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Sustainability and The Role of Information and Communication Technologies

Dr. Shalini Singh, Assistant Professor, Department of MBA
Cambridge Institute of Technology, Ranchi

Abstract

We live in a world divided between rich and poor, healthy and sick, literacy and ignorant, democratic and authoritarian, and strong and private. All the technologies we have developed in recent centuries and all the policies we have adopted to improve human development have not eliminated these glaring disparities. As the 21st-century approaches, we are faced with two conflicting scenarios for the future of the human species. On the one hand, there are possibilities of a bright future with press button life, space shuttles, information technology, genetic engineering, and other advances in science and technology. On the other hand, a dark scenario emerges with a population in full expansion, deprived of resources and suffocated by pollution. Faced with such a critical situation where we are at a crossroads to choose between environment and development, we feel the need for "Sustainable development".

Citizens and governments are increasingly aware that policy innovations and social change are essential for technology to work for the common good. It is being realized that a large fraction of the global population is stuck in poverty, undernourishment and ICT can help eliminate such glaring disparities. ICT can indeed be shaped to become an important tool. This paper tries to outline the contours of sustainable development and the role of Information and Communication Technology in sustainable development.

Introduction

In 1987 the world commission on environment and development to the United Nations (UNCED) was established. The Commission published the famous Brundtland report which defined sustainable development as

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

This has been interpreted as meaning that each generation must rely on the use of renewable sources of energy and should reuse and recycle waste before considering removing new resources from the land that cannot be replaced. In this way, we must adopt a way of life which passes on the earth's resources undiminished to the next generation The key objective of sustainability includes:

Reviving economic growth so that it has a reduced impact on the environment by using

A. Fewer materials and energy

B. Maintain a sustainable population level.

C. Conserving and enhancing our natural resource base

D. Reorienting technology and managing risk.

E. Blending ecological and economic considerations into decision-making.

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We must plan for "development without destruction" and manage our environment based on the ethical principle of social and economic equality and ecological sustainability. Environmental management and sustainable development programs should work in tandem. The key to growing sustainable is not to produce less but to produce differently in a way that is environmentally friendly and compatible i.e., by adopting the philosophy of "cleaner production"; not to consume less, but to consume wisely and efficiently within the limits of the capacity to regenerate the Earth's ecosystems and with a minimum of waste generation.

GLOBAL TARGETS OF DEVELOPMENT

A number of meetings were held on the question of development. The most important amongst them have been: Agenda 21, Millennium Development goals (MDGs), Johannesburg Summit, and the World Summit on Information Society. The Millennium Declaration was adopted by the Member States of the UN in September 2000, followed by the Millennium Development Goals.

Millennium Development Goals:

1. Eradicate Extreme Poverty and hunger
2. Attain universal primary education.
3. Promote gender equality and empower women
4. Reduce child mortality.
5. Improve maternal health.
6. Combat HIV/AIDS, malaria, and other diseases.
7. Ensure environmental sustainability.
8. Develop a global partnership for development.

ICT is recognized as an all-purpose enabling tool for development. Here, the debate is not one of "either-or" but of complementarity. ICT will not directly realize the Millennium Development Goals (MDGs) but will be an important tool in achieving the same.

Concept of Environmental Sustainability

Environmental sustainability involves making decisions and taking actions that are in the interests of protecting the natural world with particular emphasis on preserving the capability of the environment to support human life. Key components include:

i) Resource Management: It is a purposeful activity that aims to maintain and improve the state of an environmental resource affected by human activities. It tries to identify the factors that have a stake in the conflicts that may arise between meeting the needs and protecting the resources. Environmental resource management aims to ensure that ecosystem services are protected and maintained for equitable use by future human generations.

ii) Environment protection: It is a practice of protecting the natural environment on individual, organizational or governmental levels, for the benefit of the natural environment and humans. Environmental protection is influenced by three interwoven factors: environmental legislation, ethics, and education.

iii) Habitat Restoration and Preservation: This activity aims at returning a degraded or former habitat to a healthy, self-sustaining condition that resembles as closely as possible its disturbed state.

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ICT for Development

A few technologies are classified as all-purpose technologies. They become an indispensable element in society's portfolio of development. Over a period, their contribution to economic and human development becomes large replacing older and less efficient methods. The rapid diffusion of new communication technologies suggests that innovations from ICT for sustainable development can also be faster than the progression shown by earlier technologies. This could provide the corporation with targeted tools for sustainability programs.

