Information Technology for Development 10 (2003) 73–84
IOS Press

Can information and communications technology applications contribute to poverty reduction? Lessons from rural India

Simone Cecchini[a] and Christopher Scott[b]
[a]*ECLAC, United Nations, Casilla 179-D, Santiago, Chile*
E-mail: scecchini@eclac.cl
[b]*Department of Economics, London School of Economics & Political Science, Houghton Street, London WC2A 2AE, UK*
E-mail: c.d.scott@lse.ac.uk

Abstract. Information and Communications Technology (ICT) can reduce poverty by improving poor people's access to education, health, government and financial services. ICT can also help small farmers and artisans by connecting them to markets. It is clear that in rural India -as well as in much of the developing world- realization of this potential is not guaranteed. This paper outlines a simple model to explain why a digital divide may exist between rich and poor. Low-cost access to information infrastructure is a necessary prerequisite for the successful use of ICT by the poor, but it is not sufficient. The implementation of ICT projects needs to be performed by organizations and individuals who have the appropriate incentives to work with marginalized groups. Furthermore, grassroots intermediaries and the involvement of the community are identified as the key factors that foster local ownership and the availability of content and services that respond to the most pressing needs of the poor.

1. The poverty-reducing potential of ICT

The World Development Report 2000/01: Attacking Poverty identifies three priority areas for reducing poverty: increasing opportunity, enhancing empowerment, and improving security. Opportunity makes markets work for the poor and expands poor people's assets. Empowerment makes state institutions work better for poor people and removes social barriers. Security helps poor people manage risk. In light of current experiences in rural India and elsewhere in the developing world, it is apparent that ICT -defined as the set of activities that facilitates the capturing, storage, processing, transmission and display of information by electronic means [32]- can be utilized to support poverty reduction strategies. The use of ICT applications can enhance poor people's opportunities by improving their access to markets, health, and education. Furthermore, ICT can empower the poor by expanding the use of government services, and reduce risks by widening access to microfinance.

2. ICT projects for poverty reduction in rural India

Although most of the rural poor in India are isolated from the information revolution, there are several examples in rural India where ICT is used to contribute to poverty reduction in the areas of opportunity,

empowerment and security. The following case studies highlight ICT applications that are attempting to realize the potential of ICT. The first two focus on improving opportunity, the third is on improving empowerment and the last on security.

2.1. Supporting pro-poor market development: Computerized milk collection centers

Small farmers and artisans living in rural areas typically lack access to information about prices, data on crops, weather conditions, credit facilities, and market opportunities. ICT can remedy such information asymmetries and stimulate poor people's entrepreneurship by better connecting them to markets [30].

In Gujarat, computerized milk collection centers with integrated electronic weights, electronic fat testing machines and plastic card readers are ensuring fair prices for farmers who sell milk to dairy cooperatives. Traditionally, the fat content in milk was calculated through a cumbersome measurement process hours after the milk was received. Although farmers delivered milk on a daily basis, they were only paid every ten days and had to trust the cooperative society staff's manual calculations of the quality and quantity of milk. Malfeasance and under-payment to farmers, although difficult to substantiate, were commonly alleged. Computerized milk collection centers have increased transparency, led to faster processing, shorter queues and immediate payment to farmers. Furthermore, the Dairy Information System Kiosk (DISK) software developed by the Centre for Electronic Governance at the Indian Institute of Management, Ahmedabad (CEG-IIMA) provides relevant information to farmers through a database that contains complete histories of all milch cattle owned by members of the cooperative and a dairy portal connected to the Internet. The 50,000 dairy farmers who use the computerized system benefit from a more transparent and efficient cooperative system [7,9,10].

2.2. Improving access to basic services: India Healthcare Delivery project

ICT can also improve health care delivery to the poor. Telemedicine can diminish the cost and hardship of long distance travel for medical attention and diagnosis, and medical list-serves can deliver at minimal cost recent medical findings to health workers lacking research and technological facilities. Furthermore, ICT can simplify medical data collection, record management and paper filing [13].

Handheld computers, or Personal Digital Assistants (PDAs), are allowing auxiliary nurse midwives (ANMs) participating in the India Healthcare Delivery project to reduce redundant paperwork and data entry, freeing up time for healthcare delivery to the poor. ANMs shoulder most of the responsibility for healthcare delivery in vast and densely populated rural areas. Their duty is to administer immunization, offer advice on family planning, educate people on mother-child health programs, and collect data on the rural population's growth, birth, and immunization rates. Each ANM serves 5,000 people, typically residing in different villages and hamlets, often located several kilometers apart. ANMs usually spend 15–20 days per month on data collection and registration. PDAs are facilitating data collection and transmission, saving up to 40 percent of ANMs' work time. Redundant data entry prevalent in paper registers is eliminated and reports are generated automatically. These gains in efficiency multiply the impact and reach of limited resources, thus expanding access to basic services [9,10,19].

