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ABSTRACT

Extreme poverty, experienced by approximately 1.2 billion people, is considered by many to be the most significant crises in the world today. To give focus to the task of poverty reduction, in September 2000, the United Nations has established eight Millennium Development Goals to be achieved by 2015. The goals cover many areas, including income, education, gender equality, children mortality, maternal health, combating HIV/AIDS and other diseases, environmental sustainability and partnership for development.

The World Summit on the Information Society (WSIS) endorsed the importance role that information and communication technologies play in achieving these goals. Since poverty is multi-dimensional, the solution is complex. We examine the role that information and communication technologies play in helping to solve this complex issue. We present case studies that are organized into the Millennium Development Goal categories.

Keywords

Information and Communication Technologies, ICT, Millennium Development Goals

INTRODUCTION

"Like slavery and apartheid, poverty is not natural. It is man-made and it can be overcome and eradicated by the actions of human beings.

… While poverty persists, there is no true freedom."

(Nelson Mandela, speech in Trafalgar Square, London, 02-04-2005)

Today, poverty is pervasive, large, and complex. Approximately 25 percent of people of developing countries, or about 1.2 billion people, live in extreme poverty. Most live in South Asia and sub-Saharan Africa. South Asia accounts for 41 percent of the world's poor people; 21 percent of the world's poor people live in sub-Saharan Africa.

To reduce poverty in the world, in September 2000, in the largest ever gathering of Heads of State, member States adopted the "United Nations Millennium Declaration." This declaration contains eight Millennium Development Goals (www.un.org/millenniumgoals/). The MDGs detailed 18 specific development targets, each of which must be achieved by 2015. The goals cover many types of poverty including income, education, gender equality, children mortality, maternal health, combating HIV/AIDS and other diseases, environmental sustainability and partnership for development.

The World Summit on the Information Society (WSIS), which took place in Tunisia in November 2005, endorsed the importance of the role information and communication technologies (ICTs) can play in achieving these goals (http://www.itu.int/wsis/).

Information and Communication Technology plays a major role in all aspects of our daily life. It is rapidly transforming our lives, the way we do business, access information and services, and communicate with each other. ICT is defined as "A combination of manufacturing and services industries that capture, transmit, and display data and information electronically" (OECD, 1998). Among the broad set of MDGs, one stands out: "Make available the benefits of new technologies – especially Information and Communication Technologies (ICTs)". New technology, like ICT, is considered among the greatest enablers for improving the quality of life. However, the majority of ICT valuations have been directed to the industrialized and developed countries. ICT has the potential to affect a variety of fields ranging from economic efficiency to healthcare and education.

Since poverty is multi-dimensional, the solution is complex. ICT can enable new solutions only when applied with a cooperative approach from stakeholders. Governments, civil societies, private sectors, and academic communities all have an important role to play. This paper discusses the role of ICT in poverty reduction. We examine the role that information and

communication technologies play in helping to solve this complex issue.

We begin by focusing on poverty in the world. The discussion begins by defining the UNDP's (http://www.undp.org/) Human Poverty Indices. We then concentrate on *best practices* in ICT for poverty reduction. We conclude by discussing three ICT case studies for poverty reduction, organized into the Millennium Development Goal categories.

HUMAN POVERTY INDEX

The United Nations has defined poverty as the "denial of choices and opportunities most basic to human development-to lead a long healthy, creative life and enjoy a decent standard of living, freedom, self esteem and the respect of others"(UNDP, HDR 1997).

While the Human Development Index (HDI) measures the progress of the country in achieving development, the Human Poverty Index (HPI) is aimed at reflecting how the progress is distributed. HPI displays the level of destitution and poverty being experienced. There are two HPI indices most commonly used. HPI-1 is a measure of absolute poverty used in Less Developed Countries (LDC) and HPI-2 is a measure of relative poverty used in More Developed Countries (MDC).

