Taking ICT to Every Indian Village

Opportunities and Challenges

Atanu Garai
B. Shadrach

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Opportunities and challenges

A collection of four papers

What can ICT bring for the inhabitants of 600,000 Indian villages? How India is empowering the poor and marginalised citizens to participate in the emerging knowledge society? How will India provide voice to her millions of citizens? 'Taking ICT to every Indian village: Opportunities and challenges", attempts at answering such questions and exploring the complex interactions between ICT and society. For the first time, a conscious effort has been made to bridge the gaps existing between research and practice – a matrix of development verticals, founded upon the principles of human development approach, tests and validates the planning, implementation and evaluation of ICT projects. An insightful analysis of rural India portrays the complexities of social, political and economic environment in which institutions and initiatives function and operate. Argumentative, analytical and thoughtful – the collection raises many questions for practitioners, policy makers, planners and researchers on the emerging ICTD paradigm in India. A whole new direction has emerged through this discourse – making government, private sector and civil society leaders think on the social, economic and cultural consequences of taking ICTs to Indian villages.

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The OneWorld South Asia works closely with the civil society, international development agencies, private sector, media, academia and governments for "voicing the voiceless" and positioning Information and Communications Technologies (ICT) towards promoting human rights and sustainable development in South Asia. OWSA focuses on developing appropriate programmes and projects, which enhance communication opportunities, build capacities and explore alternative tools and techniques for empowering the grassroots. OWSA's key programmes include Grassroots Communication, Knowledge for Development, Research and Analysis, and Policy Advocacy supported by Capacity Building & Technical Services and Partnerships & Networking.

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Preface

We invite you to explore and learn what is the most promising, yet challenging, developmental intervention happening in India – positioning ICT in human development in this nation of more than one billion citizens. Since its origin in 1998, OneWorld South Asia, along with many of its partners, started using ICT in the works of many development organisations across South Asia. During these years, we have witnessed phenomenal growth in software industry, making giant strides in innovation, business incubation and global leadership in this sector. The rapid growth in ICT sector, however, has not contributed to the development of the larger sector of our nation – the poor and marginalised, as it was expected. The developmental promises of ICT, thus, remained unfulfilled so far.

In an endeavour to tap the potentials of ICT for a holistic development of India, the nation-wide movement called 'Mission 2007' was launched in 2004. For, ICT has the potentials to energies rural development process by infusing knowledge connectivity to human agencies while smoothening the nation's migration from an agrarian society to a knowledge society, as envisioned in India Vision 2020 that "The pace of India's future progress will depend to a large extent on its ability to make available the latest and most useful knowledge to vast sections of the population."[1] Experiences of Information Village Research Project (IVRP) which was also initiated in the year of 1998 in Pondicherry led to the launch of Mission 2007 which aims to forge multistakeholder partnerships for replicating the IVRP model in 600,000 villages by 15th August of 2007, India's 60th independence day. Experiences with infokiosks at

[1] Gupta, S. P. (2002: 34).

different parts of the world show their effectiveness as knowledge gateways for rural areas. The landmark departure towards the journey of 'taking ICTs to every Indian village' undertaken in Mission 2007 Consultation in July 2004 is thus a necessary step towards creating an Indian knowledge society. The July 2004 National Policy Makers' Workshop of Mission 2007 targeted at reaching few milestones:[2]

1. Connecting 25,000 villages as the next step;
2. Identifying, recognising and creating incentives and enabling conditions for RSPs. Software application and user interface development in local languages for local entrepreneurship and fulfilment of objectives;
3. NGOs' role in recruiting 1 million village academicians, especially women;
4. Empowering and recognizing local communities as collators of local data and users of spatial data for local planning. Two-way content and services flow – bringing content providers to collaborate and ride on the infrastructure;
5. Legitimising the Alliance to take on the mandate of a national level ICT commission;
6. Assessing the needs and perceptions of target groups and beneficiaries. This would be important in 'humanising the technology' – a critical sufficiency condition for the success of the knowledge revolution in India;
7. If we agree to go ahead with expanding the usage of ICTs (particularly the infokiosks) in enabling the proposed knowledge revolution in the country, it would be important to address the issue of resources (both manpower and financial) required for supporting the machines;
8. While the creation of new information should be an important component of the knowledge revolution, documenting and archiving existing knowledge and experiments (both successes and failures) should be equally important;
9. Radios, particularly FM radios, have the potential of bringing about a knowledge revolution in the country;
10. Policy recommendations are required in this area to free radio from strict airwave related regulatory issues.

Progress towards achieving the goal has already been started. In May 2005, NASSCOM Foundation and UNDP along with government and NGO partners launched a Knowledge Centre programme in Orissa as the first phase of the coastal knowledge network. The Network will comprise multipurpose resource centres and single window service delivery mechanisms for training and capacity building, knowledge and information systems, linked to life skill education, livelihoods, e-learning, community based disaster preparedness activities targeting women, children and young people for serving a cluster of villages in identified areas. During the financial year 2005-06, Mission 2007 secured the token financial support in the tune of Rs. 100 crore to be channelised through NABARD for establishing rural ICT self-help groups. In the Budget for 2005-06, the target of connecting the remaining 125,000 villages to the electrical grid and 66,882 villages to telecom network has been set up.

[2] OneWorld South Asia (2004).

Formulation of a job-led growth strategy has been the mandate of the current UPA government, and the creation of about additional 7 million jobs is in the IT sector by the year 2009 is envisaged. Building basic infrastructure especially in rural areas and urban slums will be supported by the revival of the Rural Infrastructure Development Fund (RIDF) through infusing a corpus fund of Rs. 8000 crore for this fiscal year. The Mission 2007 initiative, aiming towards setting up Village Knowledge Centre in every village by India's 60th independence anniversary, will also be financed by the RIDF. The Bharat Nirman proposal proposes a four-year business plan for building the infrastructure in rural India in the areas of irrigation, roads, water supply, housing, rural electrification and rural telecom connectivity. In addition, removal of customs duty on specified capital goods as stipulated in the recent Information Technology Agreement (ITA) is major development proposed in this budget.[3] In his budget speech on February 28, 2005, P Chidambaram, the Union Finance Minister of India, said that, "The National Commission on Farmers has recommended the establishment of Village Knowledge Centres (VKCs) all over the country using modern Information and Communication Technology (ICT). Mission 2007 is a national initiative launched by an alliance comprising nearly Processes and appropriation of ICT in human development in rural India organisations including civil society organisations...The Government supports the goal, and I am glad to announce that the government has decided to join the alliance and route its support through the National Bank for Agriculture and Rural Development (NABARD). I propose to allow NABARD to provide Rs. 100 crore out of the Rural Infrastructure Development Fund (RIDF)."[4]

While Mission 2007 has succeeded in securing multi-stakeholder support the progression towards establishing infokiosks in 600,000 plus Indian villages largely is yet to commence. To be able to ignite the rural development process with knowledge revolution, infokiosks need to be equipped with not only robust and reliable connectivity and electrification, but also with killer content and applications, efficient human resources and creative management to be able to attract dynamic community participation. Both data and voice connectivity in conjunction with the power supply system constitute the basic infrastructure in the infokiosks – and analyses will show that such functionalities remain the key barriers in successful operation for majority of pilot infokiosk interventions. Development practitioners have underlined the need to develop appropriate content and applications that will energise the rural development process and transform the lives of millions of rural inhabitants. Unlike provisioning telecom and internet connectivity in rural areas, content and applications development appropriate to rural population clusters that belong to diverse socio-economic milieu, speak in at least 18 major languages and 844 dialects, inherit diverse religious and ethnic beliefs and customs is a major challenge. It is imperative that the infrastructure building, content development and community-centric management of infokiosks exercises being undertaken in millions of Indian villages envisaged as part of the Mission 2007 initiative shall encompass locale-specific services delivery so that socio-economic development takes place in those villages.

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[3] Digital Opportunity Channel (2005).

[4] Quoted in, OneWorld South Asia (2005: 2).

Mission 2007 as a nation-wide movement envisages placing ICT for rural development and then, helping the ruralcitizens themselves to attain *'gram swaraj'* or village sustainabity to attain the developmental targets. At a conceptual level, IVRP serves as a role model before the Mission 2007 stakeholders for providing shared access to ICTs to the country's thousands of villages. At the same time, OneWorld South Asia which has been a key project partner both for IVRP and later on the Mission 2007, was interested to investigate the social, political, economic and technological contexts in which thousands of such village knowledge centres could be created. After Mission 2007 movement was created, Indian Government launched several large scale initiatives like the Common Services Centres (CSC) initiatives or the National e-Governance Plan (NeGP). We recognise the inherent commonalities in the motivations of these initiatives in harnessing the potentials of ICTs in human development and also the need for working towards achieving the goals in tandem.

The four papers symbiotically brought out as part of the rural connectivity research project conducted from August 2004 to March 2006, review four key distinct aspects of these initiatives. The notions of putting ICT in the context of human empowerment remains a complex issue and most often ignored or underestimated by the government and mainstream funding agencies. We have attempted at delineating the areas of interventions. In so doing, we have reviewed the institutional framework wherein such interventions would function and operate. A wide range of field-based projects those are operational in various parts of rural India have, then, been reviewed to develop a better understanding of current pitfalls and possible solutions in projects roll out process. Finally, the last paper reviews the technological situations and assesses alternative solutions that would help all in decision making on technology management.

Throughout the research project, we have been extremely benefitted by the inputs given by our esteemed colleagues and partners. In particular, we are grateful to all those who provided us with the much needed information on field projects reviewed in the papers. It is difficult to name all individuals and organisations here – however, we are especially thankful to organisations like Development Alternatives, Drishtee Foundation, Indian Institute of Technology - Kanpur, M S Swaminathan Research Foundation, n-Logue, University of California Berkley, among others. We acknowledge valued contributions made by Dr. A. Chatterjee Mr. Mohan K. Mishra and project workers in Digital Ganaetic Plain; Prof. Subbiah Arunachalam, Mr. Senthil Kumaran and volunteers in M S Swaminathan Research Foundation; and many others.

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We expect to continue bringing out research publications on the issues explored here and critical comments from the readers are welcome.

March 2006
New Delhi

A. Garai and B. Shadrach

Contents

List of tables, boxes and figures

List of tables

List of boxes

List of figures

Executive summary

In the first paper, "Processes and appropriation of ICT in human development in rural India: Bridging the research and practice gaps," the notions of ICT-enabled development is re-exami ned in the context of capabilities approach, laid down notably by Amartya Sen and Martha Nussbaum. The concept of human development as an assessment methodology for measuring development across the nations has significantly developed and refined by UNDP through a series of Human Development Reports. It is plausible that the developmental impact of ICT on society can be assessed using the human development measurement tools as well. Expanding human capabilities is seen as the prime goal of sustainable development, as noted by Dreze and Sen (2002), "One way of seeing development is in terms of the expansion of real freedoms that the citizens enjoy to pursue the objectives they have reasons to value, and in this sense the expansion of human capability can be, broadly, seen as the central feature of the process of development." According to Sen and Anand (1994), longevity, infant/ child mortality, preventable morbidity, literacy, nourishment and personal liberty and freedom are the basic features of well-being that help in expanding the human capabilities. Various forms of ICTs - capturing, storage, processing, communication and display – infuse knowledge that helps in capabilities expansion. Knowledge is vital in meeting development goals, as experiences from various ICT-assisted initiatives suggest that it amplifies citizen's voices, promotes quality in health and education services, broadens livelihoods bases of the poor and marginalised. The diffusion of ICTs across India so far has so far been modest. The realisation that disproportionate geographical concentration of projects lead to greater

disparity across the regions led to the formation of several nation-wide ICT initiatives. Integrating a human development approach to such ICT initiatives is a precondition to the success of these projects.

Rural India presents socially, culturally, economically and politically diverse environs wherein knowledge centres or knowledge gateways operate in. With an average population density of 324 people per km, rural India poses an attractive service population for knowledge centres – though the service provisioning is challenged by two major factors, income poverty and illiteracy, among many others. According to a recent estimate, the proportion of poor in the rural areas declines from 45.65 per cent in 1983 to 27.09 per cent in 1999-2000; similarly, the literacy level stands almost at 60%. With decreasing infrastructural and operational costs, chances of projects becoming self-sustainable are greater. Experiences with projects like Information Village Research Project demonstrate that rural people can acquire ICT skills fast, even without having high-level of literacy. Building institutional linkages is an effective enabler in poverty reduction – as linkages in developmental interventions span across the horizons of social, cultural, economic and political entities and in this chain government structure at various levels functions in a seamless and interoperable fashion.

Paper 3 reviews a selection of projects based on 'capabilities approach'. The literature review suggests that the impact of ICT in developing countries is thus far concentrated on economic development and network expansion. Since independence, India has made tremendous progress in expanding the communications infrastructure of radio and television; nevertheless, the broad socio-economic impact of expansion in ICT sector has been lesser than expected. An alternative evaluation methodology is proposed on the foundation of capability approach to overcome such methodological drawbacks. Project evaluation indicators are developed based upon four criteria – a) local community's access to information from formal state, market and civil society organisations; b) local community's ability to process and evaluate information; c) capacity of local communities in assimilate information in their own lives and produce information for others and d) local community's ability to advocate for local knowledge in public spheres. Projects demonstrate that they are lacking appropriate governance, human, services and technological capacities for delivering to local communities. A review of few projects – Akshaya, Bhoomi, Community Information Centre, Digital Gangetic Plain, e-Chaupal, rural e-Seva, Gyandoot, Information Village Research Project, n-Logue, Tarahaat – show relative project management strengths and weaknesses.

Despite the tremendous growth in telecommunication network, rural India is yet to witness a robust and seamless voice and data connectivity. Evolution of wireless network protocols provides an opportunity to create community-based, bottom-up internet infrastructure at the village levels. Prominent among such network standards is Wi-Fi. The issues of electricity and connectivity is remain a challenge primarily for the government and the private sector who are in the process of rolling-out ICTs throughout the country. It is recommended that appropriate political, regulatory and governance mechanism be created that facilitates growth of shared ICT infrastructure in local communities.

Abbreviations and acronyms

AC	Air Conditioning/Conditioner
Ah	Ampere Hour
AIR	All India Radio
BDO	Block Development Office
BoD	Bandwidth on Demand
BPL	Below Poverty Line
BSD	Base Station Distributor
BSNL	Bharat Sanchar Nigam Limited
CAI	Computer Assisted Instructions
CAPES	Computer Assisted Paperless Examination System
CBS	Compact Base Station
CD	Compact Disc
CD ROM	Compact Disc Read Only Memory
CDMA	Code Division Multiple Access
C-DOT	Centre for Development of Telematics
CFC	Chlorofluorocarbons
CIC	Community Information Centres
CMC	Community Multimedia Centre
CMR	Child Mortality Rate
CPE	Customer Premises Equipment
DBI	Decibel
DC	Direct Current
DD	Doordarshan

DDWS	Department of Drinking Water Supply
DECT	Digital Enhanced Cordless Telecommunications
DGP	Digital Gangetic Plane
DIT	Department of Information Technology, Government of India
DIU	DECT Interface Unit
DOEACC	Department of Electronics Accreditation for Computer Courses
DRDA	District Rural Development Agency
DSL	Digital Subscriber Line
DSSS	Direct Sequence Spread Spectrum
DTH	Direct To Home
ETSI	European Telecommunications Standards Institute
FDMA	Frequency Division Multiple Access
FM	Frequency Modulation
FMCG	Fast Moving Consumer Goods
FOSS	Free/Open-Source Software
FWP	Fixed Wireless Phone
G2B	Government to Business
G2C	Government to Citizens
G2E	Government to Employees
G2G	Government to Government
GAIL	Gas Authority of India Limited
Gbps	Gigabits Per Second
GDP	Gross Domestic Product
GHz	Gigahertz
GIS	Geographic information system
GoI	Government of India
GPS	Global Positioning Systems
HAM	Handheld Amateur Radio
HDI	Human Development Index
HDR	Human Development Report
HPI	Human Poverty Index
ICT	Information and Communications Technology
IEEE	Institute of Electrical & Electronics Engineers
IGNOU	Indira Gandhi National Open University
IIT	Indian Institute of Technology
IMR	Infant Mortality Rate
Infokiosk	Information Kiosk
IP	Internet Protocol
ISA	Industry Standard Architecture
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
IT	Information Technology
ITA	Information Technology Agreement
ITES	Information Technology Enabled Services
ITU	International Telecommunication Union
IUCN	International Union for Conservation of Nature and Natural Resources

	(World Conservation Union)
IVRP	Information Village Research Project (MSSRF)
JFM	Joint Forest Management
JRY	Jawahar Rozgar Yojana
Kbps	Kilobits Per Second
KBps	Kilobytes per second
KITM	Kerala IT Mission
KM	Kilometer
KVA	Kilovolt-ampere
KW	Kilowatt
LAN	Local Area Network
LMDS	Local Multipoint Distribution Service
LoS	Line Of Sight
LSP	Local Service Provide
LW	Long Wave
MAT	Machine Aided Translation
Mbps	Megabits Per Second
MCIT	Ministry of Communications and Information Technology
MCT	Multipurpose Community Telecentre
MDG	Millennium Development Goals
MIS	Management Information Systems
MLA	Media Lab Asia
MMDS	Multichannel Multipoint Distribution Service(s)
MMR	Maternal Mortality Ratio
MoRD	Ministry of Rural Development, Government of India
MPCE	Monthly Per Capita Consumer Expenditure
MSSRF	M S Swaminathan Research Foundation
MTNL	Mahanagar Telephone Nigam Ltd
MW	Medium Wave
NACO	National AIDS Control Organisation
NACP III	National AIDS Control Programme Phase III
NCLB	No Child Left Behind Act
NCMP	National Common Minimum Programme
NCST	National Centre for Software Technology
NE	North East
NGOs	Non -Governmental Organisations
NHDR	National Human Development Report
NIC	National Informatics Centre
NIRD	National Institute of Rural Development
NLOS	Non Line of Sight
NOC	Network Operating Centre
NREP	National Rural Employment Programme
NSSO	National Sample Survey Organisation
OCR	Optical Character Reader
OECD	Organization for Economic Cooperation and Development
PCI	Peripheral Component Interconnect

