The Information Dimension

The importance of information technology for making technical co-operation among developing countries examined. by Edward While.

THE world today is an "information intensive" place, in which the computer data base is becoming an increasingly indispensable tool. The United Nations system alone now maintains more than 300 data bases, and the number throughout the world runs into many thousands.

Information today is a resource no less crucial to development and progress than natural and human resources. Countries lacking data bases are at an enormous disadvantage in virtually every sector. Information on trade opportunities, for example, can help a country find out who needs its products, where the opportunities ate, how others have confronted problems of production or marketing similar to their own, and at what prices others are selling similar goods.

Unfortunately, not all countries have equal access to information. The flow of world information is concentrated among the countries of the north. Even when data is collected in the south, it tends to be channelled to the north to satisfy northern needs. Information needed by countries in the south for their own economic and development programmes (whether the source of the data is north or south) is often unavailable to them because of the high costs, poor telecommunications infrastructure or lack of access to the necessary computer technology.

The development efforts of these countries, however, cannot be fully effective without the benefits of information technology. This also applies to technical co-operation between the countries of the developing world.

As attractive as such South-South co-operation appears, it still does not occur on the scale that its advantages would suggest. One of the key impediments is lack of information about what is available in other developing countries around the world. This lack is due partly to difficulties in collecting data in many developing countries. More importantly, it is due to the poorly developed information links between these countries.

At the same time, there are sources of computerized data that are designed to assist developing countries in finding information relevant to their development activities. These sources are increasing in number. Among them are INRES-South, UNDP's Information Referral Service on training and expertise available from developing countries, and UNIDO's Industrial Technology Information Bulletin. UNIDO provides information on industrial technology for small and medium enterprises. Another fledgling network is the Technological Information Pilot Service (TIPS), supported under a UNDP project subcontracted to the Development Network, and NGO based in Rome, which operates a subscription service offering rapid access to trade and technical data from and in the developing countries.

Among the developing countries themselves there is a keen awareness of the key role which information can play in their development. One of the most important recent initiatives was a decision by the Chambers of Commerce of the Group of 77 to create a South-South Trade Information Network. The draft action plan calls for the establishment of three regional trade information centres. These will establish computerized registries of importers, exporters and manufacturers throughout the developing world, making use of common software ((based on the INRES-South model) for data storage and retrieval. The system will later be expanded to include timely dissemination of data on trade opportunities. It will also bring together information on policies, legislation, and the commercial environment in member stares of the Group of 77.

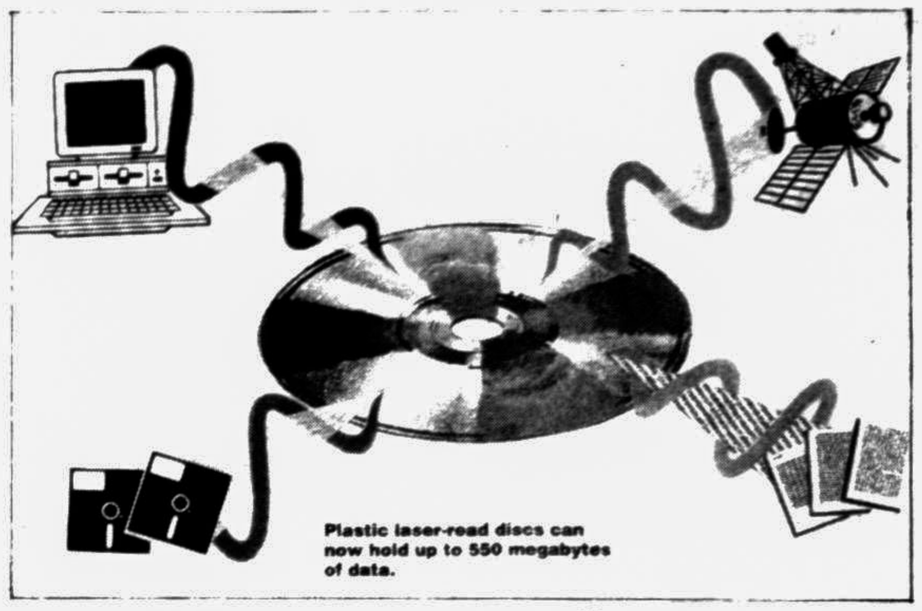
This system, which is being carried out with assistance from the International Trade Center and the Special Unit for TCDC, will have the virtue of being dedicated exclusively to the interests of the developing countries. It will also be manageable and sustainable by the developing countries themselves.

