enabling the US to monitor high end defence and sensitive technology supplied to India.

International Scientific Collaboration

Research in frontier basic sciences is becoming increasingly costly and beyond the reach of individual nations, even the US. One such example is the Large Hadron Collider Project (LHC) under CERN, Geneva. India has participated in this $ 9 billion project both in supplying components for the LHC as well as software services and is also a partner in some of the scientific experiments. The value of Indian supplied components and services to the LHC is calculated at European rates, and the amount this represents is available for funding Indian scientific workers. This is a particularly effective way for countries such as India to participate in frontier research in basic sciences. Another such project is the International Thermonuclear Reactor (ITER) at a cost of some $6-18 billion, scheduled for completion in 2018. Other examples can be cited – the Human Genome Project; the International Space Station, etc. Such international scientific collaboration opportunities are likely to increase in the future, and need to be exploited effectively.

Intellectual Property Rights

India faced a difficult challenge during the TRIPS negotiations in the WTO (then GATT) during the Uruguay round (1986-1994). Intense lobbying by the US, EU , Japan and other developed countries including the threat of Section 301 of the US Trade Act forced India to yield ground especially on the issue of product patents , which India had not recognized. This had enabled Indian pharma companies to reverse engineer drugs and discover alternative production processes and produce drugs at lower costs. Indian patent law had provided for process patents and not product patents, and had also several provisions regarding working of patents and compulsory licensing in the public interest. The US pharma lobby was opposed to these provisions in Indian legislation. They mounted a campaign against India, Brazil and other major developing countries. Indian industry also softened its position, perhaps due to the emergence of R & D capability. Public and consumer awareness of these issues was not deep.

The situation involved a compromise on India's interests in the fields of trade, copyrights, and patents, with the country being a creator as well as a consumer of intellectual property. India joined the TRIPS agreement and amended its laws by the deadline of 2005. Many critics contended that this would lead to higher prices for drugs in India. The 1994 TRIPS agreement has been widely criticized as being unbalanced in favour of patent protection as against the public interest.

The Indian negotiations were handled by the Ministry of Commerce as the nodal Ministry handling the GATT, with participation by the Ministry of External Affairs, and the Ministry of Industry. Due to the complex nature of negotiations within the WTO, and growing awareness of the issues, in later years, the consultation and coordination with in Government as well as with other stakeholders and developing countries has become much stronger and broad based. For example, during the present ongoing Doha round launched in 2001, India's key interests, including those involving TRIPS, were much more forcefully articulated both on its own, as well as through platforms such as the G-20 group of major developing countries. As a result the Doha round negotiations have proved to be much more difficult and long-drawn out.

Chemical weapons convention

The Chemical Weapons Convention (CWC, 1993) is an arms control agreement which outlaws the production, stockpiling and use of chemical weapons. While the main purpose is the prohibition of use and production of chemical weapons, as well as the destruction of all chemical weapons, the convention also has provisions for systematic evaluation of chemical and military plants, as well as for investigations of allegations of use and production of chemical weapons based on intelligence of other state parties. The convention distinguishes three classes of controlled substance, chemicals which can either be used as weapons themselves, or used in the manufacture of weapons.

The control regimes depend on the nature of the chemicals and their use in industry. The complex nature of the chemical industry as well as the toxic nature of many chemicals makes the implementation of the convention difficult. Chemicals that are used in industry, but which can also be used as weapons either directly or indirectly as precursors (dual use), must be registered, monitored, and subject to export clearances. India which has a large chemical industry has had to make a special effort to implement the provisions of this convention. Nevertheless, this Convention is widely accepted with 188 of 195 UN members states having signed it.

Services Trade

The rapid develoment of information technology especially since 1990s has generated a number of technology related issues which have become important in international negotiations. Trade in services has become an important issue.

The services trade has been the subject of intense international negotiations. A General Agreement on trade in Services (GATS) was negotiated during the Uruguay Round and finalized in 1995. The development of information technologies and the internet have expanded the range of internationally tradable service products to include a range of commercial activities such as medicine, distance learning, engineering, architecture, advertising and freight forwarding. While the overall goal of the GATS is to remove barriers to trade, members are free to choose which sectors are to be progressively liberalized, under which mode of supply a particular sector would be covered under, and to what extent to which liberalization will occur over a given period of time.