PCMCIA	Personal Computer Memory Card International Association
PCO	Public Call Office
PDA	Personal Digital Assistant
PHEDs	Public Health Engineering Departments
PIREP	Pilot Intensive Rural Employment Project
PMGSY	Pradhan Mantri Gram Sadak Yojana
PoP	Point of Presence
POTS	Plain Old Telephone System
PPP	Point-to-Point Protocol
PPP	Purchasing Power Parity
PRIs	Panchayati Raj Institutions
PSTN	Public Switched Telephone Network
PV	Photo-voltaic
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrative Phase-Shift Keying
RAM	Random Access Memory
RAS	Remote Access Switch
RBS	Relay Base Station
RDBMS	Relational Database Management System
RIDF	Rural Infrastructure Development Fund
RLEGP	Rural Landless Employment Guarantee Programme
RSPs	Rural Service Providers
RTC	Record of Rights, Tenancy and Crops
RWWO	Rural Women's Welfare Organisation
SC/STs	Scheduled Castes/ Scheduled Tribes
SDC	State Data Centre
SERCs	State Electricity Regulatory Commissions
SGSY	Swaranjayanti Gram Swarozgar Yojana
SIRD	State Institute of Rural Development
SME	Small and Medium-sized Enterprise
SPG	Symbolic Public Goods
SRD	State Rural Department
STQC	Standardization, Testing and Quality Certification
SW	Short Wave
SWAN	State Wide Area Network
TDIL	Technology Development for Indian Languages
TDMA	Time Division/Demand Multiple Access
TV	Television
UGC	University Grants Commission
UN	United Nations
UNCED	UN Conference on Environment and Development
UNDP	United Nations Development Programme
UNECA	UN Economic Commission for Africa
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific

UNESCO	United Nations Educational, Scientific and Cultural Organization
UPA	United Progressive Alliance
UPS	Uninterruptible Power Supply
USO	Universal Service Obligation Fund
V	Volt
VC	Video Conference
VEC	Village Education Committees
VHF	Very High Frequency
VINE	Versatile Intelligent Networking Environment
VKC	Village Knowledge Centre
VO	Voluntary Organisations
VoIP	Voice over Internet Protocol
VPT	Village Public Telephone
VSAT	Very Small Aperture Terminal
VSNL	Videsh Sanchar Nigam Limited
WAN	Wide Area Network
WHO CSR	WHO Communicable Disease Surveillance & Response
Wi-Fi	Wireless Fidelity
Wi-MAX	Worldwide Interoperability for Microwave Access
WipLL	Wireless IP Local Loop
WLAN	Wireless Local Area Network
WLL	Wireless in Local Loop
WS-IP	Wallset with Internet Port
WSIS	World Summit on the Information Society
WSSD	World Summit on Sustainable Development
ZP	Zilla Parishad

1

Processes and Appropriation of ICT in Human Development in Rural India: Bridging the Research and Practice Gaps

Since late 1990s, ICT deployments in various rural pockets of India and elsewhere have demonstrated their positive impact on the lives of millions of rural inhabitants. Using both traditional and modern media, such ICT deployments equip the rural communities with appropriate information and cozmmunication tools that enable them to elicit, capture, amplify, document, share and transmit knowledge and run applications, leading to social, cultural and economic empowerment in the rural society. Such functionalities quicken the developmental interventions at the grassroots, by establishing communications links within development agencies across local, provincial and national levels.[1] Today, ICT applications permeate all human activities - education, health, agriculture, community development, livelihoods activities, entrepreneurship development, governance, emergencies, to name a few. Interventions across these sectors lead to prosperity – social, economic, cultural and political at large – that entails wider ramifications for human development at large. Such developmental promises of ICT encourage us; firstly, to elaborate the role knowledge plays in human development to explore the critical inter-linkages of knowledge with various facets of human development. While underscoring the need for adopting a knowledge-infused human development approach, we argue, then, how new technologies, such as ICT, facilitate in infusing knowledge in various human

[1] Grace, Kenny and Qiang (2001); Castells, Manuel (1999).

functionings. As the key objective of knowledge infusion is to engage human beings in achieving the goals of sustainable development, we then proceed to examine how an ICT mediation assists, or at least promises to assist, in removing the barriers in furthering the sustainable human development agenda. The assessment helps us further in identifying specific development interventions as being undertaken in rural India, where an ICT mediation will not only be helpful in accelerating such processes, but also be inevitable to fulfill the ideals of sustainable human development.

1.1 Dimensions of knowledge

Knowledge is an integral component of human development. Human beings transfer, imbibe, inherit, adopt, practice, nurture, share and develop numerous kinds of knowledge cultures throughout their life cycles. The first communication of knowledge is augmented by mothers who teach their children how to utter words, how to eat, how to walk and how to grow up. The ability to communicate using a language is perhaps the most fundamental aspect of knowledge culture. Speaking, writing and reading are, thus, the cornerstones of knowledge culture for any society – they are the basic human capabilities for individuals to participate in learning; in social, cultural and economic activities; and in individual and collective decision-making. The term 'knowledge' evokes variegated connotations as semantics of knowledge varies across academic disciplines - in schools of thoughts belonging to economics, information science, management, philosophy, psychology, sociology, etc. Knowledge exists in multiple forms, communicated in variegated ways – however, at the outset, it is important to understand the knowledge needs that lead to sustainable development of local communities. One form of knowledge already persists within local communities – community workers recognise this form of knowledge as 'local knowledge', termed as 'indigenous knowledge' in scientific literature.

For several decades now, international development circles focus their attention on the issue of 'local knowledge' as evident in developmental interventions adopted by the UN system and bilateral and multi-lateral agencies, among others – through instruments like poverty reduction strategy papers, aid policies.[2] Local knowledge is often reflected and elicited through agency participation in interventions made by development agencies or by local bodies formed within the communities. It is noted that the local knowledge is often conceptualised or termed as 'indigenous knowledge' in scientific literature, and exploited mainly by economists, environmentalists and sociologists to connote a specific knowledge set dealing largely with dynamic interaction between man and nature. The following definitions of indigenous knowledge provide an understanding of the ideology

[2] See, World Bank Indigenous Knowledge Website at http://www.worldbank.org/afr/ik/.

and its practical relationship with 'local knowledge', a term that is more used in this paper:

> Indigenous knowledge – the local knowledge that is unique to a given culture or society – contrasts with the international knowledge system which is generated through the global network of universities and research institutes.[3]
>
> The unique, traditional, local knowledge existing within and developed around specific conditions of women and men indigenous to a particular geographic area.[4]
>
> Indigenous knowledge is the knowledge that people in a given community has developed over time, and continues to develop. It is: based on experience, often tested over centuries of use, adapted to local culture and environment, and dynamic and changing.[5]

Indigenous knowledge rubric is multi-dimensional; current development practices, nevertheless, relate indigenous knowledge to natural resource management, a domain that is influenced immensely by socio-cultural environs.[6] For the very susceptibility to surrounding socio-cultural precincts, indigenous knowledge exhibits variations in its evolution, dissemination and cultivation to that of scientific knowledge. Sillitoe, Dixon and Barr (2000) examine the differences in knowledge culture that exist in these two domains (Table 1.1). Such differences necessitate appropriation of conventional knowledge systems produced by scientific practices to the locale social, economic and cultural milieu. Development depends on the spread of scientific knowledge and adoption of scientific knowledge into traditional knowledge system and vice versa is a process that is evolutionary, intricate and dynamic in nature. An instance of such an interaction between indigenous and scientific knowledge is reflected in the agricultural extension services where agriculturalists produce advanced farming techniques in the agricultural research institutes, which, then, transferred to farmers through extension services network. Development, therefore, depends on citizen's ability to adapt scientific knowledge and harmonise it with his or her own knowledge for practising better way of living.

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[3] Warren, D; Slikerveer, L. & Brokensha, D. (1995: xv).

[4] Grenier, Louise. (1998: 1).

[5] IIRR (1966: 7).

[6] For a detailed discussion on this crosscutting influencing pattern between socio-cultural traditions and indigenous knowledge, see, Antweiler, C. (1998); Warren, D; Slikerveer, L. & Brokensha, D. (1995).

Table 1.1: Indigenous knowledge compared with science

Features	*Indigenous*	*Scientific*
Relationship	Subordinate	Dominant
Communication	Oral	Literate
	Teaching through doing	Didactic
Dominant Mode of thought	Intuitive	Analytical
Characteristics	Holistic	Reductionist
	Subjective	Objective
	Experiential	Positivist

Source: Sillitoe, Dixon and Barr (2000: 16).

Since citizens often lack the means to apply knowledge in their functionings, for various social, economic and cultural constraints, development workers need to recognise knowledge transfer processes for building knowledge capacities among local communities. Verrier Elwin who spent many years of his life with the Gond tribal communities in the Central India during mid-1930s mentioned the need for community development workers to be knowledge savvy long ago. Either in 1933, or in 1934, Elwin drafted the constitution, incorporating a set of common principles, of Gond Seva Mondal, reproduced in Guha (1999), which states, "Knowledge, art, music, etc. are not to be despised by the lover of the poor. Knowledge, by purifying and enlarging the mind, actually equips him with the means of better service. Members will be encouraged to make research in the customs and ancient traditions of the people, and to give some time at least daily to general study."[7] The principles adopted by Gond Seva Mondal in the British India are still prevalent today and yet to be implemented in practice. Today, the availability of ICT leads us to practise the Gond Seva Mondal principles in a more practical and tangible way than in 1930s.

1.2 Dimensions of sustainable human development

Since 1990, with the launch of first Human Development Report, UNDP champions measuring the progress of human development – locally, nationally, regionally and globally.[8] In the Foreword of 1990 HDR, Draper III (1990) observes, "We are rediscovering the essential truth that people must be at the centre of all development. The purpose of development is to offer people more options. One of their options is access to income – not as an end in itself but as a means to acquiring human well-being. Nevertheless, there are other options as well, including long life, knowledge, political freedom, personal scrutiny,

[7] Guha, Ramchandra (2005: 334-339).

[8] For a complete list of local, national, regional and global human development reports published by UNDP, See, http://hdr.undp.org.

community participation and guaranteed human rights. People cannot be reduced to single dimension as economic creatures. What makes them and the study of the development process fascinating is the entire spectrum through which human capabilities are expanded and utilised."[9] Similarly, Haq notes, "The basic purpose of development is to enlarge people's choices. In principle, these choices can be infinite and can change over time. People often value achievements that do not show up at all, or not immediately, in income or growth figures: greater access to knowledge, better nutrition and health services, more secure livelihoods, security against crime and physical violence, satisfying leisure hours, political and cultural freedoms and sense of participation in community activities. The objective of development is to create an enabling environment for people to enjoy long, healthy and creative lives."[10] Human development quintessentially entails not only economic prosperity, but also leading a healthy and learned life while enjoying guaranteed human rights, participatory rights and adequate social, cultural and political freedom. The need for expansion and utilisation of human capabilities are also underscored in the human development paradigm.

The 1990 HDR also offers a definition of human development: "Human development is a process of enlarging people's choices. In principle, these choices can be infinite, and change over time. But at all levels of development, the three essential ones are for people to lead a long and healthy life, to acquire knowledge and to have access to resources needed for a decent standard of living. If these essential choices are not available, many other opportunities remain inaccessible. But human development does not end there. Additional choices, highly valued by many people, range from political, economic and social freedom to opportunities for being creative and productive, and enjoying personal self-respect and guaranteed human rights. Human development has two sides: the formation of human capabilities – such as improved health, knowledge and skills – and the use people make of their acquired capabilities – for leisure, productive purposes or being active in cultural, social and political affairs. If the scales of human development do not finely balance the two sides, considerable human frustration may result. According to this concept of human development, income is clearly only one option that people would like to have, albeit an important one. But it is not the sum total of their lives. Development must, therefore, be more than just the expansion of income and wealth. Its focus must be people."[11]

Expanding human capabilities, thus, forms the cornerstone of the human development approach. The genesis of such an approach, however, can be found in the 'capability approach' proposed by Sen (1982, 1985, 1987, 1999)[12] and

[9] UNDP (1990: 10).
[10] UNDP.
[11] UNDP (1990: 10).
[12] Sen, Amartya (1982, 1985, 1987, 1999a).

developed by others, notably Nussbaum (1993, 1995, 2000).[13] The 'capability approach' views economic growth only as the 'means' rather than the 'ends' to human well-being, while expanding people's capabilities is seen as the 'ends'. Dr`eze and Sen (2002) opine that, "One way of seeing development is in terms of the expansion of the real freedoms that the citizens enjoy to pursue the objectives they have reason to value, and in this sense the expansion of human capability can be, broadly, seen as the central feature of the process of development. The 'capability' of a person is a concept that has distinctly Aristotelian roots. The life of a person can be seen as a sequence of things the person does, or states of being he or she achieves, and these constitute a collection of 'functionalities' – doing or beings the person achieves. 'Capability' refers to the alternative combinations of functionings from which a person can choose. Thus, the notion of capability is essentially one of freedom – the range of options a person has in deciding what kind of life to lead. Poverty of a life, in this view, lies not merely in the impoverished state in which the person actually lives, but also in the lack of real opportunity – given by social constraints as well as personal circumstances – to choose other types living. Even the relevance of low incomes, meagre possessions, and other aspects of what are standardly seen as economic poverty relates ultimately to their role in curtailing capabilities (that is, their role in severely restricting the choices people have to lead valuable and valued lives). Poverty is, thus, ultimately a matter of 'capability deprivation,' and note has to be taken of that basic connection not just at the conceptual level, but also in economic investigations or in social and political analyses."[14] According to Sen (1999), 'capability' refers "to the alternative combinations of functionings that are feasible for her to achieve. Capability is thus a kind of freedom: the substantive freedom to achieve alternative functioning combinations (or, less formally put, the freedom to achieve various lifestyles)."[15] It emerges that the 'capability approach' argues for a view of development - holistic and humane in nature - by introducing human choices at the first place, stressing the capacity of poor people to define their own development priorities and goals, whereby outside agents should only 'begin' to work with the community, once it has developed its own 'development plan' and identified its specific needs for outside support. Human choices in 'beings and doings', termed, as 'functionings' are the means for expanding and utilising human capabilities.

In furthering human capabilities, societies more often than not tend to exploit natural resources – water, soil, air, forest, fossil fuel and biodiversity - in a rate faster than the nature can regenerate them for mankind. Preservation of natural resources as essential instruments of sustainable development has taken the

[13] Nussbaum, M and A. Sen, *Eds.* (1993); Nussbaum, M and J. Glover, *Eds.* (1995); Nussbaum, M (2000).

[14] Dreze, Jean and Amartya Sen (2002: 35-36).

[15] Sen, Amartya (1999b: 75).

centrality in modern development discourse soon after the Second World War. Concern over ever-increasing environmental degradation caused by adverse natural exploitation influenced development thinkers to introduce the concept of 'sustainable human development'. Though appropriate policies and regulatory mechanisms to ensure environmental sustainability have started to evolve at local levels only in 1970s, ensuring environmental sustainability as a pious goal of development was, however, recognised globally long back. Carson's (1962) research was first to suggest the destructive effects on animal species and human health caused by catastrophic level of agricultural pesticide usage, acted as an instant eye-opener to the international community.[16] Subsequently, Ehrlich (1968),[17] in 'Population Bomb,' explored the interconnectedness between human population, resource exploitation and the environment; in June 1971, a panel of experts meeting in Founex (Switzerland) called for the integration of environment and development strategies; Ward and Dubos (1972)[18] published 'Only one earth' sensitising the need to adopt a shared concern for the future generations by ensuring natural sustainability. 1972 witnessed the genesis of United Nations Environment Programme (UNEP) in the United Nations Conference on Human Environment in Stockholm (Sweden), leading to the establishment of many national environment protection agencies. In the same year, Club of Rome published the controversial, yet alarming, study 'Limits to Growth' that predicts of dire consequences unless the growth graph swings down.[19] Protests by community women against state-sponsored deforestation and environmental degradation in a rural hamlet in the state of Uttar Pradesh (now, Uttaranchal) in India caught the attention of the world.[20] The incidence of 1973, for the first time, helped policy-makers realise the need for community participation in forestry and environmental issues. In 1974, a study by Molina and Rowland (1974) showed that continued use of CFC gases at an unaltered rate would rapidly deplete ozone layer that protects human beings from unhealthy radiations.[21]

Poverty, population pressure, social inequity and the terms of trade are identified as prime agents of environmental degradation in the 'World Conservation Strategy', released by IUCN in 1980.[22] The landmark Report of the World Commission on Environment and Development – Our Common Future, the Brundtland Report – popularised the term 'sustainable development' while exploring inevitable interconnectedness among social, economic, cultural and environmental issues. According to the Brundtland Report (1987), the

[16] Carson, Rachel (1962).
[17] Ehrlich, Paul R. (1968).
[18] Ward B. and R. Dubos, (1972).
[19] Meadows, D.L., *et al.* (1972).
[20] Guha, Ramchandra (2005).
[21] Molina, M.J. and F.S. Rowland (1974).
[22] IUCN (1980).

sustainability of development must satisfy the condition to fulfil "the needs of the present without compromising the ability of future generations to meet their own needs".[23] In 1992, Earth Summit, the UN Conference on Environment and Development, held in Rio de Janeiro, adopted Agenda 21, the Convention on Biological Diversity, the Framework Convention on Climate Change, the Rio Declaration, and non-binding Forest Principles as international instruments on environmental protection and sustainable development. The first World Conference on Social Development in 1995 in Copenhagen (Denmark) provided a platform for the international community to commit to eradicate absolute poverty. In 2002, the World Summit on Sustainable Development attracted highest level of political participation for assessing the global change since UNCED in 1992 and renew their commitments towards environmentally sustainable development. The concept of sustainable human development emulates the growing concerns pronounced throughout these years; and in 1994, HDR started accommodating 'sustainability' in benchmarking progress made by societies in furthering human development.