The variables used for determining HPI-1 are:

- The percentage of people expected to die before age 40
- The percentage of adults who are illiterate
- Deprivation in overall economic provisioning-public and private-reflected by the percentage of people without access to health services and safe water and the percentage of underweight children under five years of age

HPI-2 measures human poverty in industrial countries. Since human privation varies with the social and economic conditions of a community, this separate index has been devised for industrial countries. It focuses on deprivation in the same three dimensions as HPI-1 although with an adjusted set of criteria and one additional criteria, social exclusion measured by low incomes and long-term unemployment. The variables used for identifying HPI-2 are:

- The percentage of people likely to die before age 60
- The percentage of people whose ability to read and write is far from adequate
- The proportion of people with disposable incomes of less than 50% of the median
- The proportion of long-term unemployed (12 months or more)

POVERTY IN THE WORLD

Of the world's 6 billion people, almost half of them live on the less than $2 a day, and a fifth – 1.2 billion – live in extreme poverty on less than $1 a day. In poorest countries, more than 20 percent of children do not reach their fifth birthday, and at the same time, 50 percent of children in poor countries are malnourished.

While global wealth, global connections, and technological capabilities have been improved in recent decades, but the distribution of these achievements is extraordinary unequal. Most poor people – 680 million – in the world live extreme poverty in Sub-Saharan Africa and South Asia. Meanwhile, million of poor people live in East Asia and Pacific, Latin America, Middle East and North of Africa, and Europe and Central Asia. The following studies poverty in less developed and developing countries around the world.

Sub-Saharan Africa

In this region of the world, 231 million people or 31.6 percent of the population live in extreme poverty. Niger has the worst HPI-1 at 64.4 percent. Eleven countries have a HPI-1 greater than 45 percent (Figure 1).

In eleven countries, in Sub-Saharan Africa, more than 50 percent of people live in extreme poverty. Due to individual elements of the HPI-1, in Niger:

- 61.4 percent of people live with maximum US$1 a day.
- 85.3 percent of people live with maximum US$2 a day.
- 41.1 percent of people do not survive to age 40.
- 85.6 percent of adult are illiterate.
- 54.0 percent of people do not have access to clean water.
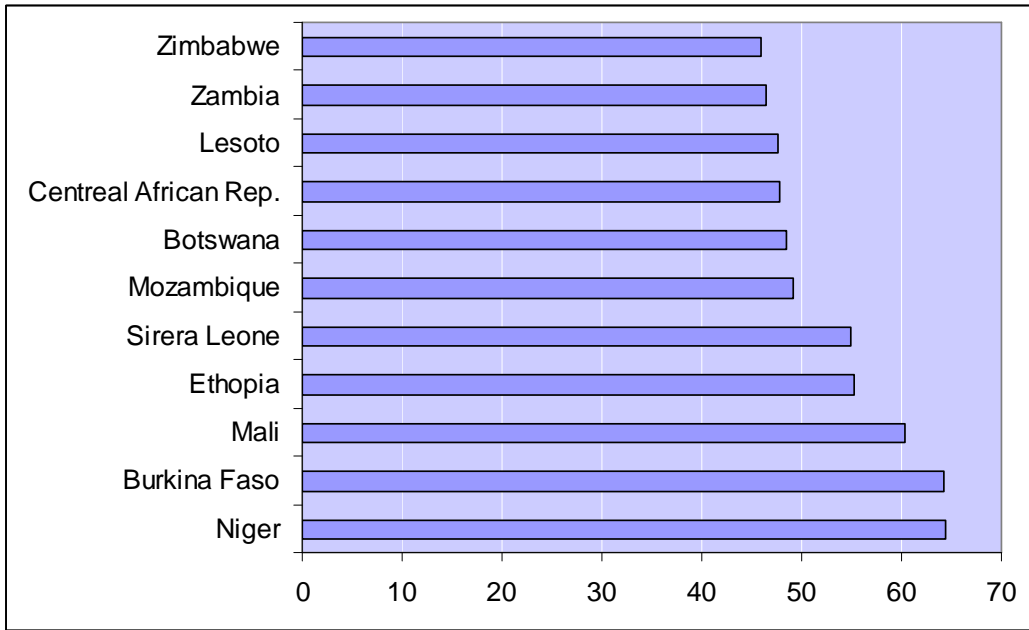- 40.0 percent of children under age five are underweight.