ICT is now a part of development. Information and Communication Technology by its performance and potential offers numerous options to help realize the Millennium Development goals (MDGs)

The following initiatives are required to make the ICT engine drive sustainable development:

1) **Improve ICT across the 4C dimensions**

a) **Computing:** ICT is more than computers, and the various thematic areas of sustainable development require innovations in hardware and software for applications such as sensors, control systems, etc. computers and other devices must become affordable and rugged for use without extensive maintenance, security efforts or other specialized skills.
b) **Connectivity:** Developing countries, especially rural areas are without connectivity. Universal access calls for new networks and business models. ICT is more than connecting to the internet, Human development programs require integration of all forms of ICT and Media such as Mobile Telephony, radio, etc.
c) **Content:** ICT will become relevant to Sustainable development if it provides relevant content to end-users. One requirement is of tools to make it easier for people to become producers of content and information, instead of just consumers. This involves developing appropriate solutions to overcome barriers related to language, the complexity of information, and incompatible or missing structure.
d) **Capacity:** Most people lack awareness of the potential of ICT and beyond technical barriers, many limitations to incorporating ICT are social, cultural, or economic. The first goal for governments must be to increase literacy among its population especially for the disadvantaged as women.

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2) Success of ICT for Sustainable Development requires Integration, Scalability, and Sustainability.

GOAL/TARGET	ROLE OF ICTs
1. Eradicate extreme poverty and hunger	Increase access to market information and reduce transaction costs for poor farmers and traders. Improve efficiency, competitiveness, and market access for enterprises in developing countries. Enhance the ability of developing countries to participate in the global economy and to exploit a comparative advantage in factor costs.
2. Achieve universal primary education Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.	Increase the supply of trained teachers through ICT-enhanced and distance training of teachers and networks that link teachers to their colleagues. Improve the efficiency and effectiveness of education ministries and related bodies through the strategic application of technologies and ICT-enabled skill development.
3. Promote gender equality and empower women	Deliver educational and literacy programs specifically targeted to poor girls and women using appropriate technologies. Influence public opinion about gender equality through information or communication programs using a range of ICT.
4. Reduce Child mortality	Enhance the delivery of basic and in-service training of health workers
5. Combat HIV/AIDS,malaria, and other diseases	Increase access to reproductive health information, including information on AIDS prevention, through locally appropriate content in local languages.
6. Ensure environmental sustainability Implement national strategies for sustainable development by 2005 so as to reverse the loss of environmental resources by 2015.	Remote sensing technologies and communications networks permit more effective monitoring, resource management, mitigation of environmental risks. Increase access to/ awareness of sustainable development strategies in areas such as agriculture, sanitation, water management, mining, etc.

ICT AND SUSTAINABLE DEVELOPMENT

ICT can be used for Sustainable Development:

1) Infrastructure Development
    a) Energy
    b) Water
    c) Transportation
2) Basic Human Needs and Development
    a) Food
    b) Healthcare
    c) Drinking Water
    d) Primary Education
3) Economic Growth and Poverty Reduction
    a) Agriculture growth

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b) Higher Education
c) Job Creation
d) e-Commerce

4) Alienation, Empowerement, and Governance
    a) National and international inclusiveness
    b) Democracy
    c) E-Governance

- **Water and Sanitation**

Freshwater is necessary for virtually all life on Earth. Humans require clean water not only for drinking but also for cooking, personal hygiene, and reducing disease. Unfortunately, much of the world lacks water and sanitation. The target of MDG is to halve by 2015, the proportion of people without sustainable access to safe drinking water and sanitation.

Challenges

1) Provide drinking water to the world's population; about 1.5 billion will lack sustainable access by 2015.
2) Provide improved sanitation access to the world's population; about 2 billion will lack sustainable access by 2015.
3) Ensure water quality and health standards are met for water consumption.
4) Ensure sustainability of water e.g. without depleting groundwater resources.
5) Make water available for non-drinking uses, primarily agriculture but also commercial and other economic uses.

Role of ICT

ICT can help in the following areas:

- Assess supply adequacy, modeling different supply and technology alternatives and factors in different usage technologies. This can include the development of dynamic Geographic Information Systems (GIS) for identifying water availability, storage, transmission, and distribution.
- Quality monitoring, especially through low-cost sensors. The quality of water impacts healthcare, agriculture, and industry.
- Optimise the allocation between different uses of water
- Water use management at a societal level including distribution systems that incorporate loss reduction

- Energy

Energy use is the energy for development. Energy generates energy, drives development, feeds and moves the civilization. Energy is used in every area of human endeavor.

Challenges

- Provide energy and electricity services to all households who lack access today; this number is at least several hundred million. Increasing electricity penetration and consumption would also require an increased supply of electricity and generation.
- Increase the use of environmentally appropriate and sustainable fuels, such as renewable.
- Reduce the losses in energy systems, both technical as well as theft. Devise alternative technologies that have higher efficiencies.