1.3 Dimensions of human capabilities

So, if expanding human capabilities are earmarked as the primary objectives of socio-economic development, what are the central human capabilities that individuals and institutions need to preserve, nurture and practice for their holistic and humane development? Alkire (2002) reviews various literatures that pronounce a wide variety of human capabilities,[24] as Sen remains incomplete in providing an operational framework to 'capability approach' for fundamental and pragmatic reasons.[25] In an attempt to define a basic set of human capabilities functionings, Alkire (2002) provides comparative analyses of different dimensions of human development founded by thinkers from different schools of thoughts.[26] Introspection in their propositions of basic human functionings reveals 'knowledge' imbibed within diverse gamut of human 'beings and

[23] Brundtland, G. *ed.* (1987).

[24] Alkire, S. (2002: 340).

[25] Alkire, S. (2002: 10); UN (1992); Allardt, E. (1993: 88-94); Andrews, F. M. and *Stephen B. Withey* (1976); Argyle, Michael and Maryanne Martin (1991); Braybrooke, D. (1987); Brentano, F (1973); Chambers, R. (1995); Cummins, R. A. (1996: 303-28); Davitt, T. E. (1968); Diener, *Ed.*, E.M. Suh, R. E. Lucas and H.E. Smith (1999); Doyal, L. and Gough I (1993); Grisez, G., John Boyle and John Finnis (1987); Fromm, E. (1949); Galtung, J. (1980); Goulet, D. (1995); Griffin, J. (1996); Krech, D, R. S. Crutchfield and N. Livson (1969); Lane, Robert E. (1969); Lasswell, H. D. and A. R. Holmberg (1969); Alkires (2002: 81); Max-Neef, Manfred. (1993); Murray, H. A. (1938); Myers, David G. and Ed. Diener (1995); Narayan, Deepa *et al.* (2000); Nielson, Kai (1977); Nussbaum, M. C. (2000); Qizilbash, Muzaffar (1996); Ramsay, Maureen (1992); Rawls, John (1971); Rokeach, Milton (1969); Ryff, Carol D. (1989); Schwartz, S. H. (1992); Sen, Amartya and S. Anand (1994); Sen, Amartya (1985); Wilson, W. (1967).

[26] Nussbaum, Martha C. (2000).

doings'. To illustrate, basic human functionings proposed by Nussbaum (2000), and Anand and Sen (1994) and Sen (1999) are presented in Box 1.1 and Table 1.2 respectively.

Despite the differences in human needs and functionings, a set of basic human well-being indicators of happiness and freedom emerges from the foregoing analyses. Being healthy is the first prerequisite for all human beings - reflected in longevity, infant and child mortality, preventable morbidity and nourishment; literacy serves as an indicator of educational attainment while per capita income is an indicator of economic attainment.

Box 1.1: Nussbaum: Central human functional capabilities

Life: Being able to live to the end of a human life of normal length; not dying prematurely, or before one's life is so reduced as to be not worth living.
Bodily health: Being able to have good health, including reproductive health; to be adequately nourished; to have adequate shelter.
Bodily integrity: Being able to move freely from place to place; having one's bodily boundaries treated as sovereign, i.e. being able to be secure against assault, including sexual assault, child sexual abuse, and domestic violence; having opportunities for sexual satisfaction and for choice in matters of reproduction.
Senses, imagination, thought: Being able to use the senses, to imagine, think, and reason – and to do these things in a 'truly human way', a way informed and cultivated by adequate education, including, but by no means limited to, literacy and basic mathematical and scientific training. Being able to use imagination, and though in connection with experiencing and producing self-expressive works and events of one's choice, religious, literary, musical and so forth. Being able to use one's mind in ways protected by guarantees of freedom of expression with respect to both political and artistic speech, and freedom of religious exercise. Being able to search for the ultimate meaning of life in one's own way. Being able to have pleasurable experiences, and to avoid non-necessary pain.
Emotions: Being able to have attachments to things and persons outside ourselves; to love those who love and care for us, to grieve at their absence; in general, to love, to grieve, to experience longing, gratitude, and justified anger. Not having one's emotional development blighted by overwhelming fear and anxiety, or by traumatic events of abuse and neglect. (Supporting this capability means supporting forms of human association that can be shown to be crucial in their development).

(*Continued on page 10*)

Practical reason: Being able to form a conception of the good and to engage in critical reflection about the planning of one's own life. (This entails protection for the liberty of conscience.)
Affiliation (i) Being able to live for and towards others, to recognize and show concern for other human beings, to engage in various forms of social interaction; to be able to imagine the situation of another and to have compassion for that situation; to have the capability for both justice and friendship. (Protecting this capability means protecting institutions that constitute and nourish such forms of affiliation, and also protecting the freedoms of assembly and political speech.) (ii) Having the social bases of self-respect and non-humiliation; being able to be treated as a dignified being whose worth is equal to that of others. This entails, at a minimum, protections against discrimination on the basis of race, sex, religion, caste, ethnicity, or national origin.
Other species: Being able to live with concern for and in relation to animals, plants, and the world of nature.
Play: Being able to laugh, to play, to enjoy recreational activities.
Control over one's environment: (i) Political. Being able to participate effectively in political choices that govern one's life; having the right of political participation, protections of free speech and association. (ii) Material. Being able to hold property (both land and movable goods), not just formally but in terms of real opportunity; and having property rights on an equal basis with others; having the right to seek employment on an equal basis with others; having the freedom from unwarranted search and seizure. In work, being able to work as a human being, exercising practical reason and entering into mutual relationship of mutual recognition with other workers.

Source: Nussbaum (2000: 78-80).

TABLE 1.2: Basic features of well-being by Anand and Sen (1994); Types of freedom by Sen (1999).

Anand and Sen (1994) *Basic features of well-being*	*Sen (1999)* *Five types of freedom*
Longevity	Political freedom
Infant/ Child mortality	Economic facilities
Preventable morbidity	Social opportunities
Literacy	Transparency guarantees
Nourishment	Protective security
Personal liberty and freedom	

Source: Alkire, S. (2002: 35).

1.4 Dimensions of ICT

ICT stands for *information and communications technology* used both as singular and plural nouns. It is used almost synonymously with IT or information technology. The term IT (and ITES or information technology enabled services) is used more in business contexts and in Americas, whereas ICT is used in development parlance, and in Europe and Oceania. Various authors have attempted toward defining ICT - Drew and Foster (1994); Mansell and Silverstone (1996); Hamelink (1997); Duncombe and Heeks (1999); UN ECA (1999); Chowdhury (2000), among others. According to Drew and Foster (1994), "The term "information technology" embodies a convergence of interest between electronics, computing, and communications, all of which are leading to the rapid development of micro-electronics. These technologies are being utilized to restructure and reorganize the spheres of production, distribution, and circulation."[27] Mansell and Silverstone (1996) observe that ICTs include electronic networks – embodying complex hardware and software - linked by a vast array of technical protocols.[28] Hamelink (1997) classifies ICT according to five distinct functionalities: (a) *Capturing technologies:* Input devices that collect and convert information into digital form. Such devices include keyboards, mice, trackballs, touch screens, voice recognition systems, bar code readers, image scanners and palm-size camcorders; (b) *Storage technologies:* Devices to store and retrieve information in digital form. Among these are magnetic tapes, floppy disks, hard disks, RAM disks, optical disks (such as CD-ROMs), erasable disks and smart cards (credit-card sized cards with memory and processing capacity for financial transactions or medical data); (c) *Processing technologies:* Creating the systems and applications software that is required for the performance of digital ICT; (d) *Communications technologies:* Producing the devices, methods and networks to transmit information in digital form. They include digital broadcasting, integrated services digital networks, digital cellular networks, local area networks (LANs), wide area networks (WANs, such as the Internet), electronic bulletin boards, modems, transmission media such as fibre optics, cellular phones and fax machines, and digital transmission technologies for mobile space communications (the new Low Earth Orbit satellite voice and data services); (e) *Display technologies:* To create a variety of output devices for the display of digitised information. Such devices include display screens for computers, digital television sets with automatic picture adjustment, set-top boxes for video-on-demand, printers, digital video discs (which might replace CD-ROM drives and audio CD players), voice synthesizers and virtual reality helmets.[29]

Duncombe and Heeks (1999) describe ICTs as an "electronic means of capturing, processing, storing and disseminating information".[30] According to the United

[27] Drew, E. and F. G. Foster, *Eds.* (1994).
[28] Mansell, R. and R. Silverstone (1996).
[29] Hamelink, Cees J. (1997: 9).
[30] Duncombe R. and R. Heeks (1999).

Nations Economic Commission for Africa (1999), ICTs cover internet service provision, telecommunications equipment and services, information technology equipment and services, media and broadcasting, libraries and documentation centres, commercial information providers, network-based information services, and other related information and communication activities.[31] Chowdhury (2000) writes that ICTs encompass technologies that can process different kinds of information (voice, video, audio, text and data) and facilitate different forms of communications among human agents, among humans and information systems, and among information systems.[32]

1.5 Knowledge in sustainable human development paradigm

It is to be noted that Nussbaum's (2000) definition of human capabilities and functionings entails enabling people's access to and development of, certain assets and capitals – human, economic (or financial), natural and social. Nevertheless, the key question here remains that – how to enable people's access to, and facilitate development of, such assets and capitals according to their own choices so that exploitation of such assets and capitals results into appropriate, yet optimum, outcome on their well-being leading them to a state of happiness and freedom. Considering that availability of a set of assets and capitals is limited in any given space and time, judicious appropriation and exploitation of such resources is key to local development. Judicious and sustainable, appropriation and exploitation of human, economic and financial, natural and social assets for local development, however, occurs only when responsible human agencies are equipped with the necessary knowledge of socially, economically and technologically locale-appropriated method to exploit the resources optimally to further human capabilities. 'Knowledge' or 'access to knowledge' as an enabling factor for human development has been recognised in the human development discourse from an early stage. In the context of 'capability approach,' defining knowledge is rarely attempted, though it is referred to as one of the key ingredients for effective human functioning, as documented by Alkire (2002).[33] Finnis (1980) in his list that contains 'all the basic purposes of human action,' puts - life, knowledge, play, aesthetic experience, sociability (friendship), practical reasonableness and religion.[34] Grisez, Boyle and Finnis (1987) describe 'knowledge' as something, which "human persons can know reality and appreciate beauty and whatever intensely engages their capacities to know and to feel."[35] If knowledge is recognised as a basic human functioning, how this functioning leads to fulfilling happiness and freedom? The foregoing discussion shows that knowledge,

[31] Economic Commission for Africa (1999).
[32] Chowdhury, N. (2000).
[33] Alkire, S. (2002).
[34] Finnis, John (1980).
[35] Grisez, Germain Joseph Boyle and John Finnis (1987).

as a human functioning, empowers a human being to analyse and scrutinise existing situations to be able to choose better opportunities leading to enhancement of human capabilities. The term 'knowledge' is explicitly employed in the HDI – 'knowledge' is one of the three key components of human development indicators, two others being longevity and standard of living. HDI measures knowledge by a combination of adult literacy (two-thirds weight) and mean years of schooling (one-third weight) and standard of living is measured by purchasing power, based on real GDP per capita adjusted for the local cost of living (purchasing power parity, or PPP). The term 'knowledge' is used as the basic capabilities deprivation in the HPI introduced in HDR 1997, containing three basic indicators and represented by:[36]

S = survival deprivation: the expected incidence of mortality by age of 40 (at current age specific mortality rates)
K = deprivation of education and knowledge: percentage of people who are illiterate
E = economic deprivation: the mean of three sub-components: {(1/3) [h+w+n]}, where
H = percentage of population without healthcare
W = percentage of population without safe water
N = percentage of children who are undernourished

HDR, thus, characterises knowledge as an educational attainment. The term 'knowledge' in the context of human development discourse apparently evokes different connotations. We recognise that knowledge is intangible information objects, which are communicable in multiple forms through multiple carriers and capable of instigating, engaging, inspiring human agencies to take active or inactive actions. Though at times knowledge is applied as a substitute of the term 'information',[37] they evoke different connotations. Wigand, Picot, *et al.* (1997) suggest that 'information can be interpreted as purpose-oriented knowledge'.[38] Acquiring knowledge, however, does not necessarily depend on other human capabilities such as reading or writing – acquiring knowledge as a basic human functioning is inherited - a child, for instance, learns to stay away from fire by experiencing the heat emanating from the fire. The illiterate old village woman, for instance, provides genealogy information to fellow villagers serving as the repository of collective memories for the village. The process of knowledge acquisition, sharing, reflecting is continuous and life-long for every human being – irrespective of his social, economic and cultural strata. However, educational attainment enables individuals in the acquisition, reflections and sharing

[36] Quoted in Alkire, S. (2002: 182).
[37] Nonaka, I. and H. Takeuchi (1995).
[38] Wigand, Rolf, T. *et al.* (1997).

of knowledge that can be applied for better 'being or doing'. If knowledge is to energise human capabilities expansion, because it has the capacity to do so, knowledge objects need to be learnt, adopted, nurtured, practised, shared and further cultivated in all aspects of human functionings. In a similar way, decision-making in judicious appropriation and sustainable exploitations of assets depends on knowledge. Being 'knowledgeable' by its very nature has been recognised as an end of human development; and, the state of 'being knowledgeable' has been recognised seen as the means for attaining the goals of human development.

1.6 Infusing knowledge through ICT

While underlining the need for judicious appropriation and sustainable exploitation of assets for local development – such that it enables effective functioning of human capabilities – we have introduced the concept of 'human agencies.' As the concepts of 'human agencies' will be central to the discourse in this paper and elsewhere, it is worthwhile to illustrate the term. The term 'human agencies' refers to the capacities of human beings to make choices and to impose such choices on the world on a collective basis, usually through democratic means. While investigating the interoperability between human agency and development, Anand and Sen (1994) do not draw a boundary between personal agency and social institutions,[39] as they observed, "In analysing the complementarity between personal agency and social institutions, it is also important to note the different levels at which this complementarity works. Institutional changes themselves are dependent on human agency, even when the changes result from evolution rather than conscious selection"[40] For this discourse, such complimentarity is useful as individuals and institutions in rural societies – human beings, families, social and cultural groups, cooperatives, local self-help groups, local governments, etc. – are collectively responsible to decide on appropriation and exploitation of assets. Moreover, we recognise individuals as decisive human agencies, because in rural India, an individual often functions as an institution – the *sarpanch*, postmaster or local schoolteacher. Similarly, each rural citizen is recognised and valued by his fellow citizen for his unique capabilities, which may range from his productivity capabilities reflected in farming produces to immaculate singing capabilities. Anand and Sen (1994) further commented, "One of the characteristics of human agency - as opposed to the agency of other animals - is the ability to scrutinize and re-examine our values and priorities in the light of fresh information and new understanding."[41]

If 'knowledge' is an essential ingredient for effectiveness of human functioning and enhancement of human capabilities, it is imperative that we attempt to ensure

[39] Anand, Sudhir and Amartya Sen (1994).
[40] *Ibid.*
[41] *Ibid.*

all human agencies are equipped with necessary and appropriate knowledge that empowers them in advancing their capabilities and making well-informed choices about their well being. Our societies have devised mechanisms to deliver healthcare services, shelter, food, electricity, education, and emergency solutions and rescue services that can meet basic capabilities deprivation of high morbidity, low educational attainment, disease proneness and lack of healthcare, hunger, lack of housing and insecurity of life due to criminal violence, disaster, etc. In India and elsewhere, public services have been made available to citizens at large to fulfil their basic needs. Considering that information and knowledge is synonymous for our argument, we have witnessed, in India, proliferation of numerous education and research organisations imparting scientific knowledge to wider masses; extension work particularly in the field of livelihoods business undertaken mainly by agricultural institutions, banking and insurance agencies; public consultations in state policy making processes, information services by state-sponsored administrative offices, public libraries and information centres and public broadcasting through radio and television. Flow of knowledge as part of educational services, extension work or mass media is characteristically limited to few target population clusters (e.g. educational services to student community, extension services to self-help groups, etc.), one-way (e.g. mass media disseminates audio or multimedia programmes to masses) and top down. As a result, knowledge disseminated by state or private sectors remains unsuitable to local environment and unusable to populations diversified by language, , religion, cultural, economic, and others human capabilities. Even though knowledge becomes suitable and usable, human agencies lack the means to provide their feedback to the knowledge providers. Moreover, knowledge that is culturally rich, inherited, traditional, diverse and intuitive possessed by local people themselves are largely ignored by these knowledge delivery mechanisms. Such mechanism fails to exploit knowledge to inspire and include human agencies to participate in collective actions that lead to social development.

Besides drawing knowledge and learning from the corpus of scientific knowledge brought out by learned communities, local human agencies also want to reflect their own knowledge, own views and perspectives. By communicating their own views, beliefs and perspectives, individuals exercise their right to voice their opinions in public space, to impose their own choices on the world through democratic means, to participate in political decision-making processes and, last but not the least, to take or help in taking appropriate decisions on judicious appropriation and sustainable exploitations of capitals. All such functionings lead to social, economic, cultural and political empowerment of local citizens. Since central or provincial-level knowledge delivery mechanisms fail to address the issue of local people's participation, it is imperative that such mechanisms also exist at the grassroots. ICT-enabled grassroots knowledge gateways – which can both capture and deliver knowledge – are indeed necessary

not only to amplify people's voices, but also to ensure public accountability and effective functioning of state machinery. To be able to execute desired knowledge functionalities, a local knowledge gateway unavoidably needs to be ICT equipped. A rural post office is also a knowledge gateway since it amasses postcards containing messages from rural citizens for distributing to neighbouring citizens and institutions in villages and cities. Never the less, knowledge contained in a postcard is primarily the targeted at individuals – hence it does not possess the capabilities of communicating knowledge to large masses generating public awareness around that knowledge object. ICT can create and distribute a postcard to millions of citizens consuming only a fraction of time, money and energy that is to be spent on an ordinary handwritten postcard. The argument, however, does not negate the importance of ordinary postcards in our lives – for, postcards are invaluable communication asset for millions of citizens; they are used to complain about negligence, misbehaviour, arbitrariness and corruption on the part of government officials to supervisory authorities. Nevertheless, the postcard analogy allows us to imagine the possibility of engaging those millions of unheard, voiceless citizens who want to speak their minds, communicate with their peers, voice their concerns to law enforcing agencies or opine on community decision-making using ICT. ICT facilitates management of information and aids varied forms of communication between human beings, between human beings and electronic systems, and within the electronic systems themselves through capturing, storage, processing, communication and display technologies.[42] ICT enables knowledge gateways to act smart, intelligent and dynamic enough to package knowledge specific to locale environment. Solution for red blight for a specific variety of potato grown in the hilly areas of Himachal Pradesh might be different from that of West Bengal. Or, knowledge and experience of communities belong to Tarai in the hilly areas of West Bengal who catch and domesticate snakes can be useful for the tea garden workers who retard from work for weeks because of snake intrusion in tea gardens in Assam valley. Globalisation, marketisation and increasing competitiveness warrant citizens to be knowledge resourceful especially in livelihoods enterprises - to be able to connect to institutions for seeking solutions irrespective of their locations, and to be able to cultivate knowledge in their cultural, social, economic and political practices. We recognise that literacy is not necessarily a barrier in harnessing and cultivating knowledge, because ICT allows less educated to perform those activities. Or, the promise of adaptive technologies in accommodating other access barriers similar to low educational attainment unfolds opportunities for human agencies to adopt ICT.