INRES-South has for some time had the goal of decentralizing its activities, so that the system is more directly accessible to end users in developing countries. To this end the system, including both software and suitable hardware, has already been supplied to several countries, where it is housed either in a government office or the office of the local UNDP Resident Representative.

While the cost of sophisticated microcomputers continues to decline steadily, one of the persistent constraints to the better utilization of information in developing countries is the high cost of installing and running adequate telecommunications. This applies to both north-south and south-south communications. Thus, for some time to come, the use of "on-line" data bases for data acquisition will remain beyond the reach of all but the most successful business enterprises or the best-endowed government departments and research centres in the developing world.

Fortunately, there is a recent development in computer technology that can help: the CD-ROM (for "compact disc, read-only memory") storage disc.

These thin, flexible plastic laser-read discs weighing only a few ounces can each hold up to 550 megabytes (550,000,000 bytes) of data, compared with 20 to 40 megabytes for a typical hard disc and 1.4 megabytes for a high density diskette. Thanks to the CD-ROM, it is now possible to mail to any part of the world, in an ordinary envelope, a data base of a size and level of sophistication that was only available on mainframe computers until very recently.



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Nor does the end user require a super micro-computer to use these data base. A fairly inexpensive and compact CD-ROM attachment can easily be fitted to an ordinary micro-computer. With suitable software to access the data, literally a world of information becomes available.

While the CD-ROM is a highly valuable information tool, it is to be hoped that on-line data bases will ultimately become more widely accessible to the developing world. One of the ways in which this could happen is through wider use of satellite communications. At present this is an expensive option, but cheaper ways of sending and receiving information by satellite are already being developed. Potentially, satellites offer developing countries a cost-effective and flexible alternative to telecommunications for gaining access to on-line data bases.

A global on-line system would make possible an almost instantaneous matching of capacities and needs. Thus, for example, a farming community in Nigeria that needed assistance in installing an irrigation system could enter a request in an international data base and immediately receive information about what capacities were available anywhere in the developing world.

We have some way to go before this goal can be attained, but an important step towards it is the recognition that information technology will increasingly be a key part of the successful implementation of TCDC.

Are 'Minicomets' Peppering the Earth's Atmosphere?

MILLIONS of tiny comets may be striking the Earth every day, according to a researcher in the US. But the comets may be disappearing in a puff of water vapour long before the ever reach the ground.

John Olivero of Pennyslvania State University believes that the disintegration of "minicomets" could explain some puzzling observations he has obtained of the upper atmosphere. While observing a particular region he noticed that roughly every three days a large amount of water vapour suddenly appeared.

Olivero's observations support a controversial theory proposed in 1986 by Louis Frank of the University of Iowa. Frank found mysterious "holes" while examining ultraviolet images of the upper atmosphere. He claimed that about 10 million minicomets — giant "snowballs," each containing about 100 tonnes of ice — were hitting the Earth everyday.

According to Frank, such minicomets would be very fragile indeed. Long before they could leave a visible trail in the sky, they would break up, dumping water vapour in the upper atmosphere.

Olivero was not looking for minicomets when he made his measurements of water vapour in the upper atmosphere. In the course of his study, however, he found evidence of this. Olivero made 22,000 separate observations, each of which lasted 20 minutes. It was during 111 of the measurement intervals that he noticed something odd : water appeared suddenly.