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Role of ICT

Role of ICT can be for:

- Data collection and system level use
    - Metering at all levels (e.g. digital meters that are cheaper than electro-mechanical and can incorporate control and communications)
    - Smart control of distributed resources and microgrids.
- Resource and needs assessment

➢ Food and Agriculture

Food is a basic human need, and agriculture employs the bulk of the global population. The MDG target of halving the number of undernourished by 2015 is difficult to realize at the current rate of reduction of hungry individuals. Also, agriculture is to be made sustainable –environmentally and economically. Sustainability is a fundamental part of long-term agriculture which is based on-

- Preserving the natural resource base
- Maintaining the soil's productivity
- Maintaining environmental quality

Role of ICT

- Sensors and information systems to optimize inputs as a function of soil, water, crops and environmental conditions.
- Interaction with experts - two-way audio-visual communications for pest management e.g. diagnosis of diseases by means of digital images and expert advice.
- Marketing and logistics improved-price discovery, trading power and supply chain efficiency.

➢ **Technology for sustainable means of subsistence.**

To be more specific, the central goal today for any developing country must be to create sustainable livelihoods, rather a large number of sustainable livelihoods. For example, to close the unemployment gap by the year 2010, India will need to create more than 12 million, perhaps as many as 15 million, off-farm jobs each year, starting today.

The second objective, for India at least, is to accelerate the rate of economic growth. While the nation's planners debate whether this rate should be 6% or 7% per year, eradication of poverty within a reasonable time-frame will require growth rates in the double digit region, perhaps as high as 15–18%.

Small businesses are the backbone of the national economy. They represent more than 60 per cent of industrial production in India and more than 65 per cent of industrial exports. They represent more than 70 per cent of industrial employment. They could represent an even bigger share, but the price distortions introduced by highly biased subsidy schemes and infrastructure investments.

However, being small, scattered and widely unregulated, their environmental and social impacts are often very negative. To overcome this, they require access to better technologies and other supports.

Many of the technologies that are needed for such enterprises already exist. So do the markets for their products. Many of the technologies needed by these businesses already exist. Much more public

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investment is needed to provide these, but probably not nearly as much as is being made today for the benefit of large, urban industries.

Even if all these conditions were not fulfilled, if SMEs had access to appropriate technology, credit, marketing channels and management expertise, they would largely overcome the remaining obstacles. Even if those conditions were not met, if SMEs had access to appropriate technology, credit, marketing channels and management expertise, they would largely overcome the remaining barriers. There are many microtechnologies out there. Industries that could be set up today and run profitably, which require capital ranging from Rs 20,000 to Rs 10 lakhs.

These companies can generally create multiple jobs, each at a cost below Rs 20,000, plus a similar number of jobs upstream or downstream at an even lower cost. In the village or small town such workplaces yield incomes for workers whose purchasing power is compared to the cost in large urban industries. At the same time, they enable very high returns on investment, often with recovery periods of less than one year.

- **Funding science for sustainable development**

There is no better investment in society than its population: its health, education, and well-being. But another investment that comes close to potential returns is scientific research.

All successful economies recognize scientific innovation as a critical component of any major economic activity. Experience in the United States, Japan, and Germany has shown that R&D spending is often offset by efficiencies, improved productivity, and better conservation of resources. In addition, national competitiveness is highly correlated with spending on science and innovation.

For almost any sector of the economy in these countries – construction, transportation, communication, industry, agriculture, etc.– general R&D expenses represent between 1% and 4% of the total turnover of this sector. In specialized scientific areas such as space, electronics, software, defense, pharmaceuticals, those R and D expenditures can easily exceed 10%. Even the private sector recognizes the need to invest in research and is making a significant contribution.

Since the 1950s, the Government of India has also recognized the importance of research and has made a major commitment of public funds to R&D. During most of this period, it spent nearly 1% of its GNP on science, although this figure is declining somewhat. It is a bigger budget for science than in any other developing country, and even bigger than in many developed countries.

However, most of that money has been spent on supporting science, which can only benefit a small minority in this country. These include space research, atomic energy, defense, high-tech industrial applications, input-intensive agriculture, and curative medicine. Apart from a small fraction of the research in agriculture and medicine, very little can be shown to have a direct or even indirect impact on the lives of the weaker sections of society.

Another interesting calculation is the relative funding available from the government for 'science and society as a percentage of total allocations to scientific research. Total scientific allocations in recent days were approximately Rs 10,000 crores per year. Allocations for science, relevant to the problems of the poor, amount, was less than Rs 20 crores. Thus, again, it would appear that, in the eyes of our decision-makers, research to solve the problems of 70% of the people of India appears to be meritless than 0.2% of the allocation made for the remaining 30%. On a per-capita basis, we place 1,000 times as much money for research of interest to the rich, urban middle class as we do for research aimed at the problems of real people.

In such circumstances, the rich inevitably enrich themselves and the poor can only be poorer. Our science policy thus serves directly to increase disparities in our country and is totally contrary to national objectives of equity and social justice.