ICT runs the knowledge gateways for the simple reason that it is not humanly possible to perform all those functionalities. It is to be noted that knowledge

[42] Hamelink, Cees J. (1997: 9).

gateways - human or technology-enabled – existed in Indian villages for centuries. We have given an example of human knowledge gatekeeper - the village woman who serves as the 'genealogy librarian' for the villagers; and till now, we may find one such old 'genealogy librarian' existing in each of India's six million-plus villages. Evolution of ICT-enabled knowledge gateway occurred in last few decades. The use of radio for disseminating information on social issues predates India's independence in 1947. Radio as India's most popular broadcasting media started its journey in 1927. With the proliferation of private radio clubs and subsequently with the formal launch of All India Radio as a state media in 1936, radio started to play its role "to inform, educate and entertain the masses."[43] With a network of 215 broadcasting centres with 144 medium frequency (MW), 54 high frequency (SW) and 139 FM transmitters, AIR covers 91.42% of India, serving 99.13% of the total population. Within India, it broadcasts in 24 languages and 146 dialects; and abroad, in 17 national and 10 foreign languages. AIR disseminates information through news and current affairs programmes and education through extension programmes for specific audience including farmers, women, children, youth, troops, besides, providing formal and non formal education, adult education for IGNOU and UGC.[44] The reach of television, compared to radio, is significantly low. The Doordarsharn, the national state television broadcaster, has a network of 1314 terrestrial transmitters covering more than 89.6% of population.[45] Television programmes like news, sports, films and serials attract large rural population; and telecast of socially relevant messages is less visible through this media.

Both radio and television have been very popular and affordable mass media in villages and their contribution towards village development by disseminating information to the masses is widely recognised. The trend of sharing single ICT facility can be traced back to the period when radio was introduced in rural India for the first time. Singhal and Rogers (2001) illustrate how people used to gather in the house, which owned a radio to listen to their favourite programmes like sports coverage, a speech by famous politician like Gandhi or Nehru or news.[46] This trend continued further as television was making its inroad to remote villages in India in late 70s. Community clubs subscribed to cable television attract young and elders alike to live coverage of cricket matches between India and Pakistan. Communities in many villages watch popular TV programmes like news and weekend cinemas together. Telecast of two most popular epic serials in India since mid 80s - Ramayana (1987-88) and Mahabharata (1988-89) - attracted all the villagers in a single place. Popular serials like 'Hamlog' (1984) were most favourite topic of gossips among the villagers.

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[43] All India Radio.

[44] Ministry of Information & Broadcasting.

[45] Doordarshan.

[46] Singhal, Arvind and Everett M. Rogers (2001).

Television gained wide popularity among the masses during the last two decades. Researchers attribute two landmark developments that led to sudden popularity of television: first, the national telecast of 1982 Asian Games by Doordarshan (DD) over colour TV which was made available for the first time; secondly, the nationwide installation of transmitters for terrestrial broadcasting. Foreign satellite television invaded India at the beginning of nineties and cable TV started to operate first in large metros, then in smaller towns and finally in villages. By 1995 – 1996, about 60000 cable operators existed in the country, which was to grow exponentially in the coming years. The establishment of Centre for Development of Telematics (C-DOT) in 1984 under the auspices of the Indian Government ushered a new era of telecom connectivity in India. Indigenous developments of small capacity rural automatic exchange dramatically reduced the telephony infrastructure cost. C-DOT's cost-effective, modular, low-maintenance technology solutions helped rapid proliferation of telephone exchanges at the taluka level, and subsequently facilitated the rapid growth of PCOs in rural areas. Late nineties saw the emergence of truly functional, yet commercial, public access points that provided millions of rural citizens shared access to telephony. Decreasing call charges and lowering of infrastructure maintenance cost fuelled the growth of ubiquitous entrepreneur-run PCOs in large cities, muffasils, villages, mandis and bazaars. In the last few years, number of PCOs in India has multiplied many times, contributing towards rural development through facilitating business communications for trading and marketing of agri-based products.[47] Though community centres existed in India since historical times, ICT media like telephone, radio and television have accentuated the emergence of a new type of cohesive, functional community centres in rural India.[48] Except telephony, radio, television and cable TV function as a top-down, one-way knowledge delivery system in rural India.

Internet enables citizens to interact with governments, conduct businesses, communicate with peers, innovate, inculcate novel practices into daily lives and reflect their opinions in knowledge societies. Developing economies, especially the cities in Asia, Africa and Latin America have witnessed rapid proliferation of internet cafes with reduction of access charges. Governments, multilateral agencies, private and civil society organisations have established infokiosks, modelled on the urban cyber cafes, in rural and remote areas in these countries.[49] Grassroots citizens can access ICT through the infokiosks - also termed as Community Multimedia Centre (CMC), telecentre, telecottage, Multipurpose Community Telecentre (MCT), Village Knowledge Centre (VKC). Infokiosks are generally equipped with networked computers, connected to internet and landline

[47] As of 30.11.2004, 2023923 PCOs have been installed. See, Department of Telecommunication (2005: 5).

[48] Singhal, Arvind and Everett M. Rogers (2001: 34-40).

[49] Digital Dividend documents thousands of such experiments being conducted worldwide. The searchable database is available at: http://www.digitaldividend.org.

and mobile telephony services, besides other office peripherals used for document processing. Integrating community broadcasting facilities to infokiosks enhances further its capacity of capturing and amplifying local voices. A wide range of ICT utilities, however, can be attached to the infokiosk infrastructure. It is hard to overlook the impact of growth of infokiosks as knowledge gateways in rural India. Gigler (2004) argues that "improved access to information and ICT skills, similar to the enhancement of a person's writing and reading skills can enhance poor peoples' capabilities to make strategic life choices and to achieve the lifestyle they value."[50]

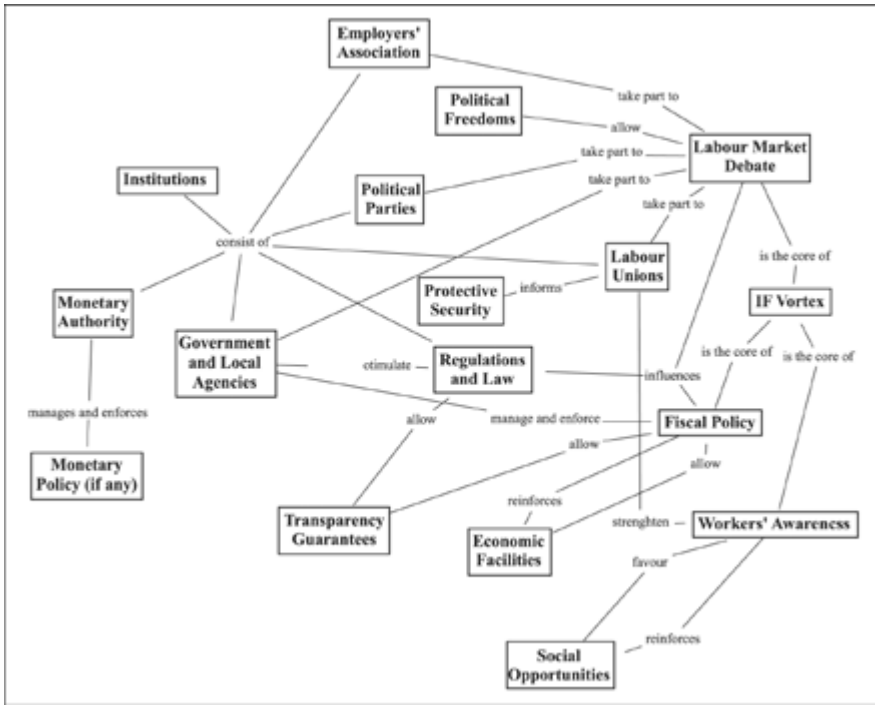
1.7 ICT for sustainable human development

The notion of sustainable human development is neither an abstract nor unachievable one, as many of development practitioners think. Globally, for many decades we have experienced emergence of numerous treaties, instruments and principles on development issues. Nevertheless, evolutions of Agenda 21, Millennium Development Goals, World Summit on Sustainable Development and the World Summit on the Information Society over last two decades have set standards for sustainable human development. While Agenda 21, with its predecessor the Stockholm Conference in 1972, and WSSD focused on sustainable development; WSIS focuses on bridging the digital divide to further human development. Corroborating the need to integrate sustainability element as advocated in Brundtland Report (1987),[51] Sen (2002) observes, "It can not be doubted that the concept of sustainable development, pioneered by Brundtland, has served as an illuminating and powerful starting point for simultaneously considering the future and the present."[52] Though the constituencies of sustainable human development are understandable, lack of informational data and functional relationship between data sets poses challenges to contextualising to the ground realities. Grasso and Giulio (2003), in an attempt to pronounce how individual choice and freedom is resonated in institutional freedom (called the IF Vortex), explore backward and forward linkages existing within social and political institutions - institutes that act coherently in poverty alleviation efforts by maximising the effective optimisation of conditionalites (e.g. international economic climate, labour market structure, public actions, etc.) against a wide variety of structural variables (e.g. employers' association, monetary authority, government and local agencies, regulation and law, etc.).[53] Figure 1.1 depicts the action and

[50] Gigler, Björn-Sören (2004).
[51] Bruntland, G., *ed.* (1987).
[52] Sen, Amartya (2002:1).
[53] Grasso, Marco and Enzo Di Giulio (2003: 18).

reactions arising out of efforts towards poverty alleviation as a result of optimisation of conditionalites; and the structural variables in the IF vortex.[54]

FIGURE 1.1: Poverty – the IF vortex map



Source: Grasso, Marco and Enzo Di Giulio (2003: 18).

The Millennium Development Goals, emerged out of Millennium Declaration in September 2000, serves as the achievable development targets adopted by UN Member States. Localised versions of MDG can be found in national planning documents of many countries and progress towards achieving MDG is periodically monitored and measured nationally and globally. A resemblance to MDG in India's Tenth Five Year Plan, which articulates the country's development strategy for 2002 – 2007, can be found, as India is a signatory along with other countries to undertake appropriate plan of action to meet the MDG targets. (Table 1.2).

[54] *Ibid*, p. 18 – 19.

Table 1.2: Millennium Development Goals and monitorable Tenth Plan (2002-07) targets

Millennium Development Goals	*Monitorable Tenth Plan (2002-07) Targets*
1. Eradicate extreme poverty and hungerHalve, between 1990 and 2015, the proportion of people whose income is less that one dollar a dayHalve, between 1990 and 2015, the proportion of people who suffer from hunger 2. Achieve universal primary educationEnsure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling 3. Promote gender equality and empower women 4. Reduce child mortality 5. Improve maternal health 6. Combat HIV/ AIDS, malaria, and other diseasesReduce infant and child mortality rates by two-thirds between 1990 and 2015Reduce maternal mortality rates by three-quarters between 1990 and 2015Provide access to all who need reproductive health services by 2015 7. Ensure environmental sustainability Implement national strategies for sustainable development by 2005 so as to reverse the loss of environmental resources by 2015 Halve, by 2015, the proportion of people without sustainable access to safe drinking water Have achieved, by 2020, a significant improvement in the lives of at least 100 million slum dwellers	1. Reduction of poverty ratio by 5 percentage points by 2007 and by 15 percentage points by 2012 2. Providing gainful and high-quality employment at least to addition to the labour force over the Tenth Plan period 3. All children in school by 2003; all children to complete 5 years of schooling by 2007 4. Reduction in gender gaps in literacy and wage rates by at least 50 percent by 2007 5. Reduction in the decadal rate of population growth between 2001 and 2011 to 16.2 per cent 6. Increase in literacy rates to 75 percent within the Plan period 7. Reduction of infant mortality rate (IMR) to 45 per 1000 live births by 2007 and to 28 by 2012 8. Reduction of Maternal mortality ratio (MMR) to 2 per 1000 live births by 2007 and to 1 by 2012;Increase in forest and tree cover to 25 percent by 2007 and 33 percent by 2012 9. All villages to have sustained access to potable drinking water within the Plan period 10. Cleaning of all major polluted rivers by 2007 and other notified stretches by 2012.

Achieving these development targets means, thus, ensuring what is the human rights for majority of the populations. Even though the goals are set by agencies

- external and distant from the daily lives of rural communities - MDGs and Tenth Plan targets mirror basic human needs, hence, onus of materialisation of these development targets remains on the citizens themselves – who will be the principal actors of development, rather than any state-sponsored agencies. Governments – national, provincial or local – at best can provide finance and technical expertise to undertake infrastructure building, it is the duty of ordinary citizens to ensure that the infrastructure building is conducive to their needs; the services promised by the state have reached to them. Governance of development will be a challenge for India and herein a seamless knowledge connection across the state, market and civil society institutions is senvisaged such that. Interfaces of such knowledge connections serve the public to amplify their voice in the public administration system.

1.8 Voice in human development

We have introduced the concept of voice in our discussion. The issue of 'voice' bears substantial developmental consequences for rural communities - who are economically poor and less privileged, socially vulnerable and politically marginalised - as eliciting unheard marginalised voice to the mainstream is one of the critical instruments to impose a checker to the widespread corruption among service delivery agencies, where even local human agencies tend to be susceptible to corruption. The philosophy of voice, notwithstanding its political underpinnings in local partisan systems, encapsulates the knowledge cultivation process in socio-cultural roots of grassroots communities. Voice, as glimpses from rural communities display, act well beyond simply resonating knowledge functionings practised as part of the planned, measurable and time-bound developmental interventions prompted by agencies external to the local communities. Voice represents oral communications that take place within a family – constituted of men and women and their various relationships. It is interesting to note that elements of voice among man (as son, brother, husband, etc.) and woman (as daughter, sister, wife etc.) differ according to the relationship, distance and power structure within the family. Human development depends on such oral communication which expresses human emotions of love, affection, and tenderness at the one hand, or even, hate, betrayal and violence on the other. Love, affection and tenderness lead to development (mother's love to her child is a necessary precondition for latter's development, for instance); while hate, betrayal and violence, on the contrary, result in destruction.

Dreze and Sen (2002) observe, "Local democracy is also essential as a basis of public accountability, particularly in the context of the need for effective and equitable management of local public services. These services – from schools and health centres to fair price shops and drinking-water facilities – are often crucial for the quality of life. Their effective functioning, however, depends a great deal on the responsiveness of the concerned authorities to popular demands. To illustrate, it is difficult to see how the endemic problem of teacher absenteeism in rural India can be successfully tackled without involving the proximate and informed agency of

village communities in general and parental groups in particular. As things stand, there is no mechanism to ensure any kind of accountability of village teachers to the local community or to the parents in large parts of India, and this is an important factor in the persistence dereliction of duty."[55] Commenting on the local governance system in India, Rao (2005) states, "Strategies in India for manipulating power come via control of the political process. Therefore, electoral turnout is very high –about 70 percent for village panchayats elections. Public goods are almost entirely centrally funded – with only 24 percent of households claiming that have made any contribution towards their provision (about half the percentage in Indonesia). Public goods, such as schools, roads and clinics, are therefore hybrid SPGs – symbols of the largesse of the state rather than "owned" by the community. As a result, they represent opportunities for private appropriation manifested in high levels of absenteeism by schoolteachers, medical workers, and other state employees, and in corruption by panchayats when giving contracts. With the exception of Kerala, panchayats have very small budgets. Their funds are largely acquired from a small house tax, and petty taxes, which validate transactions such as, land sales. Most of a panchayats' budget is currently derived from programs with targeted beneficiaries—such as housing for SC/STs and food for work programs—over which pradhans have very little discretion. Yet, success in panchayat elections is a stepping-stone to higher elected office, and pradhans can control relatively lucrative contracts for village public goods. High positions in panchayats are, therefore, rather highly valued, and panchayat elections are often very competitive, being structured around the same party-based competition prevalent in state and national elections (even though some states officially ban party affiliations in panchayat elections). Despite this, panchayats do manage to get things done, often by acting as intermediaries to divert state government projects and funds to their villages. And pradhans provide public goods in a manner entirely consistent with the incentives of electoral competition – tending to take more care of their own constituents, their home village, and their caste."[56]

How do we ensure that village teachers not only teach their students according to the schedule prescribed by the provincial education administration, but also be motivated enough to impart quality learning to rural youth, innovate novel techniques of teaching adopting from learning experiments from other parts of the world and converse with their parents for creating better learning environment for their pupils? How do we ensure that the benefits of state-sponsored village public goods reach the intended recipients without any prejudices of kinship, caste, religion, political affiliations, economic status and so on? Governance of village public goods is, thus, extremely complex, dynamic and variable in nature. A national, or even provincial, legislation or law-enforcement agency might not

[55] Dreze, Jean and Amartya Sen. (2002).