2.3. Improving access to government services: Gyandoot

ICT can be used by government agencies to transform relations with citizens and businesses. In India, as in much of the developing world, it is not uncommon for rural villagers to travel long distances to government district headquarters in order to submit applications, meet officials, obtain copies of public

records, or seek information regarding prevailing prices in commodity markets. This involves the loss of a day's income as well as the cost of transportation. Once at the government office, the relevant official, record, or information could be unavailable, forcing repeated visits and additional expenses. In effect, government officials working with paper records enjoy a monopoly over information and records. Villagers may also face discomfort, harassment, and corruption on the part of public officials and are often given incorrect information about government programs and market prices [27]. In fact, compared to middle or upper classes, the poor end up paying a disproportionate share of their income on bribes.

With ICT, it is possible to locate service centers that provide documents, land records and other public services physically closer to citizens. Such centers may consist of an unattended kiosk in a government agency, or a service kiosk located close to the client. Potential benefits include increased transparency, less corruption, better delivery of government services and greater government responsiveness [33]. Information disclosure and the possibility of interacting with public officials also build pressure for government accountability. The poor become empowered because they feel they are getting a service rather than a favor.

Since January 2000, Gyandoot -a government-owned computer network- has been trying to make government more accessible to villagers in the poor and drought-prone Dhar district of Madhya Pradesh. Gyandoot attempts to reduce the time and money people spend trying to communicate with public officials and to provide immediate, transparent access to local government data and documentation. For minimal fees, Intranet kiosks -or telekiosks-[2] provide caste, income, and domicile certificates, avoiding villagers the common practice of paying bribes. The telekiosks also allow farmers to track crop prices in the region's wholesale markets-enabling them to negotiate better terms. Other services include information on school results and on the names of people included in the below poverty line list, and a public complaint line for reporting broken irrigation pumps, unfair prices, absentee teachers, and other problems. Telekiosks are run by local operators along commercial lines and are placed in villages located on major roads or holding weekly markets, so that each of them can serve 25 to 30 villages [8,11].

2.4. Improving access to microfinance: Smart Cards

Microfinance is an important tool for poor people to reduce, mitigate and cope with risk. Computerization, Smart Cards, and software systems providing loan tracking, financial projections and branch management information can reduce costs and help microfinance institutions reach clients more efficiently.

Smart Cards with an embedded microchip containing information on clients' credit histories are helping SKS, a microfinance institution operating in the Medak district of Andhra Pradesh to reduce transaction costs. One of the main problems faced by SKS, which follows the peer-lending model developed by the Grameen Bank, is the high cost of service delivery to the poor. All cash transactions take place at village group meetings and each transaction takes about 90 seconds per person. Much time is spent not only on paperwork but also discussing terms and conditions and counting coins. Office computerization alone would not bring much time savings because staff would have more free time during the day, but not in the mornings and evenings when people in villages are available for meetings. Smart Cards have been identified as a solution to the high cost of delivery, because they can lead to gains in efficiency,

[2]Best and Maclay [6] differentiate between telekiosks -which typically have only a single computer and are staffed with a facilitator- and telecenters -which have one or more personal computers and some access to the international telecommunications network.

eliminating paperwork, reducing errors, fraud and meeting time. Potential savings in operations are estimated to be around 18 percent. Once all of SKS operations are conducted with handheld computers, a read-only device will be left in each village for clients to check the information stored on the Smart Cards. Microfinance projects like SKS enable poor people and their microbusinesses to gain broader access to financial services [1,4,10].

3. Realizing the potential of ICT is not an automatic process

Realizing the poverty-reducing potential of ICT is not guaranteed. It requires attentive public policy formulation and careful project design. Insufficient information and communication infrastructure, high access costs, and illiteracy have bestowed the benefits of ICT on the better off, urban segments of the population to the detriment of the poor and rural areas. General theory and observation of the Indian experience illustrate these dynamics.

3.1. A diffusion model of new ICT

The argument can be presented in a single diagram shown in Fig. 1 which explains:

1. Why the poor and the rich use different communications techniques.
2. Why the nature of technical change in new ICT has hitherto been biased towards the rich.
3. How the consequence of this bias in technical change has been a widening of the digital divide, and
4. What the policy implications are of the current diffusion process of new ICT.