Figure 1 Human Poverty in developing sub-Saharan Africa HPI %
(Source: UNDP. 2005, Human Development Report)

South Asia

Approximately 32 percent of the populations of developing countries in South Asia, or approximately 452 million people, live in extreme poverty with a maximum US$1 a day. All of the countries in this part of the world, except Mauritius, have an HPI-1 index greater than 15 percent (Figure 2).
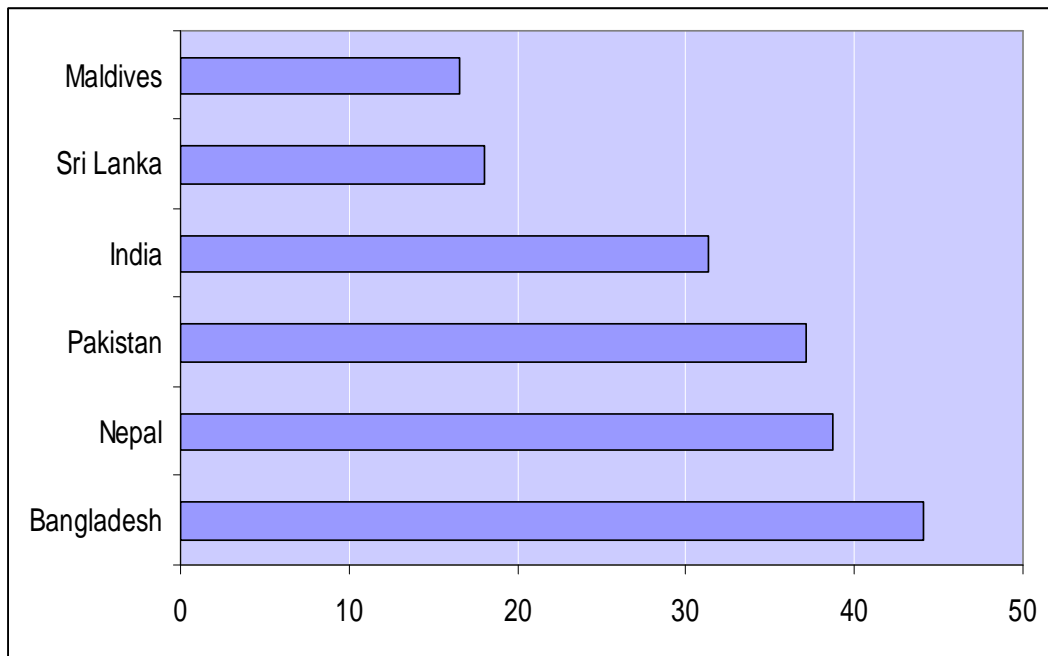

Figure 2 Human Poverty in developing South Asia HPI %
(Source: UNDP. 2005, Human Development Report)

This includes:

- 36.0 percent of Bangladeshi people live with maximum US$1 a day
- 82.8 percent of Bangladeshi people live with maximum US$2 a day.
- 15.9 percent of Bangladeshi people do not survive to age 40.
- 58.9 percent of Bangladeshi adult are illiterate.
- 25.0 percent of Bangladeshi people are not using clean water.
- 48.0 percent of Bangladeshi children under age five are underweight.