[56] Rao, Vijayendra (2005: 20-21).

be able to ensure judicious appropriation and sustainable exploitation of village public goods simply because of the reason that conditionality that affects such decision-making process may varies from village to village. Moreover, law-enforcement agencies, such as the district school inspector or even the village Pradhans can prevent teacher absenteeism in rural India, but they are handicapped to engage, motivate and inspire the absentee teacher to provide quality learning to students. Therefore, governments can build school infrastructure, train and recruit teachers in partnership with the local community, private sector and civil society organisations, but building a learning community depends on the teachers, students and their parents and the village communities as a whole. In this connection, the story of corruption in regulating rickshaw pulling in Delhi illustrated by Goetz and Jenkins (2002) worth mentioning. (Box 1.2)

Goetz and Jenkins (2002) further note, "The fact is that voice and accountability are conceptually distinguishable, but inseparable in practice. For there to be answerability – the obligation of power-holders to justify their decisions and actions – someone has to be asking the questions. And if these questioners are to be drawn from beyond the ranks of government itself, then ordinary people must be endowed with voice. But the voice presumed in accountability relationships is very different from that of the irate but passive focus-group participant. The genuinely 'questioning voice' has access to information about the context in which decisions were taken, including the legal requirements governing the actions of power-holders and the public promises made prior to action."[57]

Box 1.2: Regulation of rickshaw pulling in Delhi

Making a tough job much tougher: Corruption in regulating rickshaw-pulling in Delhi

Rickshaw-peddling is a physically demanding, dangerous, and poorly-paid job. The dangers and low rewards to this work are exacerbated by the failure of official regulatory systems to uphold safety regulations and limit the numbers of cycle rickshaws on the roads. In Delhi, for instance, there are simply too many rickshaws on the streets at least twice the legally sanctioned number of 50,000 choke the roads. Most are in poor repair, to the point of making the job of rickshaw-pulling thoroughly dehumanizing. In spite of the fact that there are simple, cheap and accessible technologies available for upgrading cycle rickshaws and making the job of pulling them less physically depleting, rickshaw wallas do not invest in these because they do not own their rickshaws. Instead, they pay over double the value of a new rickshaw every year in rents to rickshaw contractors. A new rickshaw costs between Rs. 2,500-3,000, and the daily rent paid by a rickshaw-walla is Rs 17-20, or Rs 7,200 a year.

[57] Goetz, Anne Marie and Rob Jenkins (2002: 10).

Why do rickshaw-wallas not buy their own rickshaws in order to make bigger profits, and use some of that money for rickshaw-upkeep? Why does the state not support this by better regulating the number and quality of rickshaws on the roads? In fact, regulations do exist to control the number of rickshaws and to ensure that they meet safety standards, and this is done primarily by licensing rickshaws for the low cost of Rs 27 per year. In practice, this licensing system is the starting-point for municipal officials and police to extract, on an arbitrary basis, rents from rickshaw-pullers. For instance, to obtain a license in the first place, at least Rs 500-600 of speed money per rickshaw must be paid. This license, however, does not guarantee immunity from police harassment. The Municipal Corporation of Delhi frequently rounds up rickshaws, ostensibly to check their legal status, yet even owners of those that are licensed must pay a bribe of between Rs 30 and Rs 300 to have their vehicles released, over and above the daily storage fees charged while they are held by the Corporation.

In addition, the Corporation can fine even license-holding rickshaws for a number of violations, such as missing accessories like reflectors or mud-guards. Fines are Rs 100 per vehicle. The raids are a pretext for bribery, not a means of improving road safety. The unsurprising consequence of this system of arbitrary capture and charging of rickshaws is an erosion of any incentive to invest in safe and efficient cycle rickshaws, let alone to pay for a license. Large contractors operating fleets of extremely poor-quality rickshaws arrange to bypass some of this police predation by purchasing licenses in bulk, paying hefty monthly haftas to the police, and recovering those costs from the daily rent paid by rickshaw-wallas.

Source: Kishwar, Madhu (1996: 58-59).

Source: Goetz and Jenkins (2002: 16).

A careful analysis of the observation made by Goetz and Jenkins (2002) indicates towards the need for a novel mechanism at the village level that will help the voiceless citizens to vindicate their voices while being knowledgeable about the internal and external conditionalities. The role of mass media in promoting public voice has been recognised – an accessible, widely diffused, free and independent mass media accentuates good governance implementation,[58] though the capacity of mass media in promoting grassroots voices is rather limited. In these observations, the need to ensure public accountability in delivering village public good is underlined, though a mechanism to do so has

[58] Norris, Pippa and Dieter Zinnabauer (2002: 43).

not been proposed. If traditional social institutions and personal agencies are not capable of acting as knowledge gateways, what mechanism can fulfil the functionalities of knowledge gateway The functionalities of local knowledge gateways, thus, encompass - a) capture, document, amplify, broadcast and disseminate local knowledge elicited by human agencies across the vicinity of knowledge gateways and within and beyond the villages – locally and globally; while harnessing customised, appropriate, contextual, need-based scientific knowledge from the learned communities such that human capabilities can be enhanced; and, b) participate in local, provincial and national political processes to ensure state accountability and to exercise democratic rights. Empirical evidences suggest that through performing functions (a), human agencies exploit knowledge for fulfilling their basic needs of healthcare services, educational attainment and economic growth. Voice is an important instrument in ensuring pro-poor governance policy that creates conducive environment for reaching the developmental efforts to the less privileged and marginalised citizens.

ICT enables local citizens and institutions participate in the governance and decision-making processes through exchange of information and communication between state authorities and the citizens. Using ICT, governments improve the quality and responsiveness of their services delivery to the citizens and expand the reach and accessibility of services and public infrastructure. Developments in spatial technologies like GIS and remote sensing allow communities to participate, discuss and take decision in local planning.[59] Various e-governance processes have been developed to automatise citizen services. Madon (2004) chronicles the historiography of e-governance evolution and maturity in India.[60] In the first phase, which runs from late 1960s till late 1990s, the efforts were concentrated on development of IT infrastructures and applications in the central government offices and in the second phase, in the post 2000 scenario, vigorous use of IT applications in a wide range of sectors resulted into reaching out to a larger citizens belonging to both rural and urban India with greater amount of private and civil society involvements.[61] It is only in the second phase when pilot e-governance initiative like rural e-*seva*, internet-enabled integrated service centres, have started functioning in Andhra Pradesh for providing access to different types of government services.[62] In rural e-seva, ICT catalyses the delivery of village public goods, monitors state services and enables people to provide voice their opinions to state.

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[59] Craig W.J., T.M. Harris & D. Weiner, *eds.* (2002).

[60] Madon, Shirin (2003, 2004: 3).

[61] *Ibid.*

[62] See, eSeva Online at http://www.essevation.com.

1.9 ICT for quality health services

That health care service in rural and urban India needs immediate infrastructural reform is long felt and well articulated in Five Year Plan (2002-07). Despite the progress in health sector, it is unlikely that India can meet any of the health related targets stipulated by MDG by the year 2015. It is estimated that as much as 75% of a total 100,000 maternal deaths occurring every year in India, amounting to one maternal death every 5 minutes, is preventable if proper medical attention can be provided on time. Moreover, lack of medical attention results in 10-15 maternal disabilities for every maternal death. An IMR of 70 per 1000 live births and a CMR of 95 per 1000 live births are very high compared to that of 5-6 CMR in developed nations. With 5.1 million of HIV/AIDS patients, India has the highest number of HIV/AIDS cases as a country outside Africa. Incidences of non-communicable diseases are increasing – 25 million cardio-vascular diseases, 25 million diabetes patients, 2.4 million cases of cancer, to cite a few. Water contamination, poor sanitation and hygiene cause as much as 9% of all deaths; and an estimated 24.7 million years of life are lost every year. The situation is more aggravated because of the lack of toilet facilities in rural India – currently only about 20% of rural household own a toilet; and with the current rate of increase in toilet, it will take 80 years for 100% coverage of toilet facilities in rural areas. Recent estimate shows that the governmental contribution towards total health care expenditure comprises only 20% while the rest 80% is incurred by the patients. With the cost of health care increasing dramatically, a majority of population is not in a situation to afford health care services. Health insurance - which is available as private insurance, social insurance, employer-provided cover, community insurance schemes and governmental contribution – cover only 3-4% of the population. Despite 100% of growth in insurance cover in the last 2 years, it is estimated that only 160 million or 15% of population will be protected by any kind of insurance by the year 2010.[63]

The impact of ICT in the health sector has been phenomenal, as it transforms the delivery of public and private healthcare services in the developed countries, particularly in the OECD nations.[64] For rural areas in developing countries, ICT brings expert medical advice and emergency health care though remote consultation, diagnosis and treatment. Remote consultations using telemedicine facilities are widely practised in Europe and North America; and in India, indigenous telemedicine tools have yielded with satisfactory results.[65] ICT empowers the rural health workers

[63] These statistics are taken from Ramani K V and Mavalankar Dileep (2005: 2-3).

[64] OECD (2003: 204-211).

[65] Bangalore-based Neurosynaptic Communications Pvt Ltd and the TeNeT (The Telecommunication and Computer Networks) Group at Indian Institute of Technology, Madras, have developed a low-cost telemedicine solution for rural areas. It includes a remote diagnostic kit and a personal computer to provide basic healthcare infrastructure in rural areas, and help people like Ethiraj sitting in villages

with in-service education and training and orientation to latest developments in medicine. Intergovernmental organizations such as the World Health Organization, as well as other professional medical organisations have developed disease-specific websites that provide access to medical knowledge to trained and paramedical health workers. Innovative e-learning packages along with self-assessment modules are available through interactive and multimedia portals and optical discs like CD-ROM. Dissemination of knowledge (termed 'information, education and communications' in health extension services) for promoting nation-wide family planning has been imminent to control rapid population growth and ensuring better administration of reproductive and child health programme. National Family Health Survey, 1998 – 99 (2000) posits that, "The new National Population Policy, 2000, adopted by the Government of India has set as the immediate objective of the task of addressing unmet need for contraception in order to achieve the medium-term objective of bringing the total fertility rate down to replacement level by the year 2010. One of the 14 national socio-demographic goals identified for this purpose is to achieve universal access to information/ counselling and services for fertility regulation and contraception with a wide range of choices."[66]

ICT-enabled local knowledge gateways have already started providing personalised counselling services using remote counselling methods. Formation of email and web-based virtual knowledge communities equipped the medical and development communities with knowledge-sharing facilities to deal with health-related problems. The recent launch of the National AIDS Control Programme Phase III (NACP III) e –consultation is one such instance where the United Nations Country Team has partnered with the NACO to elicit public opinions for formulating appropriate strategies to combat the menace of HIV/AIDS.[67] Online repository of latest medical journals through open access enables health professionals to access costly medical journals free of charge.[68] In the outbreak of epidemics, ICT - especially the public broadcast media such as radio and television, or other radio communication utilities such as HAM radio and walky-talkies - come to the rescue by disseminating public health messages and emergency disease prevention techniques. In many instances, internet is used for monitoring and response mechanisms of disease prevention exercises. World Health Organization (WHO), as part of its global Communicable

get advice from doctors in urban areas. The Rs 10,000-kit can be installed at villages having Internet connection. It can measure basic physiological parameters like temperature, blood pressure, pulse rate and multi-channel ECG (electrocardiogram). Raja (2004).

[66] Ministry of Health and Family Welfare (2000).

[67] Solution Exchange.

[68] India's National Informatics Centre, through its MEDLARS programme, provides access to bibliographic records of millions of medical articles. NIC has recently launched OpenMED (http://openmed.nic.in), an open access archive for Medical and Allied Sciences. Here authors / owners can self-archive their scientific and technical documents. The aim of OpenMED is to provide free service to academics, researchers, and students working in the area of Medical and Allied Sciences.

Disease Surveillance & Response (CSR) programme, has developed the Meningitis Monitoring System that monitors daily cases of meningitis across Sub-Saharan Africa using internet to help coordinate mass vaccination programs when the diseases reaches its threshold level.[69]

1.10 ICT for promoting quality education for all

Developed economies have long been testing the efficacy of education technology in their teaching and learning environments. Most of the OECD nations have adopted long-term national plans of actions to stimulate ICT-assisted learning in their educational settings. That ICT improves the teaching and learning outcomes in various disciplines, especially in the sciences and social sciences have been well documented.[70] The No Child Left Behind Act (NCLB) in the US accords funds to the provincial governments to increase ICT use in schools.[71] In developing countries, likewise, computer labs have been set up in many primary, secondary and higher education institutions. In some instances, limited Internet connectivity is provided to the computer labs, as well. In primary and secondary schools, computers are used to teach and learn almost every subject in humanities, social sciences and sciences. 'Computers' are used in practicing skills, solving problems, learning course materials, working collaboratively, producing multimedia projects or corresponding with experts, peers and mentors. 'Teacher training' is another area of ICT usage, where the later supports in the professional development of the teaching community and ensures timely, uninterrupted and peer-to-peer support as part of the in-service training. ICT has given a new meaning to distance education, as courses are delivered to remote locations through synchronous or asynchronous means. Nowadays, distance education course materials include written correspondence, text, graphics, audio-and videotape, CD-ROM, online learning, audio- and videoconferencing, interactive TV and facsimile.[72] E-learning, a method of transmitting learning instructions, runs over a broad set of applications and processes - including web-based learning, computer-based learning, virtual classrooms, virtual high schools, and digital collaboratory. The modules are delivered through internet, intranet, audio- and videotape, 'satellite' broadcast, interactive TV, or CD-ROM.

1.11 ICT for promoting livelihoods opportunities for all

Increasing food security and livelihoods opportunities form the key trajectories to enhancing people's economic opportunities in developing

[69] World Health Organization.

[70] Science and Engineering Indicators 2004 monitors statistics in education on ICT usage in US. See, National Science Board (2004: 40-43).

[71] US Department of Education.

[72] Bates, A.W. (2001).

economies.[73] In urban areas, ICT is largely employed to enhance industrial and services productivity; while in rural areas, ICT is used for expanding income generating options through facilitating local trade, enhancing market opportunities and competitiveness and providing access to information on livelihoods. Access to information on weather trends, improved farm practises, credit availability, market prices of various commodities increases livelihoods opportunities of the rural poor. Meera, Jhamtani and Rao (2004) provide a list of ICT-enabled agricultural development services suitable for the developing world (Box 1.3).[74]

Analysing the positive impacts of three ICT projects in India – Gyandoot, Warana and iKisan, Meera, Jhamtani and Rao (2004) recommended that: a) efforts should be made to incorporate ICT in all endeavours related to agricultural development; b) the organisations and departments concerned with agricultural development need to realise the potential of ICT for the speedy dissemination of information to farmers; and c) government at national and state level in India has to reorient agricultural policies so that a fully-fledged strategy is formed to harness ICT's potential for assisting overall agricultural development. In Bangladesh, Grameen Bank's Village Pay Phone project operates on the GSM network and lends money to rural women to purchase GSM cellular phones. Phone owners rent the phones out to village farmers and other community members for a fee and provide messaging and incoming call services.[75]

ICT helps in micro finance administration, as evident in Grameen Bank's work, enabling the rural communities to access to small credit easily. Rural SMEs engaged in agri-based and non-farm productions leverage ICT for reducing operational costs by decreasing material, procurement and transaction costs, resulting in lower prices for intermediate and finished goods. Internet facilitates creation of business process outsourcing jobs, global market for local handicrafts that can be merchandised through e-commerce and numerous other ways of creating opportunities for rural citizens. Recent scientific and technological researches have advanced the use of ICT in environmental protection and natural resource management. In natural disasters, ICT is widely used for monitoring and rescue operations. It helps in the reduction of energy consumption, water and other essential natural resources through adoption of agricultural and industrial procedures that are more efficient. To illustrate, precision agriculture techniques, an information-based initiative developed by the Ohio State University,[76] which uses sensors, digital application controllers, communication links, global positioning systems (GPS), computers and

[73] Jaggi (2003: 4); Kenny, Charles and Carter Eltzroth (2003), Cecchini, S. and C. Scott (2003: 74-84).

[74] Meera, Shaik, N. Anita Jhamtani and D.U.M. Rao. (2004: 6).

[75] Grameen Telecom.

[76] Ohio State University.

innovative software solutions to automatically match agricultural inputs and practices to variable local conditions within an agricultural field, optimise farm return on investment ensuring more efficient use of scarce resources. Satellite-based monitoring systems detect changes in climatic conditions and help in fight against pollution and ozone layer depletion. Spread of ICT limits the rural to urban migration while promoting the habits of telework among citizen. Table 1.3 highlights some of the most used ICT applications in rural development practices in the developing nations.

Box 1.3: ICT-enabled agricultural development services

1. Online services for information, education and training, monitoring and consultation, diagnosis and monitoring, and transaction and processing;
2. E-commerce for direct linkages between local producers, traders, retailers and suppliers;
3. The facilitation of interaction among researchers, extension (knowledge) workers, and farmers;
4. Question-and-answer services where experts respond to queries on specialised subjects ICT services to block- and district-level developmental officials for greater efficiency in delivering services for overall agricultural development;
5. Up-to-date information, supplied to farmers as early as possible, about subjects such as packages of practices, market information, weather forecasting, input supplies, credit availability, etc.;
6. Creation of databases with details of the resources of local villages and villagers, site-specific information systems, expert systems, etc.;
7. Provision of early warning systems about disease/ pest problems, information regarding rural development programmes and crop insurances, post harvest technology, etc.;
8. Facilitation of land records and online registration services;
9. Improved marketing of milk and milk products;
10. Services providing information to farmers regarding farm business and management;
11. Increased efficiency and productivity of cooperative societies through the computer communication network and the latest database technology;
12. Tele-education for farmers;
13. Websites established by agricultural research institutes, making the latest information available to extension (knowledge) workers and obtaining their feedback.

Source: Meera, Jhamtani and Rao (2004: 6).