The model is adapted from Keith Griffin's [16] work on the generation and diffusion of Green Revolution technology in agriculture, which raised issues similar to those arising in the contemporary debate over ICT. Like all models, it is a simplification of reality, and so does not address all the issues which arise from the empirical data presented in Section 2.

Suppose that in the first period, ICT consists of three fixed-coefficient communications techniques (oral, written word, fixed line telephony). Each technique requires different amounts of user time combined with different amounts of ficapital' (hard/software, human capital) to transmit a given amount of information. Since each technique is technically efficient, an information isoquant (q_1) can be constructed as a convex combination of techniques.

The ratio of the hourly value of user time to the hourly user-cost of capital varies between rich and poor. The value of time to the poor is low due to under-employment and low productivity, while the user cost of ICT capital to the poor is high due to liquidity constraints, imperfect capital markets and lack of infrastructure (see Sections 3.2 and 4 below). Thus, the relative price of capital faced by the poor is high (PP in Fig. 1). By contrast, the value of time to the rich is high as they are more likely to be employed and at a higher wage than the poor. The user cost of ICT capital to the rich is lower as they are more likely to live and work in an infrastructure-rich environment, and borrow at lower rates than the poor. Consequently, the relative price of capital faced by the rich is low (RR in Fig. 1).

This analysis implies that the rich and the poor choose different least cost ICT techniques, even if they face the same choice set (isoquant). The rich choose to communicate by fixed line telephony (technique β), while the poor choose to communicate orally (technique α). The size of the ICT divide in the first period is shown by the angle Ω.

In the second period, two new techniques become available (mobile telephony and computer access to the Internet). Mobile telephones save on significant amounts of associated infrastructure (transmission

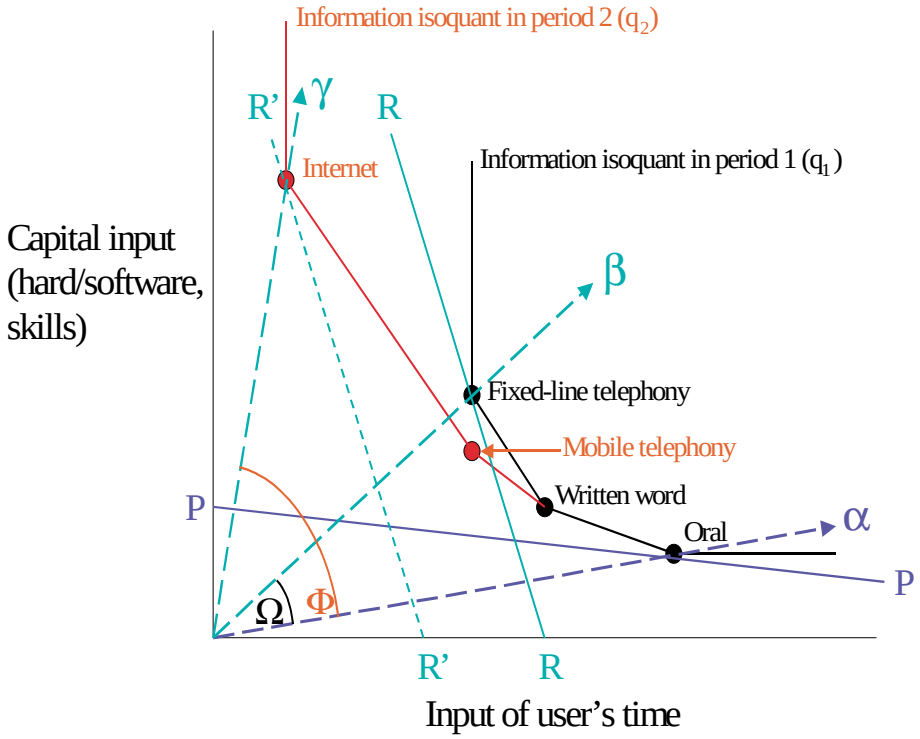

Fig. 1. A diffusion model of new ICT among the rich and the poor.

towers replace overhead/underground cables), but require the same amount of user time per unit of information communicated as fixed telephony. Communication over the Internet is very fast, thereby saving user time, but requires much more capital (hardware, software and operational skills) per unit of information communicated than any of the existing techniques. This pattern of technical change implies that only the relatively capital-intensive segments of the isoquant shift in towards the origin. Two of the initial techniques remain unaffected (oral, written word), while one (fixed line telephony) becomes technically inefficient (obsolete). The new isoquant is q_2.

