TECHNOLOGY LEAPFROGGING AND THE DIGITAL DIVIDE

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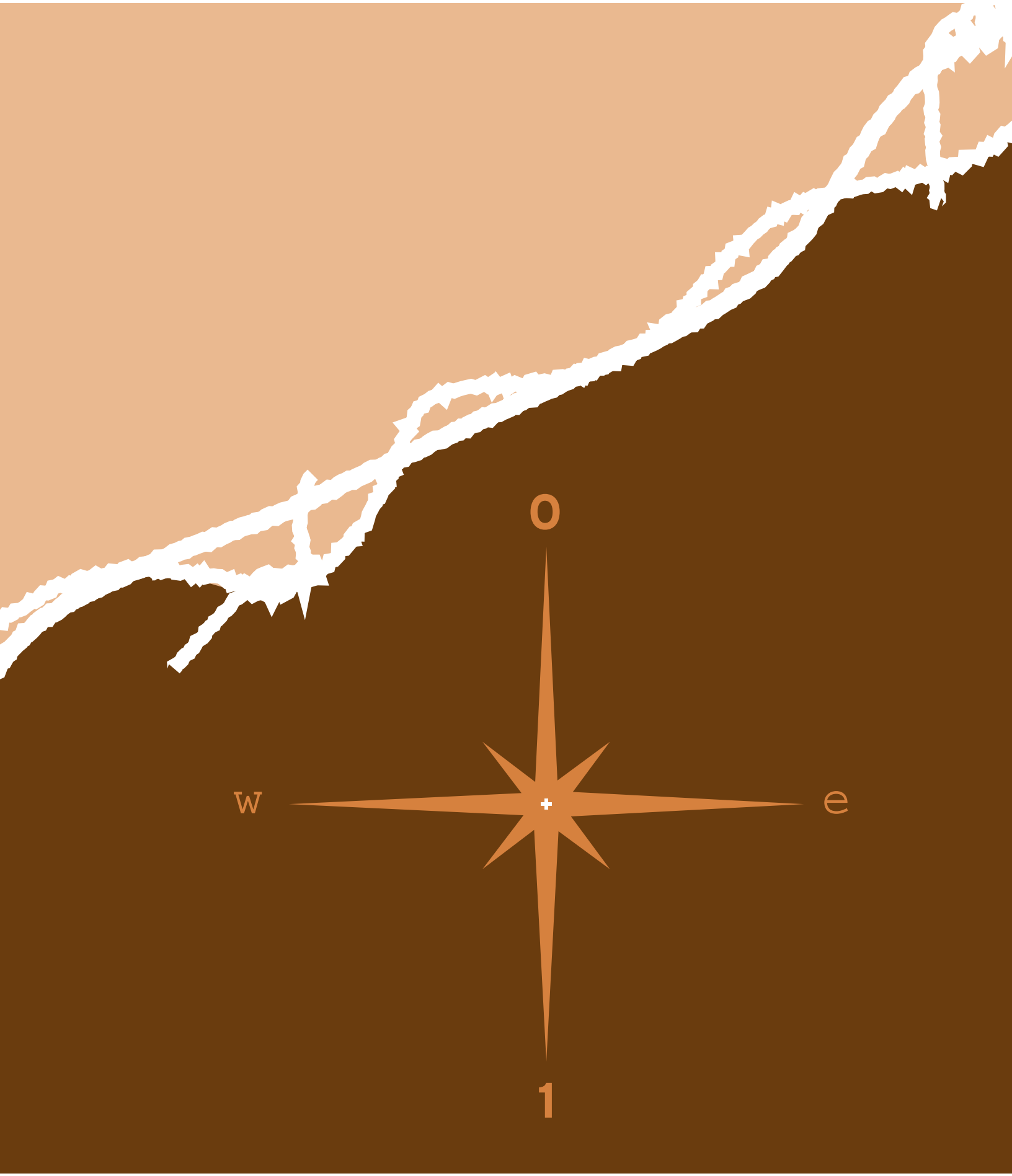
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The past two decades have witnessed a revolution in terms of technology developments. Information technology, the Internet, genetic engineering, nanotechnologies, new energy technologies – innovations that provide humanity with fascinating opportunities for new products and services, improved health and medicine, radically different ways of communication, enhanced productivity as well as more efficient use of energy and materials.