TABLE 1.3: Examples of ICT applications in rural contexts [77]

Education	*Agriculture*	*Sustainable livelihoods*
Offline multimedia e-learning tools in CD-ROMs etc	Access to market information through portals, radio, mobile phones	Exploring employment opportunities
E-learning using chat and video-conferencing facility	Expert advice on farming, animal husbandry, fishing, dairying etc.	Income opportunities for infokiosk entrepreneurs
Distance education through internet; capacity building of rural teachers	Detection of catch fish zone using satellite tracking systems	Payment of bills through infokiosk
Radio broadcast for educational contents	Knowledge sharing of indigenous farming practices	Money transactions with non-resident Indians
Health	*Community development*	*Small business development*
Telemedicine applications e.g. remote diagnosis and expert medical consultations	Interactive portals with local content in native languages, web-based newspaper	Micro-credit financing
Improved health recording system	Local culture preserved and flourished through community radio	E-commerce for local artisans
Better delivery of training modules for In-service training of semi-skilled health workers using ICT	Local jobs, matrimonial portals, Interaction with family members living in cities, abroad	Improving logistics, e.g. pre-arranging payment and delivery details before transactions
Better monitoring and knowledge sharing on disease and famine	Facilitate knowledge sharing among community, local government and grassroots NGOs	Market information, marketing of products
Governance	*Emergency Situations*	*Environmental*
Lodging complaints and grievances to state and redressal	Calling police, fire, and ambulance and location and rescue of victims in emergency	Weather forecast
Payment of state services	Emergency assistance in vehicle breakdown	Neighbourhood mapping, natural resource management
Applications for certificates, Copy of land records	Radio broadcasts (esp. using ham radio) in natural calamities	Satellite based tracking of bush fires
Information on state schemes e.g. credit and below poverty line amenities	Disseminating early warning from national and international disaster warning systems via local infokiosks	Local planning using GIS

[77] ITU (2000: 21); Senthilkumaran, S. and S. Arunachalam (2002). Rajora, Rajesh (2002).

1.12 Realising the potentials of ICT

Promises of ICT in enhancing citizen's capacities remain unmet so far largely because ICT infrastructure is lacking in rural areas. 'India' lags far behind other Asian developing economies like China, Korea and Malaysia in the usage of computer, cable TV, fixed telephony and 'mobile' phones. A recent estimate shows that per 100 people, rate of PC usage in Korea, Malaysia and China is as high as 78.6, 15 and 2.8 respectively, compared to only 0.8 in India. Similarly, in mobile telephony, India's rate of usage stands at 2.6 per 100 persons, compared to that of China's 18.3, Korea's 75 and Malaysia's 43.9 (Table 1.4).

TABLE 1.4: ICT usage comparison across Asian economies

Parameters	*Korea*	*Malaysia*	*China*	*India*
No of PCs per 100	78.6	15	2.8	0.8
No of cable TVs per 100 persons	43	0	9	6
No of fixed telephone lines per 100 persons	51	18.5	18.0	3.9
No of mobile phones per 100 persons	75	43.9	18.3	2.6
GDP (US $ per capita)	10,000	4,000	965	465
No of internet connections per 100 persons	26	12	2.5	0.4
No of users per 100 persons	65.5	34	6.2	1
No of broadband connections per 100 persons	25	0.4	1.4	0.02

Source: Telecommunication Regulatory Authority of India (2004:10).

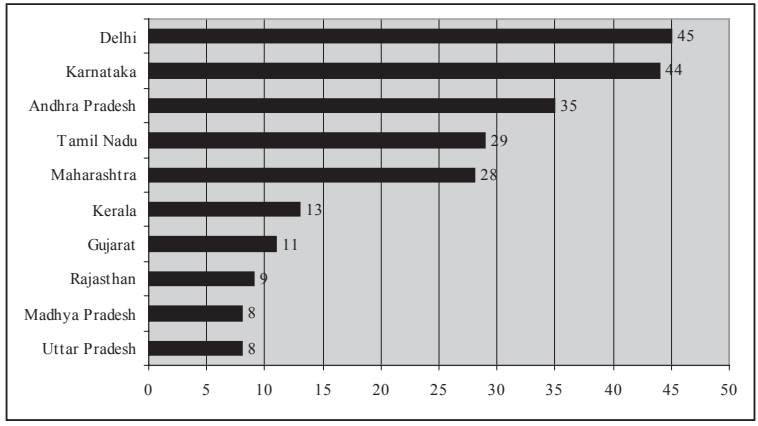
Digital Dividend (2003) shows that 33 and 37 per cent of world's infokiosk projects are concentrated in Africa and Asia respectively. A survey of the projects submitted to the Digital Dividend database shows that most of the ICT-enabled development projects are concentrated only in 10 states in North and South India – Delhi, Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra, Kerala, Gujrat, Rajasthan, Madhya Pradesh and Uttar Pradesh. Paul, Katz and Gallagher (2004) observed that, "Almost half of all projects in India are located in the southern states of Tamil Nadu, Karnataka, Andhra Pradesh and Kerala. Together, these states account for just 22% of the country's total population. A fifth of Indian projects are located in the capital city of New Delhi. Another 15% are found in the western states of Gujarat and Maharashtra"[78] (Figure 1.2).

Inter-regional disparity, limited computerisation of line departments in government agencies further undermine citizen's access to infokiosks infrastructure to fully leverage

[78] Paul, John Robert Katz and Sean Gallagher (2004: 5-11).

the benefits of ICT. It is envisioned that infokiosks need to be established in India's 600,000 plus villages to enable effective reach and monitoring of state-sponsored poverty alleviation programmes across the political boundaries of the states, allowing direct citizen's participation in such programmes. Infokiosk services, however, go well beyond the ambit of state development interventions, as it functions as the knowledge hub in the villages in its own right. We observe that the limited access to ICT itself is an inhibiting factor for furthering the ICT-enabled development agenda. In addition to limited access, there are disparities in access to ICT infrastructure within rural-urban areas, regions, gender, social, economic, and cultural strata.

FIGURE 1.2: Spread of ICT projects in India across selected states



Source: Paul, John Robert Katz and Sean Gallagher (2004: 5-11).

Moreover, selective ICT pilots accentuate social and economic disparities further within rural population clusters. Motivation for providing access to all was first enunciated in the recommendations of the National Taskforce on Information Technology and Software Development, set up in May 1998, to draft a National Informatics Policy. The impetus for rolling out citizen-centric ICT services thus emerged out of the 'Information Technology Action Plan' by the National Taskforce in 2001.[79] Limited progress has been made until 2004 July when a national level policy consultation was convened to formulate an action plan for 'taking ICT to every Indian village by 2007,' initiated by civil society organisations. The July 2004 consultation led to the formation of the 'National Alliance on ICT for Basic Human Needs,' a consortium comprising more than 120 organisations representing government, private and civil society sectors. The Second Convention of the National Alliance also provided further boost to this idea.

[79] National Taskforce on Information Technology and Software Development (1998).

1.13 Conclusion

The foregoing discussion shows that knowledge is a key ingredient for sustainable human development – hence, for furthering human development access to knowledge is a prerequisite for the Indian citizens. While urban India is relatively well connected to multiple knowledge gateways, rural India lags far behind. Though ICT infrastructure in rural India is steadily growing as part of the recent state sponsored initiatives like Common Services Centres and NeGP, their impact on human empowerment has yet to be mainstreamed into the project deliverables and outcomes. Researches on the interconnections across ICT and human development demonstrate multi-facted interlinkages across the social, cultural, political and economic issues and institutions. It is recognised that the impact of ICT in human development will much depend on the efficacy of such linkages across state, market and civil society institutions in rural India.While ICT is expected to work for human well-being in health, education, livelihoods, women empowerment, environment and other sectors, development of human capabilities in sustaining the development assistance is seen as the key goal.

2

Human Agencies for Knowledge Connection: Governance of ICT in Rural India

Yagjung is a village woman of 59 living in Harsil and Dunda villages in Utta said, "The population is increasing and, naturally, cultivated land is increasing. Wherever there is vacant land, it is under government control. The government has put it under plantation, so we cannot get grass from there. Trees are being cut. Generally the trees are cut during winters but mostly wood is stolen from the forest during this period. A permit is given for some trees in the forest to be cut during summers. Who goes to look into the forest in winter? Everyone does their farming in summer. And during *padiyali* (a specific time for mutual aid and collective work among village groups) no one has enough time to go to the forest."[1] An illiterate village weaver, like Yagjung, may not be able to use highly sophisticated and state of the art ICT devices, like a computer, to voice her concerns on decreasing availability of green pastures to the state authorities. Her illiteracy and unawareness may not permit her computing tools that require higher degree of ICT awareness, initiation to be able to reflect her knowledge. Millions of illiterate village women like Yagjung are, nevertheless, key stakeholders of the emerging knowledge society, though their inclusiveness is seldom discussed. If technology is able to mainstream voices hitherto unheard, suppressed or marginalised for various cultural, social, political and economic reasons, concerted effort towards realising

[1] Yagjung's opinion is recorded as part of the Mountain Voices project. The complete transcription is available online, here: http://www.mountainvoices.org/Testimony.asp?id=33.

an inclusive knowledge society needs to be commenced – Yagjung's voice perhaps can be captured by an infomediary using a microphone to broadcast through the local community radio. Nevertheless, it is important to recognise numerous visible and invisible barriers human agencies in rural India face everyday to communicate knowledge functionings. Understanding the problems of millions of Yagjungs is thus central to designing locale-specific services through infokiosks.

The story also reminds us that human agencies are foundational for successful evolution of community knowledge gateways - and their effecting functioning in the community lives. In the previous chapter, we have underscored the importance of recognising both individuals and institutions as human agencies, especially in the rural contexts. It is noted, therefore, that human agencies in village level comprise of individuals, families, social and cultural groups, cooperatives, local self-help groups, local governments, to name a few. Who are the human agencies that will be the chanting the mantra of rural knowledge revolution? Statistical data gathered by various central and state governments departments, market analysis agencies; academic and research institutions provide status of Indian rural society on various indicators.

2.1 Demographic profile of rural citizens

According to the Census of India (2001), 1.028 billion populations reside in 191.9 million households spread over in India's 593 districts, 5470 sub-districts, 5161 towns and 638,588 villages.[2] About 285 million live in urban areas while as much as 742 million - 77.22 per cent – belong to rural areas. In India, a village has a population less than 5000 with an average population density of less than 400 per square km, and at least 75 per cent of the male working population is engaged in agricultural activities.[3] Human well being depends on alleviation of poverty at large. The National Human Development Report 2001 observes that, "Poverty is a state of deprivation. In absolute terms it reflects the inability of an individual to satisfy certain basic needs for a sustained, healthy and a reasonably productive living."[4] NHDR and similar indices measure incidence of poverty in societies through economic attainment as reflected in the per capita income of an individual or the GDP of an economy. Progress in economic attainment is also measured through the per capita consumption expenditure. Apart from per capita income and per capita consumption expenditure, the level of employment

[2] Ministry of Statistics and Programme Implementation (2002); Registrar General and Census Commissioner (2001); Penguin India Reference Yearbook (2005: 494).

[3] Census of India 2001 classifies urban areas as places, which simultaneously satisfy or are expected to satisfy the criteria: A minimum population of 5,000; at least 75 per cent of the male working population engaged in non-agricultural economic pursuits: and a density of population of at least 400 per square km (1,000 per square mile). See, Registrar General and Census Commissioner (2001); Penguin India Reference Yearbook (2005: 494)..

[4] Planning Commission (2002: 37).

serves as the critical indicator of an individuals' state of well being. Indicators of economic well being largely serve as the standards for calculating the incidence of poverty. The Planning Commission estimates the incidence of poverty on the basis of a minimum consumption expenditure, calculated on the basis of an average (food) energy adequacy norm of 2400 and 2100 kilo calories per capita per day to define State specific poverty lines, separately for rural and urban areas.[5] The recent poverty estimate relates to 1999-2000, based on the 55th Round of large-scale quinquennial sample survey conducted by NSSO during 1999-2000. It is estimated that there has been a sharp decline between 1997-98 and 1999-2000 in the proportion of people living below the poverty line (BPL) from 51.3 per cent to 26.1 per cent, in absolute number of poor from 328.9 million to 260.3 million.[6] The proportion of poor in the rural areas declined from 45.65 per cent in 1983 to 27.09 per cent in 1999-2000; the decline in urban areas has been from 40.79 per cent to 23.62 per cent during this period.

2.2 Sustaining rural infostructure

It is noted that low per capita income and relatively higher incidence of poverty in rural areas pose major challenges to the scalability and sustainability of infokiosks. Scalability and sustainability of infokiosks depend on infokiosk's financing model, community affordability and overall economic situation of the rural society. With an average population density of 324 people per square km, India presents an attractive service population for infokiosks initiatives, both profit and non-profit. The issue of financing the infokiosks operations in rural areas is highly debated. It is argued that state financing helps creation of backbone infrastructure network for all the villages. Debates aside, village economy significantly affects the network establishment, irrespective of the fact that the initiative is for profit or not-for-profit. It is often felt that infokiosks need to be financially self-sustainable in the long run; hence, rural economy plays a pivotal role in sustaining the infokiosks movement. A classical example of profit-based network is ITC's e-Chaupal initiative, which has set up 4,000 c*haupals* covering 20,000 villages in four states assisting farmers to merchandise their farm produce. Parry's Corner has set up the first 16 infokiosks using a franchisee model. It is likely that more companies are going to rural areas to set up infokiosks as an easy route to explore new business opportunities. Prahalad and Hammond (2002) observe that providing connectivity to rural areas is economically viable as there is a latent demand for such services – from both the development and business perspectives.[7] India's rural macro-economy shows a positive picture - it contributes 24 percent to the national GDP

[5] *Ibid,* p. 38.
[6] Ministry of Finance (2004: 225, 227).
[7] Prahalad and Hammond (2002: 48).

totalling some US$ 140 billion, whereas, in 2001, the agriculture, manufacturing and trade sectors contributed 25%, 15% and 21% to the GDP respectively.[8] Affordability will vary from state to state and experiments in different states show that infokiosks shall be financially sustainable in states, which rank high in the human development index. Sustainability of infokiosks, however, depends not only on the gross spending of rural citizens for infokiosks services, but also on the total customer size. With a favourable total customer size, the village community can sustain the infokiosk even with a low per capita spending for infokiosks services. Therefore, states with relatively higher population density may rank well in the infokiosk sustainability scorecard. Few researches have attempted to weigh the level of spending rural citizens can afford on ICT. In this regard, Kayani and Dymond (1997) have highlighted the experiences of telecommunication network expansion in rural areas which shows that rural communities can collectively pay 1 to 1.5 per cent of their gross community income on telecommunications services. It is also observed that due to poor access and unreliable service delivery, rural telecommunication service providers in developing countries have rarely achieved this level.[9] Poor masses are unlikely to spend much on communication and knowledge sharing activities using ICT. Kenny (2002) cites the example of Chile where the poorest sections living on more than a dollar a day spend 2-3 percent on communications.[10] Pentland, Fletcher and Hasson's survey mentions that rural community in infokiosk deployment spends 5-6% of GDP per capita income on communication related services.[11] Jhunjhunwala (2004) shows that per capita income level is very low for a majority of rural population - for as much as 80% of the total rural population of India, the daily income is Rs. 20.[12] He opines that the expenditure is unlikely to cross 5 per cent of the household income.[13]

NSSO survey shows that the all-India monthly per capita consumer expenditure (MPCE) in rural areas stands almost half at Rs. 531 compared to Rs. 1012 for urban areas.[14] Out of the total MPCE, food and non-food expenditure shares are Rs. 292 and Rs 239 respectively. If we assume that rural citizen will spend 5 per cent of their MPCE, the total sum that rural citizens spend on ICT stands at Rs. 26.55 per month. If we assume that all the literate population will avail the infokiosks services, then in a village of 5000 population, target infokiosk service population stands at 2960.5 people, while the literacy rate in rural India stands at 59.21 per cent.[15] Therefore, on an all-India average, a rural infokiosk can generate as much as Rs.

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[8] ITU (2004: 8).
[9] Kayani and Dymond (1997:18).
[10] Kenny (2002: 141-157).
[11] Pentland, Fletcher and Hasson (2002: 2).
[12] OneWorld South Asia (2004:1)
[13] Jhunjhunwala (2002).
[14] Ministry of Statistics and Programme Implementation (2002: 13).
[15] Planning Commission (2002).

78601.28 per month. Most of the connectivity options available in today's market can be deployed at much lower cost than the figure we have derived at. Though hypothetically an infokiosk can be run profitably, interstate disparity in income level, real size of customer population and capital investment necessitate diversified financing model for scaling up. India has implemented universal service obligation policy only recently - created in mid 2002 amending the Indian Telegraph Act of 1885 and administered by the Department of Telecommunication, the fund aims to provide economical support to service providers in rural India. In the financial year of 2003 – 04, USO fund has been allocated Rs 200 crore and this amount has been invested to extend telecommunication services to rural areas.[16] Until now, expansion of internet in rural areas has not been taken within the ambit of USO funding.

2.3 Service populatuion of rural infostructure

Albeit the promises, rural society exhibits a complex scenario for adopting ICT - with almost half of the population living below the poverty line and majority of the population deprived of basic minimum civic amenities like access to basic healthcare facilities, safe drinking water and housing, villagers continue to be engaged in low-income agricultural activities. There is a wide disparity of literacy rate between the rural and urban areas – urban literacy rate is 80.06 per cent compared to rural 59.21.[17] Moreover, only 68 percent of rural males and 90 percent of rural families are either illiterate or have been educated up to the primary level.[18] Tata Literacy's experiments with computer-based Functional Literacy Programme demonstrate that computer assisted instructions (CAI) can improve literacy level at a faster pace.[19] In addition, MSSRF's experience with IVRP shows that rural inhabitants can easily adopt required ICT literacy to take advantages of infokiosk services (Box 2.1).

Box 2.1: Rural people can acquire ICT skills fast

Average time for gaining familiarity with basics (Win 95) - 2 weeks
Time taken to transact data on wireless - 3 sittings
Time taken to gain preliminary knowledge of HTML - 1 week
Word 97 - 2 days
PowerPoint 97 - 1 week
Use of Win 95 keyboard for Tamil Fonts - 10 days

Source: UNESCAP.

[16] Department of Telecommunications (2004: 4).

[17] Planning Commission (2002).

[18] Pal, Joyojeet (2003: 1, 12).