The GATS agreement covers four modes of supply for the delivery of services in cross-border trade. Mode 1 is Cross-border supply where services are generated within a supplier country and delivered to consumers in another country, for example telephone calls; business

process outsourcing across firms, etc. Mode 2 is where services from the supplier country are consumed by consumers moving in from abroad, for example tourism. In both these modes the service supplier does not move out of his country. In Mode 3 - Commercial presence and Mode 4 - Presence of a natural person, the service supplier is present within the territory of the recipient country. In both these cases, it is the service supplier that moves abroad.

For India, Mode 4 service delivery is important, since it is via this mode that India's skilled workers are able to travel to and provide services abroad. However, many developed countries have sought to regulate this mode and restrict the numbers of foreign personnel entering their country. The US H-1 visa scheme is an example. Similarly, in the European Union, there are efforts to develop a temporary work visa regime for professionals providing services thought there are considerable differences within the EU on this issue. As against this, there are concerns over unemployment in the developed world, where, foreign workers are seen as taking away jobs from nationals.

India clearly has a major stake in pressing for a liberal regime for service delivery, especially in Modes 1 and 4. This will require persistent efforts both in multilateral trade negotiations such as the Doha Round, as well as under various bilateral free trade arrangements with various countries. At the same time, India would also have to allow foreign skilled workers to work on specific projects.

Given the shortage of skilled workers in the developed countries, and the lower cost of engaging such personnel from the developing world, the issues related to various modes of service delivery are likely to remain an active issue in the future. Related issues would arise regarding security clearances of personnel for certain activities, taxation, social security coverage and transfer of amounts withheld, etc.

Information technology and security issues

Information technology has witnessed rapid development especially in India, where a large pool of low cost skilled workers is available. This has given India a comparative advantage in IT and related services. Many foreign companies have tapped this resource to become more competitive. Many governments have ambitious plans for IT enabling various services. Low cost bandwidth has enabled business processes to be outsourced across borders and India has benefited from this trend. The services range from call-centres at the lower end to sophisticated engineering and technical work.

While this revolution is a win-win situation for the foreign entity as well as the Indian partner, there has been some concern over information security issues, especially where financial services are involved. The growth of cyber crime and prospects of cyber terrorism have led to increased attention to cyber security. The legal framework as well as technical measures to thwart this form of crime have developed considerably.

However, an international convention against cyber crime and cyber terrorism has not yet been put in place. The Council of Europe has worked on such measures to pool resources amongst nations to combat this menace, but a truly global effort is still lacking. As national and international networks dealing with various services grow and become more vulnerable to attack by criminals, this issue will gain more prominence and urgency.

Biotechnology - the ICGEB example

The field of biology has witnessed rapid advances following fundamental advances in our understanding of the structure of DNA and its functioning. This revolution has had its inevitable consequences in the international field.

Developing countries were apprehensive that they might be left behind in the biotechnology revolution. To bridge this gap, under UNIDO in 1981, they promoted a project for the setting up of an International Centre for Genetic engineering and biotechnology (ICGEB). The ICGEB came into existence under UNIDO in 1987 after a conference in Madrid adopted its statutes, which entered into force in 1994 making the ICGEB an independent entity. It now has 61 member countries and has centres in Trieste, Italy, New Delhi, India, and Cape Town, South Africa.

The birth of the ICGEB was a difficult one. At one stage Spain, Cuba, and India were in competition for hosting the centre. Leading developed countries, especially the US were not supportive of the effort and did not join. Given the lack of participation by wealthy countries, funding for the ICGEB and its viability became a major problem. However, Italy and India made generous contributions including hosting facilities, and this gave the ICGEB its lease of life. India and Italy as host countries have made diplomatic efforts to convince more countries to participate. However, countries such as the US, UK, France, Japan, Korea, are still not members. Despite these problems, the ICGEB has managed to secure itself a respected place among the biotechnology R & D Centres in the world, providing research fellowships and collaboration opportunities for many institutions in member countries.

Biological Weapons Convention

The Biological Weapons Convention, 1972 presently commits the 162 states that are party to it to prohibit the development, production, and stockpiling of biological and toxin weapons. However, the absence of any formal verification regime to monitor compliance has limited the effectiveness of the Convention. It includes all microbial and other biological agents or toxins and their means of delivery (with exceptions for medical and defensive purposes in small quantities). The rapid advances in biotechnology have opened up prospects of non-state actors obtaining access to organisms deliberately modified to cause harm. These are challenges to be faced.