Take the profound impact that ICT has had on society and the way it has changed the production of goods and services, trade and distribution, research, education, information, media etc. ICT is not just another sector of economic development, nor can it simply be looked upon as a set of tools. Instead, ICT permeates every aspect of today's societal activity. Ironically, the very factors that have phenomenally improved productivity by intelligent use of the technology, also risk driving the poor to the periphery, thus creating barriers within and between societies, and could lead to social unrest and tension.

Countries and people lacking capacity for ICT will be marginalized in the new economy. New trade barriers will be erected. Moreover, without access to ICT, countries will not be able to benefit from the many innovative ways of addressing poverty and basic needs that these technologies offer.

A WIDENING GAP

One reason why the information gap is widening is that the potential of ICT in social and economic development has not been fully understood. There are still too many people in key positions in governments and aid agencies who seem to believe that only when basic needs are met does technology have a role to play. If they were right most of the poor would have to wait forever.

The debate must move beyond choosing between ICT and other development needs such as health and education. The issue is not about a trade-off between one or the other, but an understanding that these must go hand in hand. However, technology alone is not enough. Technology must be applied within its social context and that, in many countries, is providing a real challenge.

One thing is clear. The new technologies, notably ICT, will bring about major transformations in society. The structural logic of the information society will be vastly different from that of the industrial society. One eminent scholar, who has given a lot of thought to the implications of the ICT revolution, is Professor Harlan Cleveland. Here is how he perceives the future: "Information – symbols, not things – will be playing the lead role in world history that physical labour, stone, bronze, land, minerals, metals and energy once played. We will have to burn into our consciousness how very different information is from all its predecessors as civilization's dominant resource."
In his speech to the American Association for History and Computing (April 2000, Baylor University, Texas) Cleveland continues: "Information expands as it's used – no "limits to growth" around here. It is ready transportable, at close to the speed of light. Information leaks so easily that it is much harder to

hide and to hoard than tangible resources were. The spread of knowledge empowers the many, by eroding the influence that once empowered the few who were "in the know". Information cannot be owned, only its delivery service can. And giving or selling information don't give rise to "exchange" transactions; they are acts of sharing."

If Cleveland is right, we are at the doorstep of a democratic revolution. In the industrial era, poverty was explained and justified by shortages of things. In the coming years, physical resources will still be important, but their role in wealth creation will gradually be overtaken by information. And since each baby is born with a brain, there ought to be radically different prerequisites for development and progress at the level of the individual, also in the poor regions of the world. But there is a catch: whether or not the information revolution is really going to lead to greater fairness depends to what extent the poor will have access, not only to the modern information technologies, but also to education. If such access is not provided, the expected fairness revolution will be turned into its opposite.

In February 2001, well above 400 million people worldwide were users of the Internet. This represents phenomenal growth, given that the Internet is less than three thousand days old. But the spread of Internet use is very uneven. The vast majority of Internet users are found in OECD countries. There are more hosts in Manhattan than in continental Africa; more hosts in Finland than in Latin America and the Caribbean; and notwithstanding the remarkable progress in the application of ICT in India, most of its villages still lack a working telephone.

To bridge the digital divide is both a moral and a social imperative. If we do not succeed, entire regions and hundreds of millions of people will be left behind. The consequences in terms of poverty and deprivation will be devastating.

LATE-COMERS BENEFIT FROM LEAPFROGGING

But there is another, equally compelling argument for developing countries to embrace the new technologies. By investing in cutting-edge technology, through leapfrogging, they will be able to bypass certain stages of development. The benefits can be financial, social, as well as environmental. As "late-comers", developing countries can be better placed to take advantage of the newest technology developments, not the least in ICT, since they are not hindered by the previous investments in obsolete technology. Since prices come down very quickly in the area of ICT, investments in a telecommunication

infrastructure today may cost just a fourth or a fifth compared to what was the case a few years ago.

The environmental benefits would be significant, since leapfrogging would make it possible for developing countries to avoid repeating some of the mistakes of industrialized countries. Take energy. Worldwide total energy production-related investments for 2000 to 2030 are estimated at between US 12 and US 17 trillion dollars (IIASA-WEC scenarios, World Energy Assessment 2000). The majority of these investments will be made in developing countries. Presently, most of them will favour fossil fuels, primarily coal. If this trend continues, the resulting emissions in terms of carbon will be disastrous. And these emissions will negatively affect people all over the world.