[19] Tata Computer Based Functional Literacy Programme teaches a person to read within a span of 30 to 45 hours spread over 10 to 12 weeks. See, http://www.tataliteracy.com/tata_solution_overview.htm

Illiteracy and low educational attainment; cultural and religious stratification created by hundreds of religions, castes and classes; inefficiency in governance delivery mechanism; societal exploitation and exclusion; small farm land holdings hinder development of rural society for generations. Despite these constraints, researches show that there are ICT-mediated information and communication needs among the villagers. Though public health does not directly affect infokiosk, public health forms a significant component of the integral rural system in which infokiosk functions. Despite notable progress in healthcare infrastructure development through the establishment of primary health care centres, dispensaries and hospitals in rural areas, there is a stark difference in the reach and quality of service delivery within the states and rural-urban areas. In 2003, a total of 163,195 government and semi-government run primary healthcare centres served 638,365 villages, averaging four villages per centre.[20] The National Human Development Report (2001) shows that 63.85 per cent of urban households have access to toilet facilities, for rural India the per cent is only 9.48 per cent.[21] Percentage of households having access to safe drinking water in urban and rural areas stands at 81.38 and 55.54 respectively.[22] The Report mentions that about 25 per cent of the villages do not even have assured source of drinking water for about 4-5 months during the year. The life expectancy at birth is 66.3 years for urban India and 59.4 years for rural India. 73.3 per cent of urban births were attended by health professionals compared to only 33.5 per cent for rural India.[23]

The issue of social exclusion in Indian context has many dimensions – communities are mentally and physically barred from the mainstream societies for various reasons, e.g. age, sex, language, social and economic status, religion, caste, class etc. Sukumar and Murthy (2002) note that societal inequalities created by several hundreds of religions and casts and sub casts in the country have forged barriers for communities, dominated by upper cast and religious groups, to access to public institutions like schools, health care services.[24] Similarly, with 18 major languages and 844 dialects, India's rich linguistic diversity has created many linguistic minority groups who do not comprehend the most used languages like English and Hindi. Relatively low level of literacy, lack of training in ICT usage, domestic responsibilities and traditional male-dominance pose significant challenge for women population in harnessing the benefits of infokiosks. Hafkin (2002) puts that internet infrastructure is also a gender issue as it is more urban-centric while more women reside in rural areas.[25]

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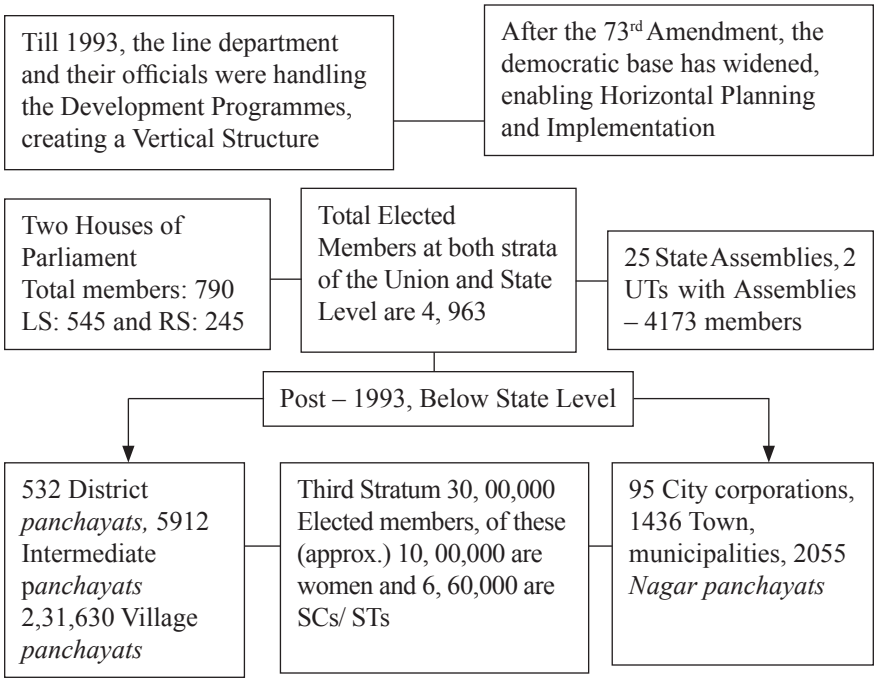
[20] Ministry of Finance (2003).
[21] Planning Commission (2002: 40)
[22] *Ibid*, p. 41
[23] *Ibid*, p. 63-87.
[24] Sukumar and Murthy (2003:188).
[25] Hafkin (2002).

2.4 Social institutions in rural India

We have seen that building infrastructure in rural India in the areas of irrigation, roads, water supply, housing, rural electrification and rural telecommunication connectivity is prioritised for developing the quality of lives of the rural inhabitants. Statistical data point out rural citizen's lack of access to these services at large. India Villages exhibit typical characteristics of rural areas in the developing countries - with almost half of the population living below the poverty line, rural inhabitants remain deprived of basic civil amenities like power supply, primary health care, drinking water facilities, housing and education. Illiteracy, caste and gender barriers, poor governance and societal exploitation prevent the socio-economic development of the rural society. A wide range of public, private and civil society organisations are engaged in providing civic services to the citizens, while traditional socio-cultural institutions also exist in villages. Figure 2.1 itemises the hierarchical structure of government institutions at central, state and local levels with their respective human capacities engaged in the rural development scenario.

FIGURE 2.1: Governance structure in India



Source: ISS (2000)

Political decentralisation has empowered the *Panchayats* to operationalise and monitor state-sponsored rural development programmes virtually in all the villages in India. The enactment of the Panchayat Act by all the states by 1959 created 231,630 village panchayats covering over 96 per cent of the rural population in 579,000 inhabited villages and 92 per cent of the total rural population (Figure 2.1). It is estimated that a *panchayat* covers on an average a population of 2400, covering 2 to 3 villages.[26] Kaushik (2005b) further observes, "As a result of conferring power on people's representatives, there was an improvement in the attendance of teachers in primary schools, block administration became more responsive, *panchayats* emerged as an attractive grievance redressal system for the rural masses etc. Besides, they were successful in curbing pretty corruption among the subordinate staff and newly elected leaders."[27] It is argued that *panchayats* can play a pivotal role in the design and delivery of community development programmes enumerated in the panchayats Act through the infokiosks. Experiments like *Akshaya* and *e-Seva* prove that village administrations can act as the facilitators for these projects by providing electricity, space and other logistical support in the construction and maintenance of the infokiosks. The bouquet of services, however, designed specifically to support deliverables mandated by the *Panchayat* Act and the central government sponsored scheme, need to be customised to local situations. Projects like Community Information Centre in the North East or *Akshaya* in Kerala testify the viability for accommodating infokiosks in public administrative buildings, such as *panchayats* offices, that can also provide telecommunication and internet connectivity to kiosk's network. Apart from the *panchayats,* various other government and semi-government bodies including educational institutions, rural banks, cooperatives, post offices, police stations, healthcare centres serve rural citizens. Educational institutions in villages comprise crèche, *anganwadis*, children activity centre, primary, secondary and higher secondary schools and, in some rare instances, institutes of higher education. It is widely recognised that access to ICT infrastructure is a prerequisite for a nation's transformation from an agrarian and industrial society to a knowledge economy.[28] Rapid economic growth in the Asian economies of China, Korea and Malaysia has been attributed to their adherence to open economy, promotion of competitiveness and an ICT-led growth agenda. In a similar vein, proliferation of ICT in rural and urban areas of India will be instrumental in triggering a job-led social and economic prosperity across all the social and economic verticals, leading India to a knowledge economy. However, infokiosk's services largely depend on locale-

[26] Kaushik, P.D. (2005b: 80).
[27] *Ibid,* p. 80
[28] Clarke, Mathew (2003).

specific needs, a generic list of services for all infokiosks can be drawn to exploit infokiosk's full potential for rural development. Kaushik (2005a) observes that ICT services modelled on the *Panchayati Raj Act* can provide the rural society a knowledge-based mechanism for fighting against poverty and enhancement of citizen's access to government entitlements.[29] Infokiosk services aiming for rural development shall facilitate the implementation, monitoring, and evaluation of deliverables of PRIs. As infokiosks contribute towards community development, its social and economic benefits cascade out of the vicinity of village communities to help all the societies in meeting development goals – national, as proclaimed in the Union Government's development directives, notably, the Tenth Five Year Plan 2002 – 07 and more recently, the National Common Minimum Programme adopted by the Government of India and global – United Nations Millennium Development Goals.[30] Nevertheless, rural development programmes have so far been focusing on building social and physical infrastructure for increasing employment; livelihood opportunities; access to electricity, safe drinking water, and sanitation, public heath care facilities and education, national and local development agenda, particularly those designed for alleviating rural poverty in India, are yet to incorporate ICT into their programmes.

It is argued that infokiosk services facilitate electronic communication within the government (government to government or G2G), government to business (G2B) and government to citizens (G2C) emulating e-governance practices for grassroots citizens. Public access to government services through infokiosks in already being facilitated by a number of ICT projects – *Akshaya* (Kerala), Bhoomi (Karnataka), Community Information Centre (North East), Rural e-*Seva* (Andhra Pradesh), *Gyandoot* (Madhya Pradesh), to name a few (these projects are reviewed in Paper 3). Rural kiosks can act as the hub to facilitate monitoring the rural developmental interventions locally, provincially and centrally and measuring its impact studies at the micro-level (Figure 2.2). Essentially, infokiosk functions as the direct citizen interface to the already existing data and voice communication networks - SWAN at the state level and the NICNET at the national level in parallel to hierarchical structure of government agencies. While NICNET has the infrastructure of gateway nodes in central government departments, 35 state/ UT secretariats, and in almost all 602 district collectorates, for IT services, formation of SWAN in different states are already underway as provisioned in the DIT SWAN Guidelines (2004).[31]

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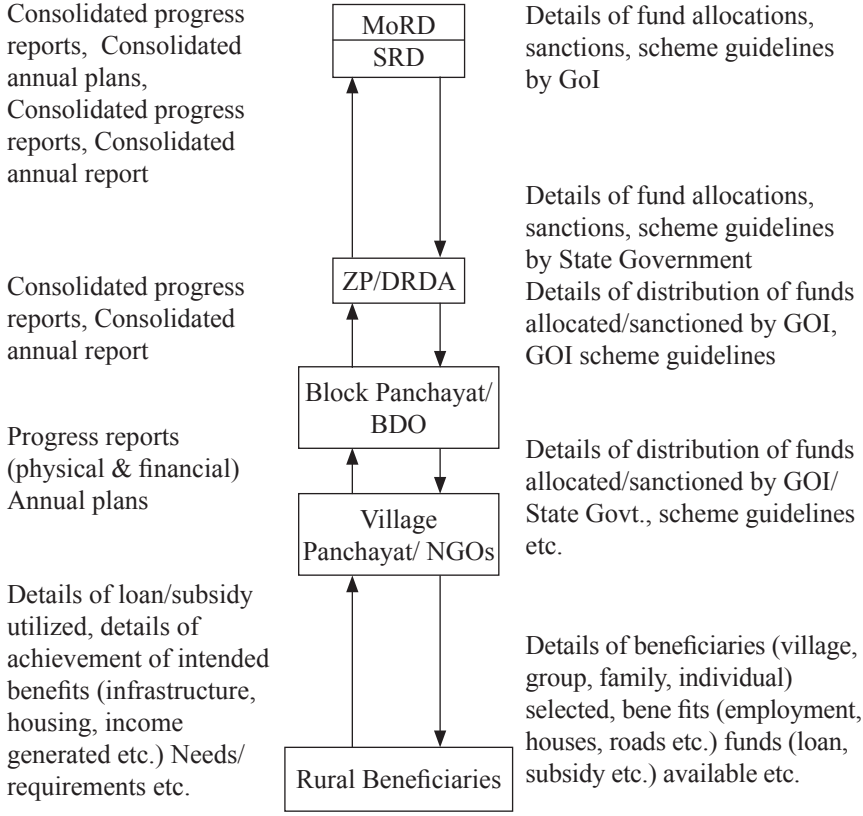
[29] Kaushik, P.D. (2005: 211-286).

[30] UN (2005a).

[31] Department of Information Technology (2004).

FIGURE 2.2: Typical flow of information within the RD sector of Government of India.



Source: NIC.

While acting as the direct citizen's knowledge interface, infokiosks harness public entitlement information from divergent of public institutors to cater to a wide range of consumers. Figure 2.3 delineates sources of public entitlement information emanating from different rural development agencies and their respective target consumers. Infokiosks provide public entitlement information includes policy and programme guidelines, fund disbursement details, *maandi* prices, land records, certificates for income, domicile, caste, grievance redressal, forms for government schemes, BPL family list, employment news, driving license, board examination results, etc. using customised software modules like e-Panchayats.

TABLE 2.1: Public entitlement information - sources and consumers

Information	*Source*	*Target Consumers*
Policy & programme guidelines	MoRD, SRDs	DRDAs, PRIs, NGOs, Rural Beneficiaries (citizens, groups, families, villages etc.), other interest groups such as researchers, academicians, media etc.
Fund allocation details	MoRD, SRDs, DRDAs/District Panchayats, Block Panchayats, Donor Agencies	SRDs, DRDAs, PRIs, NGOs, Rural Beneficiaries (citizens, groups, families, villages etc.), other interest groups such as researchers, academicians, media etc.
Fund disbursement details	MoRD, SRDs, DRDAs, District Panchayats, Block Panchayats, NGOs, VOs	SRDs, DRDAs, PRIs, NGOs, Rural Beneficiaries (citizens, groups, families, villages etc.), other interest groups such as researchers, academicians, media etc.
Details of beneficiaries (individuals, families, groups, village etc.) selected, benefits (loan/subsidy, houses, drinking water & sanitation facilities, roads schools etc.) given	Block Panchayat, Village Panchayat, State Government agency at village level such as PHEDs (Public Health Engineering Departments), BDOs (Block Development Officers – State Government Functionary at block level) etc.	Rural Beneficiaries
Utilization Certificates, Progress/Implementation details on schemes (no. of beneficiaries assisted, no. of benefits given, expenditure incurred etc.)	Village Panchayat, Block Panchayat, State Government agency at village level such as PHEDs, BDOs etc.	Rural Beneficiaries, Block Panchayat, District Panchayat, DRDAs, SRDs, MoRD, other interest groups such as researchers, academicians, media etc.
Annual plans	Village Panchayats, Block Panchayats, PHEDs, BDOs etc.	Block Panchayat, District Panchayat/DRDAs, SRDs, MoRD etc.
Information from concurrent evaluation and impact assessment studies	Independent research organisations	MoRD, SRDs, NIRD, SIRDs, other interest groups such as researchers, academicians, media etc.
Various survey data such as BPL survey, habitation survey etc.		

Source: NIC (2005).

Voluntary sector has plays pivotal role in rural development – PRIA (2002) observes that more than half of the 1.2 million voluntary sector organisations in India belong to the rural areas.[32] Civil society organisations strengthen community participation and involvement in community development, forging linkages with the public and private sectors. Community based CSOs include, various self-help groups, especially those run by farmers, women and young people, cooperatives, community media centres such as community TV centres, radio listeners club, voluntary agencies and NGOs. In addition, parallel institutions like the Joint Forest Management (JFM) Committees, Village Education Committees (VEC), and Water User Groups etc. are influencing bodies in villages. Cooperatives have been formed in villages with support from the government primarily to safeguard the interests of a vast number of small and marginal farmers from the vagaries of agro-markets and to control unfair treatment of the producers from the business interests of private enterprises.[33] The number of cooperatives grew fast, and for the credit societies, it stands at 140347 in 1999-2000. Micro-finance cooperatives and self-help groups provide the access to rural credit.

A wide variety of private institutions operate in villages. They comprise franchisee-based extensions of global multi-national companies that merchandise products (mainly FMCG products), financial institutions, SMEs, entrepreneurs and trading and business entities. Private sector involvement is facilitated through the engagement of entrepreneurs selected from local communities for operating infokiosks. In most cases, the private sector undertakes the development of hardware and software installed for network building and is also responsible for issues related to technical training. Local private entrepreneurs are contracted for maintenance, repair and troubleshoot of faults developed in the infokiosks. Village-level institutions house the infokiosk set-up; and it is observed that lack of all-weather roads prevents rural inhabitants from accessing public institutions, especially during rainy seasons. Infokiosk usage is promoted by its central location; easy access and vicinity to civic amenities, especially in rural settings, where walking and cycling are the main means of commuting. Roads, primary means of travel and transport, are lacking in more than 25 per cent of the villages and as much as 60 per cent villages lack all-weather road links. However, the states like Kerala, Haryana and Punjab have connected almost all villages by all-weather roads.[34] As the foregoing discussion

[32] PRIA (2002: 5).
[33] Datta and Singh (2002: 28-45).
[34] ITU (2004).

shows, public spaces like schools, healthcare centres, *panchayat* buildings, post offices etc. are abundant in villages.[35] Rural citizens access public institutions providing services related to education (e.g. pre-primary school, secondary school, college etc.), health (e.g. primary health centre, community health centre/government hospital, private hospital etc.), communication (e.g. public call offices, internet café, post office etc.), administrative offices (e.g. panchayat offices, block development offices etc.) and other utility services like shops, banks, fertilizer/ fair price shops. The distances from railway stations, bus stops are also important determinants in this context (Table 2.2).

At all-India level, 94 per cent of the villages are located more than 10 km away from the district headquarters; and more than 70 per cent from the *tehsil* headquarters. Only 10 per cent of Indian villages lie within 10 km of a railway station; only 45 per cent of villages had a metalled road. The survey also records the proximity of villages to the information and communication facilities like post and telegraphs office, public telephone and e-mail facility. While about 22 per cent of Indian villages had a post office, another 26 per cent are within the two km, and another 35 per cent are within five km of one. Though this study by clubbing telegraph/PCO/email facility into one category, does not specifically point out the proximity of email access facility in villages, it shows that only one-fifth of all the villages can access such facilities within their boundaries, about one-third within two km, and about a quarter more than 10 km away from the villages.[36] A whopping 68 per cent village had pre-primary schools and about 65 per cent villages either had secondary schools within the village or located within five km of one. Nevertheless, access to a primary health centre or a rural hospital is difficult as in most cases such facilities are 5 km away from the villages. Small public places where village people gather can be seen in almost all villages. *Panchayat* buildings, school premises, post offices, telephone booths are popular locations for the villagers to interact with each other. Community television centres can also be seen in many villages. On an all India average, 65 villages out of 1000 have a community TV centre. Such facilities are mostly concentred in Tamil Nadu (82 per cent), followed by Kerala (41per cent) and Gujrat (18 percent) while this facility in all other states is less than 10 per cent.[37]

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[35] Ministry of Statistics and Programme Implementation (2002: 38).
[36] *Ibid.* p. 38.
[37] *Ibid.* p. 31.