East Asia and Pacific

In East Asia and the Pacific, 269 million people or 15.3 percent of the population live in extreme poverty, including eight countries have a HPI-1 greater than 15 percent (Figure 3). Cambodia has the worst HPI-1 index at 41.3 percent.
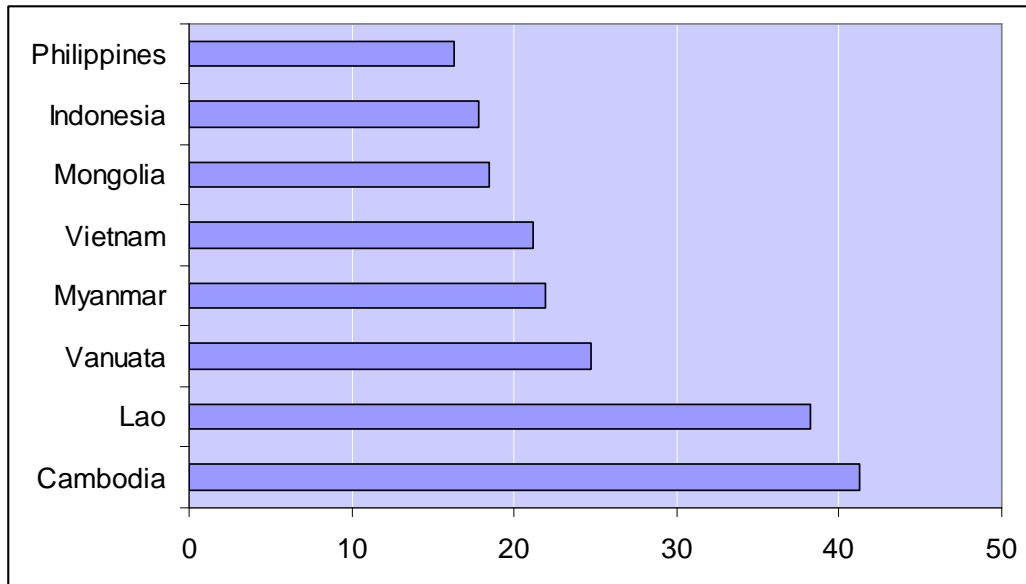

Figure 3 Human Poverty in developing East Asia and Pacific HPI %
(Source: UNDP. 2005, Human Development Report)

In Cambodia:

- 34.1 percent of people live with maximum US$1 a day.
- 77.7 percent of people live with maximum US$2 a day.
- 28.3 percent of people do not survive to age 40.
- 26.4 percent of adult are illiterate.
- 66.0 percent of people do not have access to clean water.
- 45.0 percent of children under age five are underweight.

Latin America

In Latin America, 50 million people or 10 percent of the population live in the extreme poverty. Haiti has the worst HPI-1 index at 38.0 percent. Seven countries have a HPI-1 greater than 15 percent (Figure 4). In Haiti:

- 65.0 percent of Haitian people live under national poverty line.
- 34.4 percent of Haitian people do not survive to age 40.
- 48.1 percent of Haitian adult are illiterate.
- 29.0 percent of Haitian people are not using clean water.
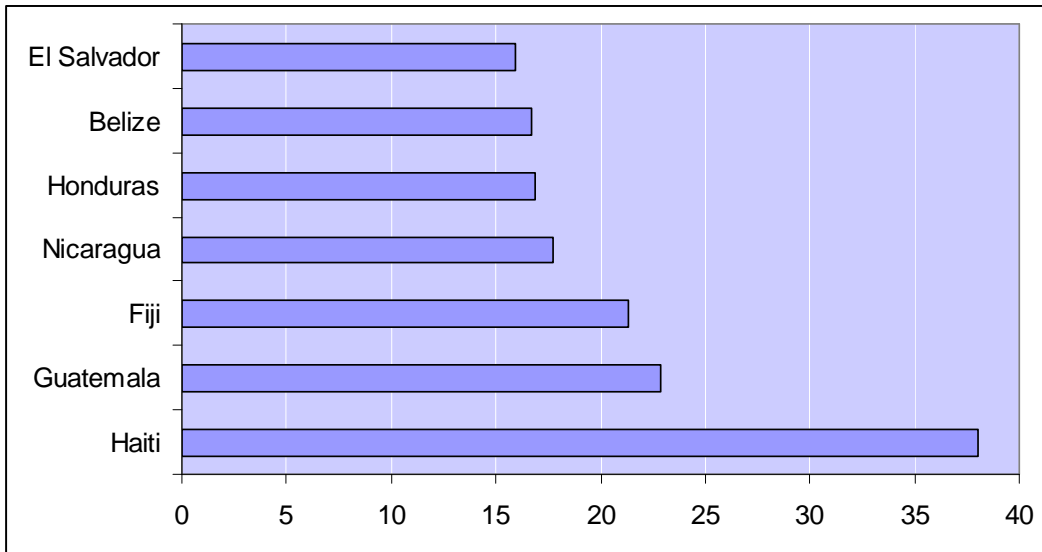- 17.0 percent of Haitian children under age five are underweight.