New systems of energy supply and consumption are badly needed. Less polluting and more efficient energy technologies are available, but normally at a higher investment cost than conventional fuels. The challenge is at least twofold: i) to help build the necessary capacity in terms of institutions and skills in developing countries to enable them to adapt and expand on new discoveries and make them applicable to their specific needs, and ii) to provide investors with the right kind of incentives to make investing in alternative energy solutions attractive. Only if these preconditions are fulfilled will leapfrogging be possible.

Investing in clean energy and transport are the most obvious examples of how the natural environment in developing countries could benefit from technology leap-frogging. But the opportunities do not stop there. The ICT revolution by itself offers fascinating possibilities for enhancing energy and resource efficiency and reducing pollution. When society becomes more digital, the possibilities for major structural change and efficiency gains multiply. New avenues open up. Concepts such as de-materialisation, tele-working, tele-conferencing, distance education, the flexible office, e-Commerce all promise great leaps forward in terms of enhanced resource efficiency.

Environmentally sound technologies (ESTs) often depend on sophisticated measuring devices, data transmission networks and automatic data processing equipment. This can be provided by ICT, thus bringing about more efficient production processes as well as greatly enhanced product performance. Moreover, with advanced communications many conventional products will be transformed into services. A newspaper becomes an on-line news service; an instruction manual becomes an interactive technical advice service; cinema film re-production becomes a “video-on-demand” service in the home, etc.

It appears obvious to us that a high-tech economy based on knowledge, skills and innovation ought to be a cleaner, greener economy. But few attempts have been made to assess specifically to what extent the digital revolution and the sustainable development agenda complement each other. In some areas developments so far have been disappointing. For instance, as long as e-Commerce is a marginal phenomenon in society, demand for transportation seems to increase, not the opposite. When more and more people will shop on the Net, things will change. The main reason is economics. When volumes increase it will be good business to organize transport and logistics in the most efficient way. As a result the environment will benefit.

The reader may find that most of what ICT can offer in terms of enhanced energy and resource efficiency are relevant examples only in the context of OECD countries. Activities such as telework, e-Commerce, on-line services were pioneered in the US, Japan and Europe. But there is no reason why such activities should not start penetrating countries of the South as well. In fact, they already have. Many people do not realize that China is the single biggest market for mobile phones in the world today. As the volume of foreign direct investments in developing countries has multiplied in recent years, the result will be an increased transfer of high-tech from OECD countries to developing countries. True, private investments in the South are concentrated to a limited number of countries. The challenge is to include more countries in this process, and to focus specifically on applications that would promote sustainable development.

GREEN TECHNOLOGY LEAPFROGGING

Traditionally it was accepted that economic growth, as measured by GDP, was inevitably linked to growing demand for raw materials and energy as well as the negative consequences of pollution. If such linkages were to last long into the future the overall consequences for mankind would be disastrous. There are already clear signs that pollution levels are exceeding the absorption capacity of the global eco-system. Climate change is the most obvious example but there are others. Parallel to excessive pollution levels, the pressures on forests, farmland, fresh water resources and fisheries are mounting.

Efforts to try to de-link GDP growth and demand for energy and materials have therefore become a priority for policymakers in several OECD countries. The achievements are still limited, but there are signs of progress. For instance, the energy intensity of OECD countries has been reduced in the

recent past. This is the result of a shift towards more energy-efficient technologies and less energy-intensive materials. Scientists claim that this trend will continue, as a gradual saturation of traditional consumer goods will take place. One obvious reason is the move into the information economy. In such an economy an increasing part of transactions will be immaterial. Many products will be turned into services, which depend less on energy and material throughput.

Long-term studies of energy-intensity in several countries indicate that economies use more energy per unit of output during the early phases of development, reach a peak, and then start to decrease. Liberalization and information technologies should allow knowledge to be transferred more easily, enabling emerging economies to climb the so-called energy and technology ladders more quickly. This means that latecomers ought to be able to avoid the peak in energy demand by benefiting from more modern methods of manufacturing and more efficient energy technologies. However, there are many barriers to overcome for such change to happen. Studies do confirm that energy intensity is on the increase in most developing countries, not the opposite. The only exception is China, where deliberate efforts are being made to use both energy and materials more efficiently (Goldemberg, Leapfrogging strategies for developing countries).