The distributional consequences of this pattern of technical change are profound, because only the segment of the isoquant (economically) relevant to the rich is affected. So, in the second period, the rich switch from communicating by fixed telephony to using the Internet, while the poor remain communicating orally.[3] This leads to a widening of the ICT gap as measured by the angle between the capital/labor ratio of the communications technique used by the rich (γ) and that used by the poor (α). The magnitude of the digital divide in the second period (shown as Φ) is clearly greater than in the first period (shown as Ω).

The implications for a pro-poor ICT policy are clear. The relative price of capital to the poor should be reduced by improving access to training, extending the electricity grid to low income areas, and by granting selective and temporary subsidies to poor users. In addition, the focus of R&D in ICT should shift to poor-user techniques. That is, efforts should be made to pull in the south-eastern segment of the

[3]Of course, in practice the rich are likely to use both mobile phones and the Internet, but each for different purposes. Furthermore, mobile phones can in certain circumstances provide access to the Internet.

Table 1
Access to sources of information and communications for the rural poor in India

Source	Personal ownership (%)	Shared/ communal (%)	Not available (%)
Radio	77.3	22.7	–
Newspapers	11.3	80.0	8.7
Television	9.3	84.0	6.7
Telephone	–	63.3	36.7
Fax	–	0.7	99.3
Computer/Internet	–	12.0	88.0

Source: Pigato (2001).

information isoquant.

3.2. Access to ICT in rural India

In India, even where telephone lines have reached rural areas through the introduction of Public Call Offices (PCOs), the poor have indeed very limited access to ICT. As revealed by a recent survey conducted in five villages in Uttar Pradesh, West Bengal and Andhra Pradesh [25], only radios are owned by a majority of poor households. Televisions, telephones and newspapers are available to the majority of households on a shared basis. Very few families have shared access to a computer or Internet connection, and some households have never viewed television, read a newspaper or used a telephone (see Table 1). Surveys also suggest that the poor rely on information from informal networks of trusted family, friends and local leaders, but these networks do not adequately satisfy their information needs [25]. This indicates that ICT could play a pivotal role in improving access to information by the poor. However, it remains very difficult for people with low levels of education to reap the full benefits of new technologies, including wide access to knowledge and information.

4. Achieving low-cost connectivity: A necessary condition for pro-poor ICT

While many factors contribute to the success of ICT projects in rural areas of developing countries, low-cost access to information infrastructure is the basic necessary condition to reach the poor. Inadequate or absent connectivity and unstable power supply clearly reduce the economic viability of ICT projects [23]. Gyandoot, for instance, faces problems with dial-up connections because most of the local rural telephone exchanges do not operate with optical fiber cable [8].

Given that it is not realistic to provide telephone lines or computers to all households in developing countries, government and regulators should be concerned with policy instruments for achieving "universal access". The latter is generally defined as the presence of a public telecom booth in every village, or within reasonable distance [20,22]. India is striving to achieve universal access through its national telecom policies focused on the provision of telecom facilities to every village at "affordable and reasonable prices" but almost 40 percent of rural communities still lack shared access to a telephone [29].

4.1. Fostering competition

Fostering competition in the telecom sector can significantly reduce communication costs, and thus improve physical access to ICT by the poor. In countries that reformed their telecommunications sector, teledensity (the number of telephone mainlines per 1,000 people) grew at a much higher rate

Table 2
Trends in Teledensity Across States in India, 1997–2000

State	Telephone Mainlines per 1,000 people		
	1997	2000	Change 1997–2000
Punjab	33.4	61.8	+85%
Maharashtra	33.8	52.8	+56%
Kerala	26.7	46.8	+75%
Tamil Nadu	21.4	37.2	+74%
Gujarat	24.4	36.4	+49%
Haryana	20.0	33.1	+66%
Karnataka	19.8	32.6	+65%
Rajasthan	13.2	25.7	+95%
Andhra Pradesh	13.5	22.0	+63%
Madhya Pradesh	10.6	18.2	+72%
West Bengal	9.6	13.9	+45%
Uttar Pradesh	6.8	12.5	+84%
Orissa	5.9	9.6	+63%
Bihar	3.6	5.9	+64%

Source: Nanthikesan (2000).

between 1996 and 2000 than in countries where reform had not taken place [5]. In India, teledensity has significantly improved between 1997 and 2000 (see Table 2). This has been mainly the result of market-oriented reforms in the telecom sector. Prior to 1992, the Department of Telecommunications was the sole provider of telecom services in India, and the rigid regulatory framework was a big obstacle to the development of telecom infrastructure. In 1992, the mobile market was privatized. In 1994, the fixed services market followed and finally, in 1999, national long distance operations were opened to private competition [14]. Soon after VSNL -the international calls monopoly- was privatized in 2002, national and international call charges fell by as much as 50 percent [15].