Figure 4 Human Poverty in developing Latin America HPI %
(Source: UNDP. 2005, Human Development Report)

Middle East and North of Africa

Eight million of 232 million people or 3.5 percent of the population lives in the extreme poverty. Seven countries have an HPI-1 index greater than 15 percent (Figure 5). In Yemen:

- 15.7 percent of people live with maximum US$1 a day.
- 45.2 percent of people live with maximum US$2 a day.
- 18.8 percent of people do not survive to age 40.
- 51.0 percent of adult are illiterate.
- 31.0 percent of people do not have access to clean water.
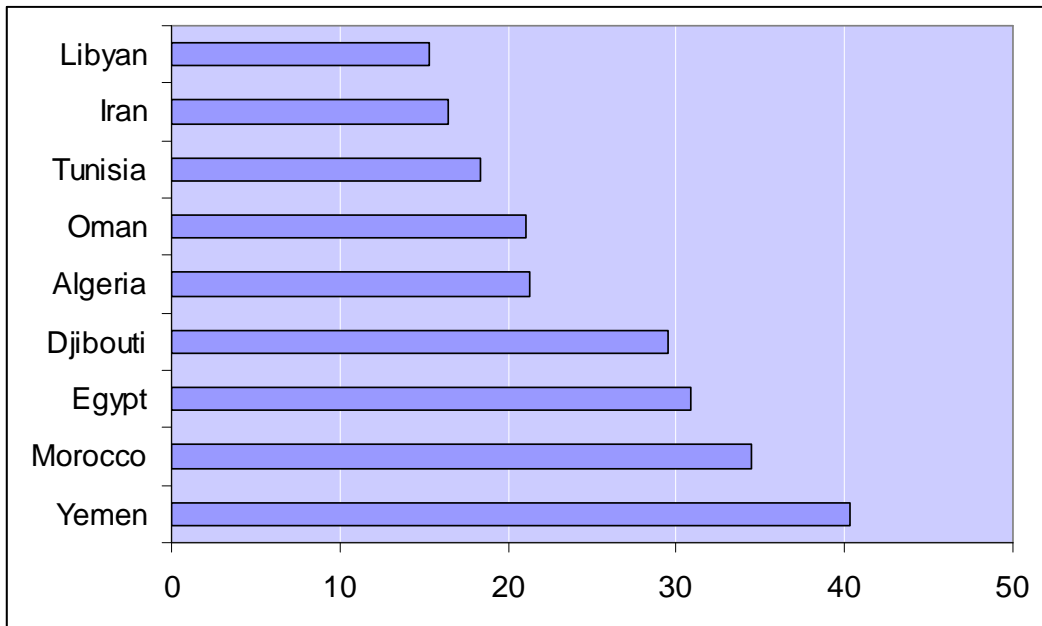- 46.0 percent of children under age five are underweight.

Figure 5 Human Poverty in developing Latin America HPI %
(Source: UNDP. 2005, Human Development Report)

THE MILLENNIUM DEVELOPMENT GOALS

In September 2000, at the United Nations Millennium Summit, world leaders agreed to set of time-bound and measurable goals and targets for combating poverty, hunger, disease, illiteracy, environmental degradation and discrimination against women, called the Millennium Development Goals (MDGs). The summit's Millennium Declaration, a document signed by 189 countries including 147 Heads of States, defined eight goals to be achieved by 2015.

1. *Eradicate extreme poverty and hunger:* Halve, between 1990 and 2015, the proportion of people whose income is less than US$1 a day.

2. *Achieve universal primary education:* Ensure that by 2015, children, anywhere, will be able to complete primary school.

3. *Promote gender equality and empower women:* Eliminate gender disparity in primary and secondary education sooner than 2005 and in all level of education no later than 2015.

4. *Reduce child mortality:* Reduce by two-third, between 1990 and 2015, the under-five mortality rate.

5. *Improve maternal health:* Reduce by three-quarter the maternal mortality by 2015.

6. *Combat HIV/AIDS, malaria, and other diseases:* Have halted and begun to reverse the spread of HIV/AIDS, malaria, and other major diseases by 2015.

7. *Ensure environmental sustainability:* Halve the proportion of people without sustainable access to safe drinking water by 2015.