In order for the necessary transformation to more efficient and environmentally sound technologies to happen in developing countries, several barriers to change have to be tackled. Most important is to address the capacity needs. While much knowledge for improved problem-solving is now available in many scientific and engineering institutions around the world, very little of that know-how is geared specifically to addressing development and environment needs in developing countries. Most of these countries lack the scientific institutions and infrastructure to adapt and expand on new knowledge and discoveries in order to make them applicable to their local needs.

Public planning and regulatory activity is crucial to the dissemination of most ESTs. We are dealing with capital-intensive infrastructure, which is meant to provide a public service at an affordable price. In most countries energy distribution, public transport, waste management etc. are considered to be public services. Increasingly, public authorities are choosing to delegate the operation and management of public services to the private sector. If and when this happens, it is crucial that the necessary regulatory framework is in place to guarantee environmental quality.

To create an adequate legislative and regulatory framework for the protection of the environment is a difficult process in any country. This is particularly true for most developing countries, where government structures are weak. Governments need to implement fiscal and regulatory policies that encourage innovation and provide direct incentives to companies that develop or disseminate technologies that contribute to sustainable development. Fiscal incentives should also be used to stimulate businesses and households to purchase such technologies. Parallel to that, subsidies in support of fossil fuels and other technologies that are harmful to the environment should be dismantled. The next step would be for governments to apply the Polluter Pays Principle, i.e. to make sure that environmental externalities are reflected in market prices. This represents a real challenge in OECD countries, and even more so in developing countries, but it has to happen.

As already stressed, the strengthening of institutional and human capacities is a primary prerequisite for ESTs to become a priority in the development process of developing countries. The same is true for most development co-operation agencies. In a recent study on "Technology co-operation in the field of environmentally sound technologies" to the European Parliament by IED (Innovation Energie Dévelopment, 2001) the authors conclude that "a review of organisational structures and portfolios of bilateral and multilateral co-operation agencies and banks shows that there are grossly insufficient human capacities in the areas of energy co-operation. If ESTs are to become a priority of development co-operation, the institutions of international co-operation must first and foremost be given the means to understand the issues and to formulate and manage projects".

Until recently, science and technology was more or less absent from the sustainable development debate. More recently a change can be discerned. The Human Development Report 2001 "Making New Technologies Work for Human Development" is one example. The report emphasizes the crucial relationship that exists between science, knowledge and human capacity in addressing issues of sustainable development.

One important message from the Human Development Report is that technological progress and knowledge applications are key drivers of economic growth. The logical conclusion is that support to science and technology ought to become a top priority for development co-operation.

The little attention given by ODA, so far, to science and technology also means that support to ESTs have been largely neglected. The only mechanism

at international level worth mentioning in this context is the Global Environment Facility (GEF). The GEF has given support to capacity building in the field of sustainable energy and to renewable energy pilot projects. But compared to the total investments in energy production in developing countries, the resources of the GEF have been woefully inadequate.

One possible source of finance, that ought to be utilised in support of investments in ESTs, is the export-credit agencies (ECAs) of OECD countries. However, until very recently these agencies were paying no attention at all to the environmental aspects of their lending. On the contrary, during the period of 1994-99, it is estimated that more than 100 billion of US dollars were being mobilised through the ECAs in support of investments in carbon-based technologies. Just imagine if the same attention had been given instead to investments in energy efficiency and renewables.

Efforts have been made within the climate convention to establish new sources of finance to assist developing countries both in climate adaptation and investments in clean technologies. It is too early today to judge to what extent the new mechanisms will make a difference.

THE DIGITAL DIVIDE CAN BE BRIDGED

Presently, we experience the technologies of the information and communication revolution at the cutting edge of progress. Their application also offers momentous opportunities for development. They present developing countries with real opportunities in helping to bridge the economic and prosperity gaps between them and developed countries.

Today, village computer centers in developing countries help farmers check the going prices for their produce in the city, thus avoiding arbitrary markups by middlemen. The same centers provide distance education and learning and help improve health services. Today, rural artists and craftsmen in remote villages can reach a global market with their products, thanks to non-profit Internet sites.