However, only large corporations were effectively allowed to take part in the privatization process. Privatization permitted prospective telecom operators to bid for the right to operate in a whole State. Given the size of states in India, bids of over US$1 billion were common [21].

4.2. A role for small entrepreneurs

Large telecom operators tend to limit their operations to higher-income urban areas because of the lower revenue potential of poor rural areas and the higher cost of servicing them. Small entrepreneurs, on the other hand, see the opportunity to make a profit even in a lower revenue environment, and thus have the proper incentive to enter rural markets. A good example of this is cable TV in India. Typically, micro entrepreneurs install dish antennas for cable TV and provide service to subscribers within a 700-meters radius. Operators sell the connection and visit homes to collect charges, typically between US$1.50 and US$4 per month. Customers know the operator personally, and the service operator is available to rectify problems anytime of the week. For these reasons, cable services in India are considered superior to telephone services, although cable technology is significantly more complicated than telephone technology. Consequently, it can be argued that privatization should be opened up to allow small entrepreneurs or Local Service Providers to supply telecom services in rural areas [21].

4.3. Regulatory mechanisms

However, the market by itself might not be able to provide a sufficient level of connectivity to the poorest and most isolated rural areas. The key to achieving connectivity for these areas is to determine

how far market forces will carry the rollout of voice and data networks. The gaps left by the private sector can then be remedied by public intervention. Regulatory mechanisms that can help extend access to information infrastructure include geographic coverage requirements and universal access funds.

One approach is to invite private operators to bid for services in areas that are not commercially viable in return for a subsidy financed from a universal access fund. A concession contract is then awarded to the company requesting the smallest subsidy. In Chile, for example, this mechanism has been used to leverage US$40 million in private investment on the basis of just over US$2 million of public subsidy. As a result, 1,000 public telephones have been installed in rural towns, at around 10 percent of the costs of direct public provision. Subsidies of this kind could also be used to support the development of Internet-enabled community centers, content relevant to low-income groups and to people that speak languages not well represented on the web, and community postal and radio facilities [32].

5. Project design lessons

Even if information infrastructure reaches rural areas, there is no guarantee that the poor will access ICT applications. Many of the projects that attempt to provide access to the Internet in rural India, for instance, end up favouring middle and upper-class men [11,12]. Rural women tend to be excluded because of their restricted mobility, lack of education, and, in some cases, male control over information and media [3]. How can we ensure that ICT projects reach poor women and men?

5.1. Grassroots intermediaries

In rural India, as in much of the developing world, direct ownership and use of ICT -for instance through a PC with Internet access- applies only to a very small fraction of the population. Although the availability of content in local languages and the use of graphic and voice interfaces can make ICT applications more accessible to poor people, illiteracy, low levels of education are all powerful obstacles to the use of computers and other ICT tools. It follows that, in most cases, poor people have to rely on a human intermediary between them and ICT, in what is termed a "reintermediation model" [18]. The profile of the intermediaries who add human skills and knowledge to the presence of ICT is thus critical for projects that want to reach the poor [17].

Successful examples of ICT projects for poverty reduction are conducted by intermediaries that have the appropriate incentives and proven track record working with poor people. In Andhra Pradesh, ANMs have been working with poor villagers on a daily basis for years. SKS, the microfinance institution, adheres to a philosophy of reaching out to the poorest women in rural areas. In Gujarat, dairy cooperatives have been the best agent to target small farmers. If these intermediaries are grassroots-based and understand the potential of ICT for social change, they can be tremendously effective in promoting local ownership of ICT projects. In rural India, many telekiosks operators are young, educated, computer-savvy, and very attached to their communities. They are also extremely entrepreneurial. In the case of Gyandoot, successful telekiosk operators – besides offering e-government services – often create and manage database and work on data entry for private clients, offer PC training, provide voice, fax, copy, Internet and many other services.

Given the right incentives and opportunities, these grassroots intermediaries are keen to make access to information easily available for everybody and are willing to train others in the villages [10–12].

5.2. Community involvement

Applications developed by or with the collaboration of local staff are more likely to be appropriate for local conditions when there is continuous involvement and feedback from the community. Local ownership fosters the success and resilience of ICT projects. Outside control and top-down approaches, on the other hand, often waste resources in the initial periods of projects endangering their future sustainability.