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This is clearly ridiculous. There have been many arguments against funding scientific research on sustainable development issues. They are generally associated with issues such as "the need for urgent action rather than research". Neither of these arguments is substantive. For example, money on research in glamorous areas has been forthcoming in huge floods – witness the atomic energy programme, the space programme, the electronic programme, the super conductivity programme, the green revolution programme and many others. None of these had absorptive capacity at the outset. It was rapidly built up by making massive investments in it.

We now need the same commitment and investment in research aimed at eradicating poverty and generating livelihoods – in terms of sustainable development – and absorption capacity will develop automatically. And only thus can our scientific effort begin to address the nation's priorities.

- **A framework for sustainable technologies:**

At a local level, we need new forms of institutions that can achieve social goals and work like businesses. NDDB, C-DAC, C-DOT provide excellent examples. For such institutions to deliver successful results, they can be neither in the public sector nor the private. Or rather, they must have the best of both. One such independent institutional framework has been designed and is currently being implemented and tested in India at Development Alternatives.

At the national level, a large-scale commitment is needed to put in place institutional mechanisms to place the scientific development of sustainable technologies at the center of the country's agenda.

Therefore, we may conclude that a completely autonomous institution be established, which will comprise a network of local units throughout the country, capable of handling geographically or topically relevant societal problems. In terms of coverage, the concept could be modeled after the CSIR network of national and regional research laboratories. However, in the scope of work, mode of operation, and linkages with the economic sectors it deals with, its structure and functions will be entirely different from that of CSIR.

It will use a business R&D approach to identify and solve fundamental societal development problems. This means that, unlike CSIR, it will not only undertake laboratory and prototype-level R&D but will go all the way through productionizing and proving commercial viability by the actual operation of model enterprises.

Taking a systemic view of its mandate and work, such an organization, will, if it is properly designed, be able to have an impact on the lives of the poor, which is several orders of magnitude higher than that of any existing institution in this field,

The absorptive capacity of this institution can easily be built up within a few years to employ a reasonable fraction of the good scientific minds presently under-employed in the country and to utilize funds similar in magnitude to those currently being spent on conventional scientific research. Only thus can we begin to hope for the needed improvement in the lives of the majority of our people.

And every measure necessary must be taken with the highest urgency to attract the best young minds in our country to the study of science

Future Technological Development for Sustainable development

- Commercialization of clear hydrogen fuel for automobiles and solar, wind, geothermal, and oceanic energy for utility power generation.
- Making the conventional energy sources more clean and green and thus more sustainable.
- More efficient energy use and conservation homes, institutions, and industries.
- Cost-effective technology for water and wastewater.

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- More recycling of all municipal and industrial wastes for their safe disposal and conversion into valuable resources.
- More dematerialization technology to increase the efficiency of natural resource use and reduce their waste.
- More recycling for all municipal and industrial wastes, for their safe disposal and conversion into valuable resources.
- Degrading the existing non-biodegradable plastic wastes, and development and commercialization of biodegradable plastics.

Some of the remarkable technological achievements made for sustainable development are:

- More fuel-efficient, quieter, and less polluting automobiles driven on environmentally benign auto-fuels like compressed natural gas (CNG), LPG, and Ethanol.
- More energy-efficient electrical appliances and instruments.
- The 'fuel-gas desulfurization technology' (FGDT) in coal power plants has led to a significant reduction in sulfur dioxide.
- The 'coal-gasification technology' (CGT) in coal power plants has led to a significant reduction in greenhouse gas dioxide (CO_2).
- The 'solar photovoltaic call technology' (SPVCT) has brought a new era in economic lighting and devices.
- Partial plugging of the ozone hole in the stratosphere has been achieved by developing lesser evil substitute hydrochlorofluorocarbon (HCFC) which has 30% less ODP than CFC.
- Hybridization technology and agri-biotechnology have produced high-yielding varieties of crops.
- Biological control of pests has become more effective after scientific improvement of herbal pesticides.
- A significant reduction in the waste of potable water has been achieved by developing 'automatic closing taps' water-efficient showers and dual-flushing cisterns.

Conclusion:

It is impossible to separate economic development issues from environmental issues. Sustainability in human society with good quality of life for all can be achieved in two ways:

- By persuading the people to behave ethically towards the environment, reduce consumption and have a simpler lifestyle.
- By embracing the philosophy of sustainable development with appropriate technologies that allow people to enjoy the same good quality of life with a high standard of living but at a significantly lower 'environmental cost.'

Given the difficulty of changing people, the second option appears more pragmatic. Mankind will perish if the protection of the environment does not become an integral part of all technological development, planning, and management. Making economic development programs less dependent upon 'fossil fuels and more dependent on renewable energy sources is the need of the hour. ICT, if used appropriately for sustainable development can definitely meet the goals of sustainable development.

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