Convention on Biological Diversity

Increasing public awareness of the damage caused to the environment by human activity and especially loss of biodiversity and the threat of extinction of species led to the adoption of the Convention on Biological Diversity (CBD) in 1992.

The convention recognized that the conservation of biological diversity is "a common concern of humankind" and is an integral part of the development process. The agreement covers all ecosystems, species, and genetic resources. It links traditional conservation efforts to the economic goal of using biological resources sustainably. It sets principles for the fair and equitable sharing of the benefits arising from the use of genetic resources, notably those destined for commercial use. Importantly, the Convention is legally binding; countries that join it ('Parties') are obliged to implement its provisions. The convention highlights the precautionary principle that where there is a threat of significant reduction or loss of biological diversity, one should not wait for full scientific certainty in order to take measures

to avoid or minimize such a threat. 193 countries are parties; the US has signed but not ratified the Convention.

Biosafety and Genetic Engineering

Advances in biology have made it possible to modify DNA in organisms to alter their characteristics in a more focused way than earlier, when random mutations were used, for example, in plant breeding. Genetic engineering technology can now transfer genetic material across species, and even between the animal and plant forms. A synthetic gene has recently been inserted into a life form by Craig Venter's group. These developments have provoked concern and opposition in various countries.

Reacting to these issues, the international community has adopted the Cartagena Protocol on Biosafety as an addition to the CBD. The objective of the 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 sustainable use of biological diversity, taking also into account risks to human health, and specifically focusing on transboundary movements.

Genetically Modified Foods

In recent years, the issue of genetically modified food has become intensely discussed including in India. The international community is deeply divided over the issue, with some like the US, Australia, Brazil in favour of GM crops, while the EU and Japan are opposed to it. India has followed a middle path, allowing non-food GM crops such as cotton. However, recently the government has cleared the release of GM Brinjal, which has generated much controversy. A number of other GM food crops are under field trials, and the government may have to take decision in the near future on releasing these. Meanwhile, the long pending proposal for a single window National Biotechnology Regulatory Authority (NBRA) has been activated. The regime finally adopted in India for GM crops will have an impact on our agricultural and food exports especially to markets like the EU.

Ozone Layer and the Montreal protocol

Growing international concern over depletion of the earth's ozone layer, which shields us from harmful ultraviolet solar radiation, led to the adoption of the Montreal Protocol. The depletion of the ozone layer had been noticed since the 1970s, due to the release of halogens from various chemicals particularly chlorofluorocarbons (CFCs) used in the refrigeration industry. The Montreal Protocol, 1987 seeks to phase out the use of ozone depleting substances. It has been ratified by 196 countries and is an outstanding example of international collaboration including the chemical industry. A special fund was set up to help developing countries to phase out use of ODSs. Recent studies indicate that the ozone layer may have started to recover.

Global warming – the threat to mankind

The global warming threat and international responses pose a particularly difficult challenge for India's foreign relations. Over the years, increasing scientific data has accumulated attesting that the earth's average temperature has been rising steadily. In the 20 th century the rise was 0.74 deg C. This rise is primarily due to increasing emissions of greenhouse gases

such as carbon dioxide, methane, and nitrous oxide emanating from human activities. Carbon Dioxide levels in particular have risen dramatically from 284 parts per million by volume (ppmv) in 1832 to 390 ppmv in 2010, and is rising at a rate of 1.9 ppmv per year. The rise in CO2 levels has been linked closely with use of carbon based fuels especially after the industrial revolution. Methane and Nitrous oxide emissions arise mostly from agricultural activity.

The increased CO2 levels result in greater absorption of solar energy by the earth, resulting in global warming. Various models have been developed to attempt to predict the exact rise in temperature, and these show considerable variations. The International Panel on Climate Change (IPCC) a global scientific group has nevertheless estimated that if the present trends continue, the global average temperature would rise by an additional 1.1 to 6.4 deg C by 2100. This would lead to significant, large scale and irreversible changes in the earth's climate, including increase in extreme climate events such as storms, floods, droughts, and rise in sea levels that could submerge coastal and island areas.