The water vapour anomaly occurred about once every three days. Frank had predicted that an impact in a region the size that Olivero observed should occur about once every two days — a close match.

Many astronomers are sceptical of Frank's theory. Alex Dessler of Rice University, in Houston, Texas, compares Frank's proposal to cold fusion, and points to "a vast amount of contrary evidence". For example, he says that seismometers left on the Moon by Apollo astronauts have not detected impacts of minicomets.

In addition, Dessler says that if only a few kilograms of water were dumped in the upper atmosphere, it would make the ionosphere — a charged layer — disappear locally. Although such an effect should be seen easily from the ground, no one has detected it. Finally, Dessler says that any incoming objects would have been picked up by satellites used for military surveillance.

Comets May 'Short-Circuit' Neutron Stars

MYSTERIOUS bursts of gamma-rays that astronomers have detected in the sky in recent years may be caused by comets passing through magnetic fields of neutron stars, according to researchers in the Soviet Union.

Over the past 20 years, astronomers have observed several hundred short bursts of gamma-rays. They come from different directions, none of which corresponds to a known astronomical object.

The gamma-rays have such high energies that they must be produced in a very extreme environment. Many astronomers believe that the intense gravitational field around a neutron star must be involved. Neutron stars are very compact stars, no more than 30 kilometres across, in which gravity has crushed together protons and electrons to form neutrons.

One possibility is that the nuclei of comets are hitting neutron stars. But theorists have shown that such collisions would be too rare to account for the number of bursts detected.

Now Roald Sagdeev, project scientist of the Soviet Vega mission to Halley's Comet in 1986, has re-examined the question. The Vega probes and Giotto, their counterpart from the European Space Agency, found that the nucleus of Halley's Comet was much darker than expected. Previously, astronomers had estimated the mass of comets from their brightness, with the assumption that their surfaces reflect light fairly well.

The results from Halley's Comet show that comets must be about 60 times as massive as previously thought. This means that faint comets — which are much more numerous than bright comets — should be sufficiently massive to produce bursts of gamma-rays.

According to Sagdeev, a comet does not have to hit a neutron star in order to produce gamma-rays. As the comet nucleus passes though the star's magnetic field, intense electric currents are induced in the comet and it vaporises. The ionised matter from the comet then short-circuits the magnetic field, and so produces a burst of gamma-rays. Many more comets will pass through a neutron star's magnetosphere than will hit its surface, so this idea also helps to increase the number of bursts predicted.

Sagdeev also believes that most of the gamma-ray bursts are caused by comet nuclei in interstellar space that just happen to pass unrelated neutron stars. However, astronomers have found two sources that have produced more than one burst. Sagdeev suggests that here, the comets are coming from a cloud around the star, similar to the Oort Cloud that surrounds the Sun.

What is the Greenhouse Effect ?

THE term "Greenhouse Effect" was coined by a Swedish chemist, Svante Arrhenius, in 1896. Arrhenius theorized that the burning of fossil fuels would increase the amounts of carbon dioxide in the atmosphere, and would lead to a warming of the planet. He calculated that if carbon dioxide concentrations in the atmosphere doubled, we could expect a 4.5 degree celsius temperature rise — a figure which is remarkably close to the predictions being made today.

For millions of years, this greenhouse effect has sustained life on this planet. In a greenhouse, the sun's rays enter and warm the interior, but are prevented by the glass from escaping back to the cooler air outside. Consequently, the temperature in a greenhouse is warmer than outside temperatures. Similarly, the greenhouse effect keeps our planet warmer than the bitterly cold temperatures of space. Tiny quantities of greenhouse gases in the atmosphere trap the sun's heat, warming land, air and water and allowing life forms to flourish.