Yet, at the same time, billions of people still live untouched by the digital revolution. Only about 7% of the world's population can claim connectivity, and the greater majority of these are living in the developed countries. As a result, the income gap between the developed and developing countries is being further aggravated by the digital divide. This holds ominous consequences for the developing countries in terms of increased poverty, unemployment and under-development. This is not the result of some conspiracy

against the poor. Rather it is the result of a development where access to information and knowledge are becoming the most important factors of production. Those with access to information and technology naturally benefit in this situation; those without access become further marginalized.

However, the situation should not be regarded as hopeless. Even if the information revolution so far is widening the gap between the rich and the poor, this need not become a pattern for the future. There are many tangible examples from around the world of how ICTs are being deployed to address important development goals. Evidence shows that ICT initiatives need not be confined to countries with high per capita incomes, well-developed infrastructures and high levels of venture capital in order to succeed. Indeed, remarkable progress is evident where some of these elements have been lacking. The experiences of a few countries, including both developing countries and transition economies, have demonstrated that bold actions in bringing their countries into the digital age have paid off and brought tangible results in economic, social and political terms. Prominent examples are *Estonia, Mauritius* and *Costa Rica*.

Costa Rica attributes much of its recent economic growth to the widespread adaptation of ICT. The focus has been on the educational sector. Computer laboratories were installed in all of the country's public high schools, thereby reaching 50 per cent of the children enrolled in public schools. "Smart cards" have been introduced nation-wide in public administration, transportation, public telephones and health services. Parallel to that a variety of efforts have been made to use ICT to help integrate isolated rural populations, notably by introducing multi-purpose/multimedia mobile units that can be taken to any rural community and provide a variety of functions (Internet access, ICT training, e-mail facilities etc.).

Estonia had a very low level of ICT at independence in 1991. Today, the country has one of the highest degrees of connectivity in Europe. All schools have been connected to the Internet; more than 80 per cent of bank transfers are made over the Internet; "smart cards" were introduced for interaction with government services etc. The per capita income has risen from US 600 in 1991 to more than US 5000 in 2000, a development largely made possible by the very proactive ICT strategy pursued.

Mauritius adopted a National Information Technology Strategy Plan early on. The primary objectives were to bring Government closer to the people through e-Government, to use ICT to enhance the education system and the service

sector, and to improve the efficiency of the public sector. A special Ministry was created to promote ICT applications in different sectors of the Mauritian society. As a result of the dedicated efforts Mauritius has attracted a great number of small and medium-sized ICT-based companies.

The great majority of developing countries, however, have done little in terms of a coherent strategy to embrace the ICT revolution. This does not mean that nothing is happening in all these countries in terms of ICT for development. There are numerous initiatives, mainly among NGOs, that hopefully will help raise awareness and demonstrate, to governments as well as aid agencies, the great opportunities that the new technologies offer both for accelerating economic development and, more specifically, to help advance the human development agenda.

ICT MAKES A DIFFERENCE AT GRASSROOTS LEVEL

Among the many examples of initiatives at the grassroots level, the following may provide an illustration of the significance of ICT in addressing basic human needs:

Technology Community Centres Access in Egypt (TACCs)

The overall aim of the TACC pilot project – established with support of UNDP - was to "provide rural and remote communities with public access to information technology, especially the Internet, and with the training to utilize it effectively". The project's ultimate goal was to demonstrate how information technologies could contribute to "the empowerment of community members" and how such technologies could be used "for a variety of applications benefiting sustainable human development". A pilot, consisting of several cyber cafes, was established in Sharkeya.

The pilot has succeeded beyond the most optimistic expectations. Some 6,000 persons have received IT training with a view to supporting various development activities at the community level. To date, TACC staff – national and international (mainly United Nations ´Volunteers) – have developed and posted over 1,000 web pages, most of them in Arabic. The websites provide information on ICT training, health, agriculture, e-commerce, the culture and history of Egypt, recreational activities, etc.

In light of the success in Sharkeya, the government of Egypt recently decided to establish similar centers in all of the country's 26 Governorates. The TACC concept is also being replicated in Jordan.

Village Knowledge Centres

The experimental telecentre project in South India was initiated in 1998 by the M.S. Swaminathan Research Foundation. Four centers have become operational, located in villages with illiteracy rates above 50%. The project is based on the understanding that networked information requires "mediation" by professionals if it is to be accessible to poor rural villagers. The information compiled and collected for the project is primarily based on requests by the village end-users. This information – which includes items like commodity prices, weather forecasts, daily news, government information, methods of dealing with crop diseases, fishing methods etc. - is translated into Tamil, packaged into audio files and distributed via the Internet to the four Village Knowledge Centres. The local centers broadcast the audio files over loudspeakers to the illiterate villagers. Evidence suggests that the villagers benefit significantly from the information in regard to making decisions affecting their lives and well-being.