8. *Develop a global partnership for development:* Develop further an open, rule-based, predictable system.

ICT and THE MILLENNIUM DEVELOPMENT GOALS

There is more to human development than the MDGs, but progress towards the MDGs reflects progress towards development. In the same year, the G-8 established the Digital Opportunity Task Force (DOT Force) to conduct the forces of new technologies to shrink social and economic inequalities by making the benefits from new technologies, like Information and Telecommunication Technology (ICT), accessible for all people.

ICT and Poverty

The role of ICT in combating poverty and fostering sustainable development has been the subject of much debate and experimentation during the last decade. The contrast between the complexity and expense of some of these technologies and the urgent, basic needs of the poor has led some to doubt whether ICT should be a priority for developing countries (Marker, McNamara and Wallace, 2002).

Lack of access to ICT is clearly not a primary problem of impoverished nations as compared to poor nutrition or inadequate shelter (Kenny, Navas-Sabater and Qiang, 2002). ICT can play an important role in eliminating poverty. If ICT is appropriately deployed to take into consideration people's differing needs, it can become a powerful economic, social and political tool for the poor, and for all those who work to eradicate poverty. ICT can help achieve this objective by:

- Stimulating macroeconomic growth
- Increasing market access, efficiency and competitiveness of the poor
- Improving social inclusion of isolated populations
- Facilitating political empowerment

ICT and Education

Differences in educational access across countries are substantial. The average of length of schooling in high-income countries is ten years, but in developing countries, it is only 4.6 years. Of the 680 million children of primary school age in developing countries, 115 million do not attend school – 60 percent of these children are girls and 74 percent live in South Asia and sub-Saharan Africa (UNDP Human Development Report, 2005). ICT can provide various channels to bring educational options to those who have been excluded by:

- Increasing access through distance learning
- Enabling a knowledge network for students
- Training teachers
- Increasing the availability of quality educational material

ICT and Gender Equality

In no regions of the world are women equal to men in legal, social, and economics rights. In economic opportunities and in power and political voice imbalances are extensive. Through ICT, awareness of gender inequality issues can be raised and enhanced. ICT can be irreplaceable tools in positively affecting gender inequalities. In some cultures, women are expected to stay at home and are not permitted to have face-to-face contact with men other than family. For such cultures, ICT may open economic opportunities for women through telecommunications and the Internet, allowing them to interact with men without face-to-face contact. (Daly, 2003).

ICT and Health

ICT have had a deep impact on health care within developing countries. ICT enables health care workers to perform remote consultation and diagnosis, access medical information and arrange research activities more effectively. ICT is an important tool for the international development communities and for health care workers in their combined effort to address three of the MDGs:

- MDG #4: Reducing child mortality
- MDG #5: Improving maternal health
- MDG #6: Combating HIV/AIDS, malaria and other diseases

Prior to the 1990s, child mortality rates had been steadily declining but during the last decade, progress has slowed considerably. In fact, in some parts of Africa, child mortality rates increased (UNDP, Human Development Report 2001). The World Health Organization (WHO) estimated that diseases or combinations of disease and malnutrition are responsible for 70 percent of the child mortality (World Bank, 2002). These deaths are avoidable and ICT can help. Childhood diseases such as Measles are easily preventable through vaccination. The mortality due to diarrhea can be reduced with oral re-hydration therapy. Health care workers can use ICT to establish databases to track vaccination progress and to coordinate antibiotic shipment.

Tele-medicine systems can be used to provide health systems for poor people, who live in rural areas. They utilize a computer equipped with a scanner, a digital camera, and software application that enables out of reach medical centers to scan and send x-rays and blood-test results to appropriate diagnostics specialists and the specialist then emails treatment recommendations to the rural medical center.

Currently over 42 million people worldwide are living with HIV/AIDS. Information and Communication Technologies (ICT) can be used as a powerful tool for preventing the spread of HIV/AIDS and mitigate its impacts. Teachers, aid workers, and health care professionals are increasingly utilizing ICTs as a tool for education, awareness, and active support. Organizations working in HIV/AIDS areas are also starting to harness the potential of ICT and use them as Knowledge Management (KM) and knowledge sharing tools for combating the epidemic.