Thanks to the ability of greenhouse gases to trap the sun's heat, this heat remains in the lower atmosphere long enough to evaporate water from soil, vegetation, rivers, lakes and oceans, turning it into steam which rises into the cooler heights of the atmosphere to form clouds and rain.

Before industrialization, the greenhouse gases occurring naturally in the atmosphere absorbed just enough of the sun's heat to keep the world at an average temperature of about 15 degrees celsius. Now, however, manufactured gases are trapping more and more of the sun's heat in the lower atmosphere, preventing it from escaping to space. As a result, global temperatures are forecast to rise by 2-5 degrees celsius by 2100 — and to continue rising till we reduce our emissions of greenhouse gases to an extent where their atmospheric concentrations once more approach pre-industrial levels.

Each year human activity is responsible for releasing 5.7 billion tonnes of carbon into the atmosphere, along with substantial volumes of other greenhouse gases such as chlorofluorocarbons, methane and nitrous oxide. Carbon dioxide is the major greenhouse gas, accounting for about 55 per cent of global warming. Four-fifths of all carbon dioxide emitted through human actions comes from burning fossil fuels — coal, oil and gas — and most of the rest comes from cutting down tropical forests.

Chlorofluorocarbons, used mainly in refrigeration, air conditioning, the manufacture of foams and insulation materials, and in aerosols, make the next largest contribution to global warming — around 24 per cent — while methane contributes a further 15 per cent and nitrous oxide accounts for 7 per cent .

Greenhouse gases remain in the atmosphere for decades and even centuries.

Consequently, even if we stopped all emissions tomorrow, the planet would continue to warm, and the climate would keep changing, for at least a century.

SCIENCE AND CLIMATE CHANGE

CLIMATE change is a global problem, and to meet the challenge of finding solutions requires an international and co-ordinated approach. UNEP and WMO have borne the primary responsibility for co-ordinating international studies and assessments of the likely risks of climate change, the possible effects and necessary responses.

In 1988, at the request of their governing bodies, UNEP and WMO jointly established the Intergovernmental Panel on Climate Change. Its brief was to assess the magnitude, timing and potential impacts of climate change, and to formulate recommendations for action, to provide governments with the necessary information for policy development.

The IPCC established three working groups, to investigate the science, the impacts and the possible response strategies. More than 300 scientists from 35 countries completed in two years what seemed at the time to be a ten-year task. All available science was collated; new research was carried out, and the final reports were comprehensively reviewed by top-level scientists around the world. The IPCC reports were adopted in September 1990 and presented to the Second World Climate Conference in Geneva a few months later.

The IPCC reported that the earth had already warmed by 0.5 degrees celsius in the past century. Over the same period, global sea level had increased by 10-12 cm. Five of the warmest years on record had occurred in the 1980s. That information has now been updated to six of the warmest years on record occurring in the 1980s, with 1990 breaking new ground as the hottest year on record. World-wide, glaciers have been melting at a remarkable rate, and since 1980 a dramatic and continuing decrease in the planet's snow cover has been recorded. This melting is expected to accelerate over the next few decades.

The Science working group said global warming was inevitable, as a result of the extra quantities of greenhouse gases already released into the atmosphere. It predicted that if emissions continued at their present rate, global temperature would rise by about 0.3 degrees celsius per decade — a speed of warming greater than any experienced in the past 10,000 years. The working group predicted a rise in sea levels of about 6 cm per decade over the next century.

Its report said predictions of likely global warming could not include the extra warming that would come from the reactions of natural ecosystems, oceans, ice and land masses. It also warned that climate change could well occur in abrupt, drastic shifts.

The second IPCC working group, which studied the impacts of climate change, warned that climate change was inevitable and would be irreversible. It said agriculture and forestry would be seriously affected, as would natural ecosystems, many of which would not survive the warmer temperatures.

The Impacts working group warned of water shortages as the climate changes, pointing out that in many parts of the world, relatively small changes in climate can cause large water supply problems. It said global warming would accelerate sea level rise, change ocean circulation and alter marine ecosystems, with significant adverse effects on human populations and national economies.