Grameen Village Pay Phones

Women members of Grameen Bank are offered micro-credit loans to purchase cellular phones, which are subsequently rented out to village farmers and other community members. As of July 2001 phones had been placed in more than 1.000 villages. Phone services in rural areas are highly valued in Bangladesh and have rapidly increased incomes and savings among phone owners. The village phones allow family members to stay in touch and communicate with family members abroad about financial matters like remittances. Local farmers use the phones to have access to market information, weather reports and pest alerts. The phone services have also contributed to improvements in disaster response, crime rates and livestock mortality through better access to public services.

Reproductive health information on-line

The association of Uganda Women Medical Doctors was started in 1987 with a mission of improving and facilitating the promotion and protection of health to women, young people and children in Uganda. They decided in the spring of 2000 to try to make use of Internet in their work. The aim of the project was to disseminate information on reproductive health electronically to other women NGOs. Medical doctors in Kampala download the necessary information, repackage it and send it online to the participating NGOs. Feedback from the

NGOs is also received via the Internet, including specific questions asked by clients at health clinics. Already after a few months the project had demonstrated increased awareness among rural women of reproductive health issues.

TARAhaat (Technology and Action for Rural Advancement)

A fascinating pilot project in the field of ICT for development is currently being developed by Development Alternatives, Delhi. The main objective of TARAhaat– the Internet Portal connecting rural India to the global village - is to use the power of ICT to bring knowledge, services and products to the villages in India. Starting in Punjab and Uttar Pradesh, the plan is to establish tens of thousands of Internet and computer enabled business centers all over the sub-continent in the years to come.

The portal offers email, e-Commerce, education, entertainment, access to e-Government facilities, etc. Eventually TARAhaat plans to bring the village manufacturers in contact with buyers and designers the world over. Access to the portal is being provided by franchised cyber kiosks, which are operated by local village entrepreneurs. Satellite communication, wireless broadband and local power generation will be used where there is no electricity or phone.
Overall few donor-funded ICT projects in developing countries have proven to be self-sustaining once external assistance has run out. The encouraging thing about TARAhaat is that its pilots shows signs of being able to stand on their own feet only after six to twelve months of operation. This means that the revenues generated by these kiosks are sufficiently large to provide a surplus. What this demonstrates is that even in the poorest of villages there is significant demand for communication and ICT services.

Masai pastoralists on the Web

In Tanzania, Masai pastoralists living in the Ngorongoro have used the Internet to voice their opposition to Government conservation management policy that threatened their land and their livelihood. A member of the Masai community came up with the idea of putting his people on the World Wide Web after he made a video about the critique of the pastoralists on the Governments management plan for their land. He put clips of "real people" from the video to the website and managed to mobilize support for the cause of the pastoralists around the world. In addition to obliging the Tanzanian Government to listen to the voices of the local communities, the Masai say that their web site makes them feel less isolated: they feel part of a "bigger world".

INTERNATIONAL COMMUNITY FINALLY RESPONDING

ICT has been extremely beneficial for those nations that have used it with determination and enthusiasm as part of their national development strategies. Many individual examples from developing countries also demonstrate how ICT, appropriately applied, can help address basic social needs. In spite of this, the international donor community has been slow in addressing the digital divide. There has been much talk but little action. At the receiving end, there has also been a lot of resistance. Quite a number of developing country governments have been slow to open up to ICT, either for political or cultural reasons, or simply because they do not believe that ICT can be of importance to the development of their countries.

If the general trend among donors can be characterized as passivity, a few institutions have understood the importance of ICT for development. Canadian IDRC has been a strong promoter of ICT capacity building for over a decade. Swedish SAREC also played a supporting role in the early years. The main focus for IDRC and SAREC has been to build capacity for ICT at universities and scientific institutions in the South. IDRC has also been a pioneer in other areas, using ICT in natural resources management, the provision of health care, etc.