CASE STUDIES

Village Phone

Most people in developed countries are easily able to contact others by telephone, but for those in many developing countries, in particular the rural poor, these communications are extremely limited or nonexistent. In developing countries, due to the high cost of deploying telecommunication infrastructure, governments and industrials have little financial resources to extend communication networks to rural areas. As a result, millions live without the ability to contact people outside their village. High initial infrastructure investment, relatively low call volumes, high maintenance costs, remote locations, and high transportations costs are the main barriers to providing telecommunications access to rural areas in developing countries.

The Village Phone is a program that has been developed by Grameen Telecom, a subsidiary of Grameen Bank (http://www.grameen-info.org), in Bangladesh. Grameen Telecom is a company dedicated to bringing the information revolution to the rural people of Bangladesh. It is planning, over the next 4 years, to provide GSM 900/1100 cellular mobile phone service to 100 million rural inhabitants in 68,000 villages of Bangladesh by (1) financing 60,000 members of Grameen Bank to provide village pay phone service and (2) providing direct phones to potential subscribers.

Initiated in 1997, The Village Phone program has continued to grow at a robust pace over the years. As of August 2005, there are more than 165,000 VP subscribers. In rural villages, where no phone service has previously been available, mobile phones are provided to very poor women who use the phone to operate as a business. These micro-entrepreneurs purchase the phone starter kit with a loan from Grameen Bank and then sell the use of it on a call basis. The typical "Village Phone Lady" has an average income three times the national average -Gross National Income (GNI) of Bangladesh was $420 in 2004 (World Bank Development Indicator, 2005).

The roles and responsibilities of Village Phone program participants include:

I - Grameen Bank, microfinance institution
- Credit finance to Village Phone operator
- Conduct for equipment and prepaid airtime card to Village Phone operator
- Village Phone operator training

II - Grameen Telecom, telecommunication provider
- Provide communication infrastructure
- Provide communication coverage to needed rural are
- Prepaid airtime supply to microfinance institution

III - Grameen Phone, Village Phone program provider
- General problem solving
- Financial management
- Monitor overall program progress

The most obvious benefit of the Village Phone (VP) program is the economic impact that this program brings to an entire village. Farmers from the villages use the phones to call the city markets to find out prices for their products. Phones have even been used in urgent situations, such as accessing medical assistance during natural disasters.

Hundred Dollar Laptop

The $100 laptop (http://laptop.media.mit.edu/) was first unveiled on November 16, 2005, by Kofi Annan, Secretary-General of the United Nations, at the World Summit on the Information Society (WSIS) in Tunis, Tunisia. This laptop is an ultra-low-cost, full featured computer designed by Massachusetts Institute of Technology Media Lab's founder and director, Nicholas Negroponte, to enhance children's primary and secondary education worldwide.

The Hundred Dollar Laptop (HDL) is a joint project of the MIT Media Lab and One Laptop per Child (OLPC) association. OLPC is a non-profit organization created by faculty members from the MIT Media Lab to design, manufactures, and distributes the $100 laptop, which helps to equip the world's schoolchildren and their teachers with a personal, portable, and connected computer. The laptop is designed for tough, developing country conditions, with a dual-mode display that can switch from color to black and white, to make it easier to view in bright sunlight. The laptop is encased in rubber to make it more durable, and a hand crank provides power when there is no electricity.

Brazil, Thailand, Egypt, Cambodia, Costa Rica, Tunisia, and United States (state of Massachusetts) have already committed to buy millions of $100 laptops. The laptop will be sold to governments, to be distributed through the ministries of education.

The $100 laptop is WiFi enabled, supports VoIP, and includes a touch screen with a separate writing pad. The following lists the $100 laptop's hardware specifications:

- 500 MHz CPU by AMD
- 1 GB of flash memory (No Hard Disk)
- SVGA 8" display
- 128 MB of DRAM
- Power source: AC cord that doubles as carrying strap, 4 rechargeable D-size batteries and a hand-crank
- WiFi support
- 4 USB ports

All the software on the $100 laptop is open-source (http://www.opensource.org/); it includes:

- Red Hat Linux
- A web browser
- A word processor
- An email program
- A programming system (including the Squeak programming language)

The OLPC association hopes this by setting the price low they will maximize the number of laptops they can make available to children in developing countries; opening up educational opportunities for millions students. Children would be able to take the computers with them wherever they go, learning languages, math, science, geography, and economics, as well as, playing games and chatting online with friends. They will likely be able to use the devices to draw and compose music. The

$100 laptop will help students enjoy subjects such as math, which is typically less interesting when done with pencil and paper. A laptop's multimedia capabilities, enables the students for communicating complex thinking about subjects such as global warming, which are often better understood visually.