The prospect of such changes has generated increasing international concern and led to demands for effective action to combat these effects. In response, the international community adopted a Framework Convention on Climate Change (UNFCC, 1992), and subsequently the Kyoto Protocol, 1997 in which 39 industrial countries and the EU committed to reduce their collective greenhouse gas emissions by 5.2% over 1990 levels. The Protocol contains several mechanisms to help developing countries reduce greenhouse gas emissions, including financial mechanisms. The first commitment period under the Protocol will expire in 2012, and therefore intensive negotiations are going on to evolve a future arrangement.

The fundamental issue in these negotiations is the need to provide for developing countries to continue their economic development which inevitably would lead to higher emissions, although the per capita emissions of developing countries are far below those of industrial countries. Developed countries are seeking ways to avoid their people making sacrifices for fighting global warming which entails political costs, while putting the burden of these on developing countries. This in essence is the root of the conflict, behind the various charts and technical reports. A smaller constituency rejects the claims of global warming altogether, stating that the scientific basis is still doubtful. However it is generally accepted that mankind must follow a path based on the precautionary principle.

Protracted negotiations including the Copenhagen Climate change summit in December 2009 failed to reach agreement. The summit came out with a non-binding Copenhagen Accord among some key players - the United States and in a united position as the BASIC countries (China, India, South Africa, and Brazil). It is not legally binding and does not commit countries to agree to a binding successor to the Kyoto Protocol. But it represented a minimal gain. So far countries representing over 80% of global emissions have engaged with the Copenhagen Accord and many have submitted emissions reduction targets by 2020, including India (20-25%). A further effort will be made at the next climate change Conference in Cancun, Mexico in December 2010. The global economic recession in 2009 has meanwhile made it more difficult to reach agreement on climate change issues.

Climate change represents a very difficult challenge for India's foreign policy. The complex scientific nature of the issues involved makes it particularly difficult to generate public awareness and informed discussions. Yet the implications for India's economic development

especially in meeting its energy needs are enormous. Seen against the targeted economic growth rate of 10%, the target of emission reduction of 20-25% by 2020 will call for a great effort in energy production, distribution and consumption, cutting across the entire economy. It will require massive injections of advanced technology and financial resources to achieve. At Copenhagen, the solidarity displayed by the group of BASIC countries caught the industrial countries by surprise, and prevented an unbalanced outcome. The position taken by the BASIC countries is based on fairness and equity and this needs to be more forcefully articulated through public diplomacy targeted at the industrial countries.

Nanotechnology- the emerging enabling technology

Nanotechnology which covers the applications of materials science at the scale of a nanometer is emerging as an important enabling technology. Carbon nanotubes are a subject of active R & D. Nanoporous materials are another. Many governments have invested funds into nanotechnology initiatives. The US launched a National Nanotechnology Initiative in 2000 with a funding of $ 4 billion. The DST in India has launched a Mission on Nano Science and Technology (Nano Mission) in May 2007. with an allocation of Rs. 1000 crore for 5 years. Nanotechnology has potential applications over the entire range of human activities, and could render many existing industries obsolete. It opens up the possibility of competitive, small-scale, scalable, transportable, dispersed production of useful materials. As its development proceeds, international relations will be impacted by its consequences.

To sum up, we have given several examples where there is increasing and close interaction between scientific and technological development and India's foreign relations environment and the challenges this has thrown up. Given the pace of technological development, India will need to remain vigilant and react with an agile foreign policy response to safeguard its interests in a world where technology is a key determinant of global competitiveness and power. In this effort, much closer collaboration between India's scientific and technical establishments and India's foreign policy establishment will be needed to generate wide awareness and sensitivity to key issues and effectively respond to future challenges. Technology issues will need to be carefully factored into foreign policy strategy and policy discussions, formulation, and practice.

Dr. Bhaskar Balakrishnan
28 September 2010

Role of technology in India's foreign relations

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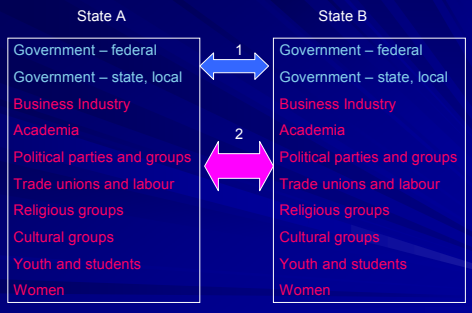
Technology and social evolution

- Technology is as old as civilization
- Part of the search for knowledge.
- Technology is key to advancement of society
- Motivation for technology to gain dominance and security
- Has brought about major changes in societies and power relations.