Rising sea levels would render some island nations uninhabitable, seriously threaten low-lying urban areas, flood productive land, displace tens of millions of people, contaminate fresh water supplies and change coastlines. All the impacts will be considerably worsened if droughts and storms become more severe.

Human health could be seriously affected, especially in urban areas, as a result of changes in the availability of water and food. There could well be increased health problems arising from heat stress and from increases in the severity and geographical spread of infectious diseases.

The IPCC warned that many of the impacts of climate change would be felt most severely in regions that are already under stress, mainly in the developing world. People most at risk as the climate changes live in developing countries, in lower income groups, on coastal lowlands or islands, or in semi-arid grasslands. They also include the urban poor in squatter settlements, slums and shanty towns, especially in megacities.

The working group dealing with response strategies highlighted the fact that industrialized and developing nations alike share a common responsibility for dealing with climate change. It said industrialized countries have particular responsibilities for taking action, party because they are responsible for most of the emissions which have begun the problem of global warming, and partly because equity demands that developing nations must be able to continue to improve their people's survival chances, and standards of living.

This third working group called for a flexible and progressive approach to reducing greenhouse gas emissions. It said strategies would have to include measures to deal with the rate of growth of the world population.

In the shorter term, it recommended improvements in energy efficiency, use of cleaner energy sources and technologies, improved forest management and afforestation, a complete phase-out of chlorofluorocarbons, and changes in agricultural management practices and waste disposal methods.

It recommended emergency and disaster preparedness policies and programmes, risk assessment and management plans for vulnerable populations, and improvements in the efficiency of natural resource use — including control measures for desertification and enhanced adaptability of crops to more saline environments.

Plant Fungus Keeps its Host in Good Health

A rare fungus discovered in Western Australia could one day control some of the common diseases and pests that attack crops. The sterile red fungus— so-called because it produces no fruiting bodies or spores— establishes itself inside the roots of a plant. It then appears to both protect and stimulate the growth of its host.

Scientists from the University of Western Australia in Perth discovered the sterile red fungus in late 1987. They have been carrying out research and field trials since 1988, together with colleagues from Biotech International, a company in Perth. The results of the trials are now emerging.

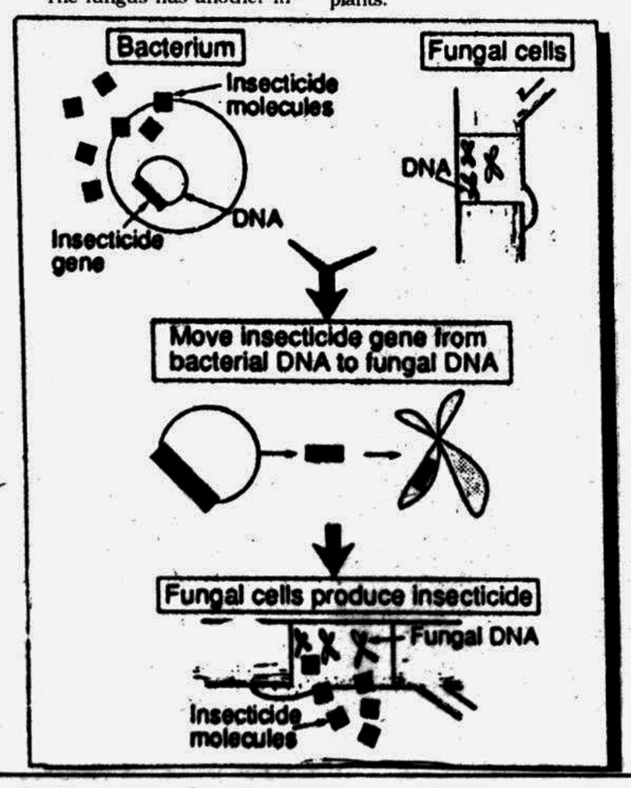
So far, the researchers have tested the sterile red fungus on about 40 species of plant— ranging from cereal crops such as wheat to species that are native to Australia, such as eucalyptus. The fungus makes plants grow faster and increases the yield of crops by up to 40 per cent.