DakNet: Rethinking Connectivity in Developing Nations

The copper and fiber optic landlines common in developed countries are often impractical in developing countries due to infrastructure cost. For example, the typical cost for a telephone line is US$400, which is acceptable in the United States but not in most developing or poor economies. So, how can communications be a driving computing force in such regions? Most of networking technology including telephony and the Internet is on providing continuous, real time, and synchronous communication. However, the connectivity and power infrastructure may be too expensive for deployment in many developing countries. Many useful applications could instead be designed around asynchronous communication and Store-and-Forward Wireless Networking. Using this infrastructure can be is more cost effective. This intermittent networking supplies different types of applications like electronic form filing, weather forecasting, offline search engine queries, and support popular applications like email and voicemail.

The DakNet is an intermittent or Store-and-Forward network that uses wireless technology to provide asynchronous digital connectivity developed by MIT Media Lab researchers. The DakNet has been successfully deployed in remote parts of India and Cambodia. The DakNet wireless network takes advantage of the existing communication and transportation infrastructure to distribute digital connectivity to outlying villages lacking a digital communication infrastructure.

In the DakNet, road buses carried 802.11 mobile Access Points through remote villages in India to connect with local kiosks. In the course of stopping at each village, the hub would download and upload messages from each kiosk for transportation back to the city network. In Cambodia, the system was extended to use motorcycles and ox carts because of difficult terrain. Due to the large volume of 802.11 devices currently manufactured for the developed world, cost has dropped to as little as US$5 per chipset, allowing for the development of inexpensive access points and kiosks. DakNet transmits data over short point-to-point links between kiosks and portable storage devices, called Mobile Access Point (MAP) mounted on and powered by a bus, motorcycle, bicycle or even an ox cart with a small generator. A Mobile Access Point physically transports data between public kiosks and a hub (for non-real-time Internet access) and among kiosks and private communications devices (as an intranet). Low-cost WiFi radio transceivers automatically transfer the data stored in the MAP at high bandwidth for each point-to-point connection. DakNet operation has two major steps:

- As the MAP-equipped vehicle comes within range of a village WiFi-enabled kiosk, it automatically senses the wireless connection and then uploads and downloads tens of megabytes of data.
- When a MAP-equipped vehicle comes within the range of an Internet access point (the hub), it automatically synchronizes the data from all the rural kiosks, using the Internet.

The steps repeat for every vehicle carrying a MAP unit, thereby creating a low-cost wireless network and seamless communication infrastructure. Even a single vehicle passing by a village once per day is sufficient to provide daily information services. Although DakNet does not provide real-time data transporter, a significant amount of data can move at once. The total cost of the DakNet MAP equipment used on the bus is $580, which includes

- A custom embedded PC running Linux with 802.11b wireless card and 512 Mbytes of compact flash memory.
- A 100-mW amplifier, cabling, mounting equipment, and a 14-in Omni directional antenna
- An uninterruptible power supply powered by the bus battery.

The average total cost of the equipment used to make a village kiosk or hub DakNet was $185. Assuming that each bus can provide connectivity to approximately 10 villages, the average cost of enabling each village was $243 ($185 at each village plus $580 MAP cost installed on a bus traveling to 10 villages daily).

CONCLUSION

ICT can play an important role in developing nations by providing new and more efficient methods of production, bringing previously unattainable markets within reach of the poor, improving the delivery of government services, and facilitating management and transfer of knowledge; key factors in reaching the Millennium Development Goals. At the same time, it is important to realize that ICT cannot do the job of poverty reduction on its own. ICT will only be useful to the extent that users are able to use the technology and take advantage of the opportunities it creates.

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