In the case of e-governance projects, the local administrative and political machinery needs to be involved in the implementation of the project, or otherwise the chance of failure is almost certain. Information technology officers working on the CARD (Computer Aided Registration Department) e-governance project in Andhra Pradesh have also learned that it is important to develop constituencies outside the political and administrative system, i.e. with citizens themselves. By involving citizens, the administration can, among other things, ensure that the move to introduce computerization does not get wedded to the political fortunes of the party in power [2].

In Rajasthan, the state-sponsored RajNidhi e-governance program has failed to deliver, despite the fact that the software is easy to use and in Hindi, because of extremely centralized planning that did not take local conditions into consideration. Content, in fact, lacks regular updating because of communicationsproblems between the state and the local government [28].

5.3. Information needs, locally-contextualized information and pro-poor services

Local, governmental, non governmental and international organizations planning ICT prohects in the field should thoroughly assess the information needs of a community should be thoroughly assessed before launching ICT projects. Rapid, participatory rural appraisals and other survey instruments have been used for several years to ensure community ownership of development programs. These tools could be used in the context of ICT initiatives [26].

Content provided through ICT should not be limited to the knowledge that can be accessed from outside sources, but rather extended to ensure that the poor have the means to speak for themselves. The poor know a great deal: they know their needs, circumstances, worries and aspirations better than anybody. In sum, the poor may demand access to locally-contextualized information, more than access to existing information from an alien context [17]. The Honey Bee Network, with its database of solutions to local development problems, is an excellent example of the creation of relevant content for the lives of poor people. Innovative solutions presented in the database include a tilting bullock cart, a simple device to fill nursery bags, an improved pulley for drawing water, and a gum scrapper to enable woman to collect gum from thorny bushes or trees. The database also features a large number of small machineries, herbal pesticides, veterinary medicines, new plant varieties, and agronomic pesticides developed by small farmers. Many of these innovations are extremely simple but can significantly improve the efficiency of farm workers and small farmers. [13].

It is advisable that ICT projects focus on a limited number of well-run pro-poor services – and expand them incrementally- rather than offer a great number of services that end up lying unutilized because of lack of demand. Gyandoot, for instance, offers about twenty services. However, only a handful of them are heavily requested, and of those in demand only a few – like grievances, applications for income, domicile and caste certificates or information on the below poverty line list – can benefit directly the poor [11]. Among the core services that telekiosks can offer to attract clients and generate revenue, voice and text communication services are definitely among the best candidates. Information systems that connect people to each other despite barriers of time, distance, literacy, and ownership of a telephone or PC are in fact in high demand among poor rural communities [6].

Table 3
Frequency of access to information by the rural poor in India

Information accessed	Very often (%)	Quite often (%)	Seldom (%)	Never (%)
News/Politics	57.3	28.7	10.7	3.3
Entertainment	51.4	32.7	12.7	3.3
Health/ Education	41.3	46.7	10.7	1.3
Training Programs	17.3	42.0	28.7	12.0
Agriculture/ Markets	13.3	46.0	26.0	14.7
Welfare Programs	11.3	31.3	41.3	16.0
Employment Opportunities	10.7	25.3	38.0	26.0

Source: Pigato (2001).

5.4. Awareness-raising and training

Raising awareness among the poor about the potential of ICT is another important aspect of successful ICT projects. In the Dhar district of Madhya Pradesh, poor people are generally not aware of the services offered by Gyandoot. Although some efforts have been undertaken to raise awareness, by designing posters with pictorial depictions of the services offered at the telekiosks and by displaying prominent Gyandoot signs outside the telekiosks, more could be done [11]. Word of mouth is often a very powerful tool for publicity. The leaders of poor communities, as well as school children, could be brought to the telekiosks for a demonstration showing what ICT can do for them. Furthermore, the provision of content that is not directly related to development goals, such as news, matrimonials and entertainment information could also be a winning strategy to raise awareness about telekiosks. A recent survey from rural India found that entertainment programs, together with news, are the types of information most frequently accessed by the rural poor (see Table 3) [25].

Training poor women and men in information technology skills is also important. Failure to get the poor involved in the use of technology can lead to further marginalization. Participatory communications approaches require innovative and interactive training processes, since learning is more effective through practice [3]. SEWA (the Self Employed Women Association), for instance, has successfully trained poor women in the use of video cameras and audiovisual equipment. A team of 8 full-time and 20 part-time members is now producing videotapes as a tool for learning, education, development, and policy action.