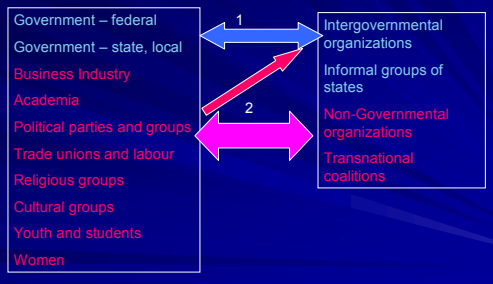
Examples from history

- Settled agriculture – complex societies.
- Composite compact bow- Mongol mobile archers
- Cannons used by Babur at battle of Panipat, 1526
- Printing and use of paper - an information revolution.
- Atomic bombs on Japan forced immediate surrender.
- Catholic church obstructed technological advances.

International relations



International Relations



International relations

- Power plays an important role in IR
- Power arises from control over key resources, ability to influence other players.
- Power may be military – hard; or economic and cultural – soft
- Hard power implies coercion, soft power implies persuasion.
- Technology plays a key role in determining power – hard or soft.

Importance of technology

- Mastery over basic knowledge and technology are key determinants of power.
- Technology can lead to military and economic power.
- Technology leadership is temporary.
- Efforts to control spread of technology can only be temporarily successful.
- Maintaining leadership in technology needs a continuous effort.

Technology leadership

- Material resources alone are not sufficient.
- Human resources are crucial – innovators and researchers.
- Mastery over content of knowledge is not sufficient
- Technology leadership is built upon innovation and creative thinking.
- Hardware vs Software of knowledge.

India – the early years

- India had been a source of technology and knowledge in ancient times
- Early 20 th century – reformist movements led to new thinking.
- Post independence – Nehru recognized and gave top importance to scientific research and technology
- Government driven atomic energy and space programmes, CSIR laboratories, IITs.

India – foreign relations

- Nehru laid foundations of foreign policy
- Non-alignment, Non-interference in internal affairs, cooperation with all.
- Space for economic development.
- End of Cold war, new environment ,
- Emergence of new poles of power -USA, EU, China, Russia.
- Restricting and managing weapons of mass destruction.
- Competition for resources, energy, materials.
- Global issues – terrorism, climate change, biodiversity, financial stability, trade and investment issues, etc.

Technology in IR

- Post War, nuclear technology became important in IR.
- Arms control agreements and verification a key area where technology was involved.
- NPT, Test Ban Treaties, Chemical weapons convention, Biological weapons convention are examples.
- Technology transfer, Intellectual property issues.

India – nuclear issues

- Efforts for complete nuclear disarmament failed
- Nuclear option kept open
- Nuclear programme pursued under DAE
- NPT considered discriminatory- resist attempts to impose it on India
- Nuclear Technology denial regime post 1974 the NSG; post 1998
- Post 2005 - Indo-US nuclear deal, NSG waiver. De facto status similar ot nuclear weapons states.
- Restraints on nuclear testing, separation of civil and strategic components, international safeguards on civil component.
- No first use policy, objective of complete ban on nuclear weapons.

India space and missile issues

- Government launched space programme.
- Payloads developed indigenously
- Launch system development – restrictions under MTCR
- Indigenous launch vehicle development including cryogenic engine.
- India's missile development programme- IRBM Agni III
- Brahmos supersonic cruise missile.

Technology control -examples

- Wassenaar Arrangement – coordinates export controls on dual use technology - 40 participating countries
- US technology export controls – Bureau of Industry and Security of Dept. of Commerce – export licensing for sensitive goods and technologies.
- India-US agreement on end user verification of defence and sensitive technology.

International scientific collaboration

- Increasing role of ISC projects due to high costs and complexity of basic research projects.
- Examples – International Space Station, Human Genome Project, LHC, ITER, etc.
- Indian participation in LHC, ITER.
- Indian contribution to LHC on mutually beneficial terms.
- Role of ISC set to grow in future

Intellectual Property rights

- Indian stand on patent protection – process not product patents in pharma sector.
- Indian pharma industry able to reverse engineer and produce lower cost drugs.
- Intense pressure on India to change patent regime.
- Post Uruguay round, India changed its patent laws.
- Greater awareness among all stakeholders, tougher negotiations in Doha Round.