In each species, the fungus appears to prevent damaging diseases, such as fungal infections that rot the plants' roots. Such diseases are the most significant cause of lost cereal crops in Western Australia, and there are many areas in Australia where the risk of root-rotting disease is so high that farmers have no choice but to avoid growing cereal crops completely.

Peter Keating, Biotech International's director of research and development, says that the fungus secretes a protein that appears to have an antibiotic effect against other fungi. At the same time, it secretes another chemical that stimulates the growth of roots.

"There is a principle in microbiology : first in, best dressed," says Keating. "So if there is a beneficial fungus living in the roots of a plant, pathogenic (disease-causing) fungi can't get in."

The fungus has another intriguing property that makes it unique, says Keating. It appears to infect every type of plant the researchers have tested it on. Usually, fungi that interact with plants are specific to a particular group of plants.



The researchers have used a culture of the sterile red fungus in the laboratory to treat native plants at the micro-propagation stage. They applied the culture directly to crop seeds such as wheat. Field trials also took place in various areas of Western Australia towards the end of last year.

According to Keating, the trials demonstrated that the growth seen in the laboratory can also be achieved in the field.

On the strength of the trials, the researchers have won the cooperation of most state agriculture departments in Australia, and larger-scale field trials will be carried out in 1990. "We expect that by 1990, we'll be producing the fungus for the wheat industry and for horticultural applications," says Keating.

The prospect of genetically engineering sterile red fungus has excited researchers. It could be manipulated to produce tailor-made secretions within a host plant— resulting in what the team calls "indirect genetic engineering of plants".

It might be possible, for example, to make the fungus produce a protein secretion similar to BT Toxin—a chemical which controls budworm and which is sprayed seasonally on spruce forests in Canada. The host plant of the fungus would then find itself in possession of a lifelong supply of "natural insecticide".

This sort of insecticide might protect a plant against a particular pest or even a class of pests. Some agricultural pesticides could be rendered obsolete.

Already, the Australian government has provided A $650,000 (£325,000) for the work, the largest research grant ever received by the university.

There is also some evidence, which has yet to be confirmed, that the sterile red fungus can fix small amounts of nitrogen from the air. Biologists believed that only some bacteria and blue-green algae can do this. If the fungus does indeed fix nitrogen, then this mechanism could be enhanced by genetic manipulation. A plant infected with such a modified fungus would posses a built-in source of fertiliser.

Keating believes that genetically engineered varieties of the sterile red fungus are likely to be environmentally safe. The sterility of the fungus prevents it from forming spores.

The researchers are still puzzled about how the fungus manages to propagate in the wild. They suspect that it is a natural mutant of another fungus, so far unidentified. At the moment, they are attempting to build its "genetic profile", so that they can identify it by its DNA rather than by its appearance. — I.W.

In Food Chain, Odd Is Green

A novel experiment with fish, insects and algae in a California river has uncovered new evidence in favour of a rather simple ecological theory involving the greening of the Earth. It holds that plants are suppressed when there are even numbers of levels in the food chain of a given habitat, but flourish when there are odd numbers.

The researchers experimentally manipulated a four-level food chain in which steelhead trout and smaller fish ate dragonfly and damselfly nymphs, which in turn preyed on the larvae of tiny, two-winged insects called midges, which in turn fed on algae. In this four-level arrangement, the river was rendered largely barren of algae each summer.

But when researchers removed the fish from the top of the chain, it was disrupted in such a way that the algae increased a hundredfold, carpeting the water with floating mats and thick green, 5-yard-long (4.5 meters) braids of summer growth.