5.5. Financial sustainability, monitoring and evaluation

Finally, a major challenge for ICT projects is reaching financial sustainability. Connectivity can be particularly expensive. In urban areas of India, each fixed line telephone connection costs more than US$650. A phone booth operator needs to earn at least US$190 per year to break even. Telephones in rural areas are even dearer – a line can cost US$1,500–1,700. To break even, the annual revenue per line would have to be around US$425 [28]. Since most ICT projects are recent and not expected to reach self-sustainability for three or four years, experience on sustainability is limited. Gyandoot, which started operating in 2000, has seen few telekiosks reach commercial viability.

How will we know whether the benefits derived from ICT projects outweigh the costs? In order to answer this and other questions, rigorous monitoring and evaluation (M&E) of the social and economic benefits of ICT projects in rural areas are needed. M&E measure performance, identify and correct potential problems early on, and improve the understanding of the relationship between different poverty outcomes and ICT policies [22]. M&E are especially needed to measure the success of many pilots currently under way. In fact, in the case of pilots, successful outcomes might be implicitly biased due to the choice of favorable places and conditions. Projects might not yield the same results in more challenging and realistic situations.

6. Conclusion

Reaching the poor and realizing the potential of ICT for poverty reduction in the areas of opportunity, empowerment and security is a difficult endeavor. Nevertheless, ICT projects implemented by grassroots-based organizations and individuals who have the appropriate incentives to work with marginalized groups can achieve encouraging results. Successful ICT projects are characterized by local ownership and the participation of the community.

Acknowledgements

We are grateful to all of those who spent time showing projects in the field, including Albert M. Lobo, ADP Madhavan, Ujval Parghi, Dhara Patel, Naveen Prakash, Roy Sastry, and Rajesh Sivanesan. A special thanks goes to the staff of the Electronic Governance Centre at the Indian Institute of Management, Ahmedabad: Dhawal Bathia, Ciny Mathew, Kalpesh Mehta, Monica Raina, and Shilpa Ramadesikan. Precious comments were received from Subhash Bhatnagar, Shirin Madon, Giovanna Prennushi, and Robert Schware. All findings, interpretations and conclusions in this report are entirely those of the authors and do not necessarily represent the views of the World Bank, its Executive Directors or the countries they represent.

References

[1] V.B. Akula, Putting Technology to Work for Poverty Alleviation: A Draft Proposal for $151,030 to Develop Smart Cards for Microfinance, Swayam Krishi Sangam, Hyderabad, 2000.
[2] S. Balakrishnan and R. Ramnathan, State of the Art as Art of the State: Evaluating E-Governance Initiatives through Citizen Feedback, Public Affairs Centre, Bangalore, 2000.
[3] S. Balit, Voices for Change: Rural Women and Communication, FAO, Rome, 1999. [www.fao.org/docrep/X2550E/X2550E00.htm].
[4] Baramati Initiatives, SKS-Smart Cards: Case Study, 2001. [www.baramatiinitiatives.com/cases/case10.htm].
[5] S. Beardsley, I. Beyer von Morgenstern, L. Enriquez and C. Kipping, Telecommunications Sector Reform – A Prerequisite for Networked Readiness in *The Global Information Technology Report 2001–2002: Readiness for the Networked World*, Oxford University Press, 2002. [www.cid.harvard.edu/cr/pdf/gitrr2002_ch11.pdf].
[6] M.L. Best and C.M. Maclay, Community Internet Access in Rural Areas: Solving the Economic Sustainability Puzzle in *The Global Information Technology Report 2001–2002: Readiness for the Networked World*, Oxford University Press, 2002. [www.cid.harvard.edu/cr/pdf/gitrr2002_ch08.pdf].
[7] S. Bhatnagar, Empowering Dairy Farmers through a Dairy Information & Services Kiosk, World Bank, Washington, DC, 2000. [www1.worldbank.org/publicsector/egov/diskcs.htm].
[8] S. Bhatnagar and N. Vyas, Gyandoot: Community-Owned Rural Internet Kiosks, World Bank, Washington, DC, 2001. [www1.worldbank.org/publicsector/egov/gyandootcs.htm].
[9] S. Bhatnagar and R. Schware, eds, *Information and Communication Technology in Rural Development. Case Studies from India*, World Bank Institute Working Papers, 2000. [www.worldbank.org/wbi/pubs_case37160.html].
[10] S. Cecchini, Back to Office Report: Information and Communications Technology for Poverty Reduction in Rural India, Mimeo, World Bank, Washington, DC, 2001.
[11] S. Cecchini, Back to Office Report: Evaluation of Gyandoot and Bhoomi and International Conferences on ICT for Development, Mimeo, World Bank, Washington, DC, 2002.
[12] S. Cecchini and M. Raina, Warana: The Case of an Indian Rural Community Adopting Information and Communications Technology in *Information Technology in Developing Countries*, Volume 12, No. 1, April 2002. [www.iimahd.ernet.in/egov/ifip/apr2002/apr2002.htm].
[13] S. Cecchini and T. Shah, Information and Communications Technology as a Tool for Empowerment in *Empowerment and Poverty Reduction: A Sourcebook.* World Bank, Washington, DC, 2002. [www.worldbank.org/poverty/empowerment/].
[14] Digital Opportunity Initiative, Creating a Development Dynamic: Final Report of the Digital Opportunity Initiative, 2001. [www.opt-init.org/framework.html].