ICT for development became a central issue for the World Bank in the mid 1990´s. Jim Wolfensohn had joined the bank as president and soon declared that he wanted to turn the bank into a "knowledge bank." The bank has since launched several good initiatives, like InfoDev and Gateway. Support to ICT capacity building, however, is still far from being among the Bank's priorities in terms of funding.

The UN system has been a disappointment, mainly because of shrinking funding support for UN agencies in general. There are two exceptions, the ITU and UNDP. The ITU has done its part in terms of awareness-raising activities, but – true to its mandate - focusing mainly on the need for reform and liberalization of the telecommunication sector. UNDP was a pioneer with its Sustainable Development Networks Programme and its ICT for development project. But the budgetary resources were limited, which meant that activities had to focus on information, awareness-raising activities and pilot projects.

The European Union commands significant resources for development co-operation, in fact significantly larger than the UN. But the European Commission has so far largely neglected the information revolution and its implications for development. This is in stark contrast to the efforts undertaken

within the Union itself. The European Commission has taken on a very active role in the promotion of ICT through the launching of eEurope – a broad programme aiming at enhancing ICT skills in society with special efforts made towards public schools, universities, SME:s, people with different kinds of handicaps, etc. One of the main objectives is to make sure that no citizens of the Union are being excluded from the technology developments.

If developments have been slow in the past as regards donor support to ICT for development, however important changes took place during 2000. In this year, major international bodies launched potentially highly significant initiatives to apply ICT to the needs of the developing countries.

The United Nations Millennium Summit called on the UN "to play a leadership and catalytic role in helping to bridge the digital divide and accelerate development by harnessing the development potential of information and communication technologies (ICTs)". A Special Task Force has been established to provide overall leadership in helping "to formulate strategies for ICTs development and putting them at the service of development for all, to forge a strategic partnership between the United Nations system, private industry and financing trusts and foundations, donors, programme countries and other relevant stakeholders, and to mobilize new resources for ICT for development".

Parallel to the discussions in the UN, the G8 meeting in Okinawa in July 2000 decided to establish two special task forces; one on the digital divide and one on renewable energy. The task forces included members from governments, the private sector, science and civil society. By initiating this work, the major economic powers of the world demonstrated their concern both for the issue of income poverty – access to modern energy services is a precondition for development – and information poverty. The two reports were presented at the G8 meeting in Genoa in July 2001. Both reports are of high quality and include a large number of very sensible recommendations. It is however not at all clear to what extent G8 countries will act upon the recommendations. Comments in Genoa, notably from Mr. Bush, stressed unequivocally that there was nothing binding about the recommendations. Leaving aside implementation, the two task forces did serve an important function. Their analysis is cutting-edge and they will most certainly be used to advance the agenda in terms of bridging the digital divide as well as promoting environmentally sound technologies in the South.

AN AGENDA FOR ACTION

Professor Jeffrey Sachs has pointed out (Economist, June 24, 2001) that the greatest divide between rich and poor nations is the inequality in innovation and diffusion of technology. Even as we speak this divide is widening. Among the solutions, Sachs suggests to follow the example of the Rockefeller Foundation in creating and funding great research centres around the world. New partnerships are also needed to bring together academia, governments and industry, from both rich and poor countries.

Capacity building in the new technology areas at universities, government institutions, schools, among entrepreneurs, etc, is a major prerequisite for technology leapfrogging to become successful. Furthermore, developing countries need considerable help to develop the right political, fiscal and legal frameworks to stimulate investments in ICT as well as ESTs.

One of the mistakes of the past was that development co-operation was primarily seen in the context of the governments involved. But experience has taught us that governments seldom are good at handling and managing technology. This should be the responsibility of the private sector. Hence there is a strong need in developing countries for new types of partnerships between the public and private sectors. This is particularly true in areas like telecom and energy, where rigid state monopolies very often are the main stumbling block for improvements in customer services.

There is no doubt that the economic opportunities which ICT generates will create a lot of wealth for those who master them. However, left entirely to market forces, these technologies are likely to marginalize the poor and disenfranchise them even more. A purely public sector approach will not work either. What is very much needed are partnerships between the private and public sectors, where the key role of the public sector will be to strengthen the capacity of all major sectors in society to have access to the Internet and to use it for their benefit. The private sector should be responsible for ensuring efficient and commercially viable dissemination of the technologies. Academia and civil society would help develop content so as to address important social, environmental and cultural needs in the process.