Chemical Weapons Convention

- Since 1993, 188 countries have signed the CWC
- Bans chemical weapons. But many such chemicals are used in industry – eg Chlorine.
- Requires controls on a wide range of dual use chemicals which are toxic or can be used to make toxic chemicals (precursors).
- Controls include export controls, verification and inspections, registers of chemicals, all of which involve costs of implementation.

Trade in Services

- IT revolution changed service delivery systems
- GATS covers services trade.
- India has a vital stake in service trade – Business process outsourcing, knowledge based services, etc.
- Various modes of service delivery under GATS
- Mode 1 and Mode 4 delivery.

IT and Security issues

- Rapid growth of IT in all economic sectors, government activities.
- Emergence of Cyber crime and cyber warfare and terrorism.
- Vulnerability of critical systems.
- Security of financial service systems, banks, stock markets, etc.
- Lack of a global convention to combat cyber crime and terrorism.

Biotechnology and the ICGEB

- ICGEB project to enable developing countries to get access to biotechnology.
- Countries like Cuba, India, China have made good progress in this field.
- Many developed countries did not support this project.
- ICGEB has survived due to support from India, Italy, and others, but full potential is not realized due to lack of support of major developed countries.

Biological Weapons Convention

- Since 1972, 162 countries have signed it.
- Bans bioweapons and toxins.
- Many countries have declared and destroyed their BW assets.
- Lack of agreement on verification mechanisms – US has opposed proposals from EU and others.
- Threat of terrorist groups and non state actors getting access to such weapons and materials.

Convention on Biological Diversity

- Since 1992, 192 countries have signed the CBD.
- Conservation of biological diversity, and prevention of extinction of species.
- Precautionary principle recognized in CBD – no need to wait for scientific certainty in order to take action against emerging threats.

Biosafety and GE issues

- Advances in biotechnology – possible to move genes across species, modify them and even insert artificial genes.
- Has many applications in human, animal health, agriculture, industry, environment clean up, etc.
- Problems when large numbers of living modified organisms are released into the environment.
- Agri-biotech plagued with regulatory problems – Bt Cotton, Bt-Brinjal in India
- Laboratory and closed production systems using GMOs are considered safe.
- Bioethics issues – stem cells from embryos, etc.

Environmental issues

- Ozone layer depletion led to Montreal Protocol 1987, to phase out ODS. 196 countries signed it. Special fund to help developing countries set up. Recognition of "common and differentiated responsibility" of countries.
- Global warming led to UNFCCC and the Kyoto protocol, to control emissions of greenhouse gases.
- CO_2 emissions reductions require major changes in production and consumption in society, across all sectors of the economy.
- Adjustment will have impact on economic growth – developed countries reluctant to agree to cuts, want to shift burden onto major developing countries like India and China despite their low per capita emissions.

Nanotechnology

- Nanostructures – a nanometre in at least one dimension.
- Carbon nanotubes, nanoporous materials, nanoparticles, thin films, quantum dots, etc.
- Surface area increases greatly – more reactivity. Electromagnetic and quantum effects become important.
- Many useful applications now available, many emerging.
- Can revolutionize industry – small scale, scalable, transportable, production systems.
- Government funding for R & D in many countries.
- Regulatory issues – large scale release of nanoparticles into the environment.

Conclusions

- Role of technology issues in India's foreign relations is bound to grow further.
- India will be a growing producer and consumer of technology, and participate in more ISCs
- Requires much closer collaboration between foreign policy makers, and scientific and technical establishments.
- Technology dimension of foreign policy and global issues will need to be carefully taken into account.

MEA public diplomacy

- The MEA Distinguished Lecture Series on India's Foreign Policy is organized by the Public Diplomacy Division since February 2010 to foster a more informed discourse on key foreign policy issues.
- The lecture series has tried to take the discussion on foreign policy issues outside the corridors of power in Delhi to leading universities and academic institutions within India itself.
- We live in a globalised world where foreign policy issues are inextricably linked to domestic imperatives. Transnational subjects like climate change, terrorism, trade negotiations, energy security etc can have a direct impact on our economic wellbeing and security. We hope that lectures like these will encourage at least some members of the audience to specialize in International Studies and in foreign languages.
- These lectures enable young scholars to interact directly with our diplomats and to understand the role of diplomacy. We hope that the occasion will inspire the best and brightest in the group to seriously look at the Foreign Service as their preferred career option.

Thank you