[15] E. Fernandes, The Race to Serve a Subcontinent in *Financial Times*, Thursday June 20, 2002.
[16] K. Griffin, *The Political Economy of Agrarian Change*, 2nd edition, London, Macmillan Press, 1979.
[17] R. Heeks, Information and Communication Technologies, Poverty and Development, Development Informatics Working Paper Series, Paper No. 5, 1999. [idpm.man.ac.uk/idpm/di_wp5.htm].
[18] R. Heeks, Understanding e-Governance for Development. i-Government Working Paper Series, Paper No. 11, 2001. [idpm.man.ac.uk/idpm/igov11abs.htm].
[19] InfoDev, InfoDev Quarterly Report, World Bank, Washington, DC, various years. [www.infodev.org/projects/quarterly.htm].
[20] J. James, Pro-Poor Modes of Technical Integration into the Global Economy in *Development and Change*, Vol. 31, 2000, pp. 765–783.
[21] A. Jhunjhunwala, Unleashing Telecom and Internet in India, Paper presented at India Telecom Conference at the Asia/Pacific Research Center, Stanford University, November 2000. [www.tenet.res.in/Papers/unleash.html].
[22] C. Kenny, J. Navas-Sabater and C. Quiang, Information and Communication Technologies and Poverty in World Bank, Poverty Reduction Strategies Sourcebook, 2001. [www.worldbank.org/poverty/strategies/ict/ict.htm].
[23] G. Kirkman, It's More Than Just Being Connected: A Discussion of Some Issues of Information Technology and International Development, Working Paper presented at the Development E-Commerce Workshop, The Media Laboratory at the Massachusetts Institute of Technology, August 16–17, 1999. [www.cid.harvard.edu/ciditg/resources/beingconnected.pdf].
[24] S. Nanthikesan, Trends in Digital Divide, Harvard Center for Population and Development Studies, November 2000. [www.undp.org/hdro/backgroundpapers/nanthikesan.doc].
[25] M. Pigato, Information and Communication Technology, Poverty and Development in sub-Saharan Africa and South Asia, World Bank: Washington, DC, 2001. [www.worldbank.org/afr/wps/].
[26] D. Richardson and L. Paisley, eds, The First Mile of Connectivity, FAO, Rome, 1998. [www.fao.org/docrep/x0295e/x0295e00.htm].
[27] A. Sharma and W. Yurcik, The Emergence of Rural Digital Libraries in India: The Gyandoot Digital Library Intranet, Proceedings of the ASIS Annual Conference (ASIS 2000), Chicago, 2000. [www.sosresearch.org/publications/asis2000.PDF].
[28] K.P. Syngh Yadav, Virtually There in Centre for Science and Environment, *Down to Earth Magazine*, Vol. 9, No. 18, February 2001. [www.cseindia.org/html/dte/dte20010215/dte_analy.htm].
[29] Telecom Regulatory Authority of India, Recommendations of the TRAI on "Universal Service Obligation", 2001. [www.trai.gov.in/USOREC.htm].
[30] World Bank, ıtWorld Development Report 1998/99. Knowledge for Development, Oxford University Press, 1999. [www.worldbank.org/wdr/wdr98/index.htm].
[31] World Bank, World Development Report 2000/01: Attacking Poverty, Oxford University Press, 2001. [www.worldbank.org/poverty/wdrpoverty/].
[32] World Bank, Information and Communication Technologies: A World Bank Group Strategy, Washington, DC, 2002. [info.worldbank.org/ict/ICT_ssp.html].
[33] World Bank, A Definition of E-Government in E-Government Website, Washington, DC, 2002. [www1.worldbank.org/publicsector/egov/definition.htm].