Many different kinds of technology can contribute to sustainable development. Some of these may be designed specifically to tackle environmental or poverty-related problems (e.g. solar photovoltaics). However, other technologies that have not been designed to directly address these kind of problems – like computers and mobile phones – will have an equally important role to play.

The technologies needed for sustainable development will differ from country to country. Those best placed to identify their technology needs are the different stakeholders themselves. However, they will only be able to do so if there is a supportive and enabling environment: if they have a well-developed skills base; strong, well-targeted programmes of research and development; an entrepreneurial private sector and if financing is available to the companies that are developing and utilising the technologies.

The private sector will need a lot of support in most developing countries in order to invest in the new technology areas. FDI flows are, as we know, concentrated in a few developing countries. For the great majority of countries the political as well as financial risks are perceived to be too high. Moreover, FDI will not take place in countries were the infrastructure in terms of roads, ports, telecom, energy, etc, is poor. A classic Catch 22 situation. Here the international donor community could play an important role by providing credits and risk guarantees.

Small-scale enterprises and service companies have a key role to play in developing and disseminating technology. Smaller companies in developing countries often experience difficulties to obtain financing. They are either too large for micro-credits, too small to qualify for project financing or perceived as too much of a risk for commercial loans. Strategies for providing funding to small private businesses need to be developed.

Closely related to the risk issue is the absence of sustainable business models for entrepreneurs and service companies in the field of ESTs. Here again, donors could help through support to demonstration projects, i.e. acting as agents of change. International funding, such as the GEF, could be used to cover the extra capital costs compared to conventional technologies.

The international community should play a central role in assisting development country governments in pursuing the goal of Digital Opportunities for all and to support green technology leapfrogging.

The following priority actions ought to be considered:

- Support to national eStrategies, based on broad stakeholder dialogues. These strategies should include the development of regulatory and policy frameworks so as to improve competition in telecommunications and the provision of IT services to the public.
- Support for the establishment of community access points in all developing countries. The goal should be that all communities in the developing world should be connected before the end of 2004.
- Promotion of ICT dissemination among children in developing countries, notably by connecting schools and educational facilities. To be effective, such a program must be complemented by adequate teacher training.
- Support for university-based centres and research networks, focussing on research and learning at the intersection of ICT and development. Special attention should be given to content building within areas like tele-medicine, distance education, democracy and participation etc.
- Strengthen efforts to mobilize public and private support for improvements of basic ICT infrastructure in developing countries. Sufficient ODA funds – a combination of grants and soft loans – must be raised to cover political and financial risks and to guarantee connectivity in remote areas.
- Support to national strategies for sustainable energy, i.e. strategies based on energy efficiency and renewable.
- Support to capacity building within developing country governments for sustainable energy; the same capacity needs in donor agencies and development banks must also be addressed.
- Before 2010, reduce by half the number of people without access to modern energy services, notably through investments in renewable energy. This would require a crash programme in terms of donor assistance. Priority should be given to small-scale projects that meet local needs, and on leveraging private finance.
- The development of renewables should be strengthened through focussed R&D efforts and public procurement, thereby driving down the costs of ESTs.
- Launching of a special programme to promote renewable energy systems in remote locations to which traditional grid-based infrastructure does not reach. In such locations solar-based systems can be the only cost-effective option. Through such solutions, vital energy needs like lighting, refrigeration, etc, as well as ICT connectivity can be met.
- Encourage the use of Export-Credit Agencies to promote investments in ICT infrastructure as well as in energy efficiency and renewables.
- Make sure that access to modern energy services becomes part of developing country poverty eradication strategies.
- Promoting debt swaps, by making money made available through the HIPC initiative to support the implementation of technology development programmes.
- Promoting new international centres of excellence in research in technologies for sustainable development.

Many of the suggestions may appear unrealistic, given today's level of development assistance. However, to help address the digital divide and to assist developing countries in green technology leapfrogging should not only be seen in the context of solidarity with the poor. Of equal importance is to realise that it is in all our interest that countries in the South are not further marginalized and that the technologies used by them are environmentally benign. Hence we ought to see efforts to bridge the digital divide and for green technology leapfrogging as part of a shared responsibility, as part of joint efforts for the promotion of global public goods. If we take this angle, and we should, it ought to be possible both to offer Digital Opportunities to all and to reach another billion people with environmentally benign energy technologies before 2010.