TABLE 2.2: Rural development information, source and consumers[38]

Public	*Private*	*Voluntary*
Panchayats constituted at village level with reservations for lesser-privileged sections of the society.	Private franchisees of large companies, including local FMCG shops, consumer goods.	Traditional associations, socio-cultural units based on caste, tribe, language, ethnicity, gender, age groupings.
Crèche, child care centres, educational bodies and financial institutions are seen in villages in abundance.	Agents, brokers of financial institutions. Agents sell 50 per cent of the LIC policies in rural areas.	Religious associations, based on religions, beliefs and norms.
Almost 89 per cent of a total of 1,55,669 (as on March 31, 2004) Post Offices are located in rural areas. On an average, a Post Office serves an area of 21.11 square km, and a population of 6,592.	Trade and business entities, including logistics suppliers, agri input companies, farm machinery suppliers	Social movements that aim to reform the societies at large by bringing in pro-poor reforms.
Police stations and other law enforcing agencies are also located in villages or small towns.	Public call offices (PCOs) and franchisees of mobile companies.	Membership associations include organisations set up by special interest groups e.g. Lions Club.
Primary healthcare centres, rural hospitals. In 2003, 163,195 healtcare centres existed in villages.	*Haat, bazaars and mandismelas* There are approximately 42000 rural *haats* (supermarkets); over 25000 *melas* are held annually.	Intermediary associations facilitate networking among individual citizens and organisations, e.g. Action Aid, CARE etc.

Soon after independence, the Government of India has adopted various approaches towards improving the living conditions of the rural poor – and such strategies are reflected through Planning Commission's Five Year Plan outlays. Table 2.3 highlights chronologically, the state plans and programmes adopted since 1952.

[38] Figures derived from, Businessworld (2005); Ministry of Finance (2005: 203).

TABLE 2.3: Rural development in India: Chronological highlights

1952	Community Development Programme launched (October)
1958	Three-tier structure of local self-governing bodies (*Panchayati Raj*) launched (October)
1969	Rural Electrification Corporation set up
1970-71	Drought Prone Areas Programme started (December)
1971	A Joint Consultative Council on Community Development and *Panchayati Raj* constituted (December)
1971-72	Crash Scheme for Rural Employment introduced
1972-73	Pilot Intensive Rural Employment Project (PIREP) launched. Accelerated Rural Water Supply Programme started
1977	Food for Work Programme started (April)
1977-78	Desert Development Programme started (April)
1978-79	Integrated Rural Development Programme launched
1984	NREP and RLEGP merged into one single rural employment programme to b known as Jawahar Rozgar Yojana (JRY)
1985-86	Indira Awaas Yojana started
1988-89	Million Wells Scheme started
1992	The Parliament passed the Constitutional 73rd Amendment Act to grant constitutional status to the Panchayati Raj institutions (December)
1993	Employment Assurance Scheme implemented (October)
1995	National Social Assistance Programme (NSAP) launched (August)
1999	Jawahar Gram Samriddhi launched (1 April), Swarnajayanti Gram Swarozgar Yojana launched (1 April), Innovative Stream for Rural Housing and Habitat Development Scheme launched (1 April)

Source: Kaushik (2005c: 328).

With increasing development assistance, the society is provided with greater budgetary allocation for the rural development programmes while underpinning the need to act upon key thrust areas of agriculture and rural livelihoods, health, education and rural infrastructure building. Essentially, each knowledge centre in a village serves as the information and communication anchor for diverse state-led projects. In so doing, each gateway is essentially positioned to cater to the needs of virtually all the village institutions – community, state or private (Table 2.4).

TABLE 2.4: Computerisation in rural development undertaken by Indian Government.

Initiatives	*Functions*
RuralInformatics Portal (http://ruralinformatics.nic.in)	Facilitates rural informatics experiences sharing
Portal of MoRD (http://www.rural.nic.in)	Serves as single point entry to websites of MORD (Every Department of MoRD has a web site: http://drd.nic.in - Department of Rural Development; http://dolr.nic.in - Department of Land Resources; http://ddws.nic.in -Department of Drinking Water Supply.
DRDA Portals (http://enrich.nic.in/drda.htm)	Customised eNRICH Community Software to be used to build portals for 550 DRDAs.
MORD's intranet Site "Daily"	Promoting G2E governance within the Ministry.
Automation of Ministry's financial processes	Facilitates online submission of proposals, concurrence, sanction and release of funds.
Monitoring software for DDWS schemes	Software, developed for DDWS, enables the implementing agencies to directly enter the physical and financial progress details of various schemes sponsored by the Department.
RuralSoft (http://ruralsoft.nic.in)	Solution to capture monthly progress of various poverty alleviation schemes sponsored by MoRD and SRDs, the evolved version of CRISP software.
PriaSoft (http://priasoft.nic.in)	Solution for monitoring transactions of Panchayati Raj Institutions by State RD/MoRD, helps maintaining transparency in Panchayati Raj Accounting.
BPL Survey Computerisation	Facilitates capturing of BPL BPL survey data, conducted every five years
Habitation Survey Computerisation	Facilitates capturing data from habitation survey, conducted every five years, from various potable water supply sources across the country at village level.
Land Survey (Cadastral Survey) Computerisation	Initiating to computerize Land Survey (or Cadastral survey) data in three states in the country.
Rural Bazar (http://ruralbazar.nic.in)	An e-commerce solution to showcase the products, off-line payment and on-line payment produced under SGSY sponsored projects by rural poor and artisans.
Enrich (http://enrich.nic.in)	A community software solution to dynamically generate community portals for rural communities.
OMMS Project for implementing PMGSY scheme	Enables management & monitoring of the PMGSY schemes and of creation & development of Rural Road infrastructure.
Project Information Monitoring System (PIMS), CAPART	Facilitates management of projects undertaken by NGOs. Enables quicker submission, scrutiny and approval of proposals submitted by NGOs.

Initiatives	*Functions*
LEARNINGNET, NIRD	VCs in NIRD and SIRDs connected to internet for knowledge sharing.
Land Records Computerisation	Facilitates of distribution of ownership certificate and other land details to land owners in 1900 Tehsils. Ownership changes, Mutation Workflow to effect updation of land records is operational in 16 states. Latest technology like total station, aerial photography and GPS etc. are being used to survey the areas like North-Eastern states where no land records exist. Cadastral maps are being integrated with attribute data for complete Land Information System solution.

Source: NIC.

Supportive regulatory environment fosters the creation of a necessary social, physical and economic environment that helps scaling up the infokiosks movement. Reform shall permeate all the sectors – power, road connectivity, economy, capacity building, governance, telecom, and connectivity – that affect sustainable growth of infokiosks. Several initiatives taken during the Tenth Five Year Plan (2002 – 2007) and by the current UPA government within the framework of the NCMP are worth mentioning. The Electricity Act 2003 mandates the SERCs to reform and restructure the power sector.[39] The vision of providing reliable, affordable and quality power supply for all users by the year 2012 as part of their "Mission 2012: Power for All" initiative can help lighting all the rural households.[40] Road network has got major fillip in the Tenth Plan (2002-07), with a 58 per cent additional allocation over the Ninth Plan outlay. The village road network has been prioritised through Prime Minister's Gram Sadak Yojana – Village Roads. Planners have long felt the need to link up all the villages to all-weather roads.[41] Liberalisation in telecommunication sector in the early 1990s paved the way for steady progress of the telephony network in India. The announcement of the Unified Licensing Policy and Broadband Policy envisages speedy expansion of data and voice connectivity at competitive prices. Reform in the licensing procedure enables networking infokiosks in wireless mode in an unlicensed frequency band.

2.5 Conclusion

It is apparent that rural development approaches warrant better sharing of experiences among the executing agencies. Infokiosks act as the information

[39] Basu, Ashok (2005: 115).
[40] Krishnamoorthy, R. (2005: 38).
[41] Srinivasan, V. K. and S. Suresh (2005: 158).

and communication interface for all the stakeholder institutions engaged in the social, cultural and economic well-being of the rural society. Case studies of several infokiosk initiatives in the next paper highlight the multi-sectoral developmental interventions using variegated-technology options. It is widely recognised that local governments, such as the *panchayats* play pivotal role in operationalising the infokiosk movement while involving all other public, private and civil society actors in various capacities.

3

How the Promises of ICT in Development Being Met in India: An Illustrative Comparison and Future Directions for Planning, Implementation and Evaluation of ICT Projects

In previous papers, we have seen that knowledge connectivity accelerates sustainable human development, while local knowledge gateways infuse knowledge in rural developmental interventions. To develop an empirical understanding of how far village knowledge gateways are equipped to capture and cultivate knowledge culture amongst rural societies, we analyse the characteristics of existing knowledge gateways - focusing on their evolution, functioning, usage pattern, technology model, financing and infrastructure and their role in materialising the premise that knowledge gateways catalyse sustainable human development efforts in rural India. The analysis heavily draws upon the existing corpus of studies that focuses on ICT applications in development, field visits to project sites and face-to-face and telephonic interviews with project managers and other stakeholders. Analyses of grassroots ICT interventions are constructed using a broad set of qualitative indicators, derived from capability approach methodology. In each case of a knowledge delivery model, the analysis seeks to highlight – a) geophysical environment, demographic profile of local community, b) evolution and history, c) goals and objectives, d) technological capacity, e) infrastructure (power supply, building, access), f) capacity building of service providers, g) services and content and h) financing and business model. Finally, projects are critically compared on the basis of a set of qualitative indicators to appraise their relative appropriateness in inculcating knowledge for promoting sustainable human development. Grassroots ICT interventions are generally experimented

with very few ICT applications, as we will see in projects analyses, though the need for appropriating applications vis-à-vis diverse knowledge functionings of local communities are underscored in this discussion.

3.1 Evolution of village knowledge gateways

The terms 'village knowledge gateway', 'grassroots knowledge gateway' or 'local knowledge gateway' are used in this paper interchangeably to designate the information infrastructure, which is able to facilitate two-way communications from local to supra local and vice-versa. In India, information infrastructure existed in the form of village public libraries, newspapers, schools, and more recently, community media centres (such as community TV centres, PCOs, etc.) since the ages – nonetheless, the transformation of such information infrastructure into knowledge gateway implies the ability of human agencies to participate directly in the knowledge revolution through such gateways. The need for evolution of rural information infrastructure emanates from the existence of such an infrastructure already available at national and provincial levels – constituted of communication channels like cinema, radio, television, video, book publishing, postal services, folk media, advertising, telecommunications and internet. Initiatives towards disseminating knowledge to villagers started in the pre-independent India, with the establishment of All India Radio, the country's first broadcasting service, way back in June 1936. Radio constitutes a primary information infrastructure for any society because of its relatively economical reach to a wider audience who can equally afford radio sets available even within one US dollar in most of the developing countries. Since August 20, 1921, when the first broadcast was transmitted in India, public broadcasting has reached to 99% of population covering a geographic area of 91.42% till now.[1] With 215 broadcasting centres, out of which 144 are MW, 54 SW and 139 FM transmitters, All India Radio is one of the world's largest radio organisations. Introduction of commercial channels like *Vividh Bharati* in October 1957 and *Yuva Vani* (or Voice of Youth) on July 23, 1969, radio became rapidly popularised. During mid-eighties, FM services were gradually experimented in select metros; local stations were increased; and hourly news bulletins were introduced. Early nineties saw the introduction of phone-in programmes primarily in New Delhi, Pune and few other cities. With the launch of Sky Radio Channel on April 1, 1994, subscribers were able to receive twenty radio channels on their FM receives through satellite. In the late 1990s, out of 219 AIR Centres, 32 belonged to *Vividh Bharatai* or Commercial Centres, 73 local stations and 114 regional stations. With about 12000 employees, 300 news bulletins every day on its national, regional and

[1] All India Radio.

external services AIR reached an estimated 115 million radio sets, 65 million of which belonged to rural areas, at that time.[2] Compared to MW and SW, FM provides superior quality audio output to listeners, though AIR's FM services cover only 30 percent of populations in 27 large and small cities.[3] This can be attributed to the reluctance of private companies in broadcasting beyond mega cities, bureaucratic licensing procedures adopted of the licensing authority, low penetration of compatible radio sets,[4] and governmental control over frequencies. With the establishment of 'Doordarshan,' television started penetrating in villages; and since mid 1980s, public telephone kiosks began proliferating throughout the country. Broadcasting media, like radio and television-and communication act as information dissemination channels, however, these channels present serious limitations in capturing and eliciting grassroots voices (Table 3.1).

Table 3.1: Reach of communications media in villages[5]

Radio	AM	Radio broadcasting using AM, Because of susceptible to atmospheric interference and low-fidelity sound, suitable for news and talk show programming Broadcast in several frequency bands – LW (153-279 KH_2), MW (530-1710 KH_2), SW (2300-26100 KH_2). MW is mostly used. Different frequency bands are used for various other radio devices such as baby monitors, walkie talkies, cordless telephones, radio control, ham radio etc.	AIR one of world's largest radio organisations with 215 broadcasting centres, comprising 144 MW, 54 SW, 139 FM transmitters. Covering 91.42% of area and 99% percent of the population. AIR covers 24 languages and 146 dialects.
	FM	High quality transmission for music and voice programmes, higher fidelity than AM radio, using frequency modulation, it uses VHF (MHz to 300 MHz) radio spectrum. FM transmission through VHF is usually limited to 50-100 miles.	AIR provides FM services to 27 large and small cities, FM services cover 30 per cent of population.
TV		A vast network of television broadcasting has been established with participation of public and private broadcasters. TV viewership is relatively high, compared to other developing countries. Current programming emphasis is on commercial soaps, music, films and other entertainment based programmes.	Doordarshan is one of the world's largest terrestrial network, covering 89 percent of population, through a three-tier service – national, regional and local. More than 80 private channels available through cable networks.

[2] Kumar, Keval J. (2005: 182-3).

[3] All India Radio.

[4] According to NRS-1997, barely 7% of the urban population claimed to listen to FM radio; according to All India Radio, there were only five million FM radio households out of total 11 million radio households in the country. See, Audience Research Unit (1996).

[5] Figures given in the websites of All India Radio, Doordanshan.

3.2 Evaluation of village knowledge gateways

Development practitioners often point towards the lack of knowledge sharing and learning from ongoing experiments. In 2002, Keniston in his article 'Grassroots ICT projects in India: Some preliminary hypotheses' commented that, "At least fifty grassroots projects are currently using modern ICT for development in India. Surprisingly, these projects have rarely been studied. No comparisons have been made between them. They are seldom in touch with each other. Lessons learned in one project are not transmitted to others. Appropriate technologies are rarely evaluated. Central questions of financial sustainability, scalability and cost recovery are hardly ever addressed. So, opportunities to learn from the diverse, creative Indian experience so far remain almost entirely wasted."[6] In the last three years, the incidence of grassroots ICT interventions have multiplied manifold – more than 10000, according to a rough estimate. Even then, the vast amount of literature produced within the ICT for development parlance fails to address the issues raised by Keniston – e.g. lack in study of the projects, project comparisons, intercommunications within the projects, experiences sharing and evaluation of appropriate technologies. In addition, the question of financial sustainability, scalability and cost recovery is by large remained unanswered. In view of observations made by Keniston (2002), we seek to analyse the effectiveness and lacunae in grassroots infokiosk-based ICT projects in furthering human capabilities at large. In so doing, we conduct a literature review on the roll out process of ICT in India to a) understand common project assessment and comparison framework methodology applied by various authors; b) identify major thrust areas of action and research by various stakeholders and c) assess and compare relative merits and demerits of eleven grassroots ICT initiatives, spread across all over the country.

3.3 Literature review

The literature review, undertaken as part of this research project, can be classified into four main categories: a) global and regional assessments on developmental impact of ICT in societies, produced predominantly by intergovernmental agencies, among others; b) global and regional studies that concentrate on impact of ICT in specific social sectors; c) country specific studies that analyse impact of ICT or showcase impact of ICT interventions across social sectors and d) media reports highlighting ICT initiatives. The review exercise leads to a better understanding of the motivations and tenets of using ICT for development, evolution of a preferred set of variables that

[6] Keniston, Kenneth (2002: 2).

determine projects impact on human development, and draw a comparative analysis of grassroots interventions aiming towards furthering socio-economic development of rural citizens.

UNDP defines 'global report' as "studies that present and analyse issues of global concern and reach. These are issues, such as the control of communicable diseases, which span all countries, and often, also all population segments, or at least, countries and people in several of the world's geographic regions."[7] A overwhelming amount of global and regional reports are commissioned by the UN System; although production of such reports by non-state organisations - such as private and civil society sectors – are ever increasing. It is worthwhile to note that, as UNDP (2002) documents, global reports on information and communications had its origin as early as in 1875 with the publication of Postal Statistics by the Universal Postal Union.[8] In this direction, lunch of global reports - World Telecommunication Indicator in 1993 (ITU); World Telecommunication Development Report in 2004 (ITU); World Information Report 1997 – 98 (UNESCO); World Communication Report 1998 (UNESCO) and World Information and Communication Report 1999-2000 (UNESCO) – are watersheds in monitoring progress made by societies in the adoption of ICT. World Information Report 1998 and World Communication Report 1998 focus on infrastructure availability in the domain of information and communication services respectively. World Information and Communication Report 1999-2000 (1999), despite stressing upon the cultural diversity as essential cornerstone in human development and recognising human development as 'a process of enlarging people's choice',[9] dwell upon socio-economic impact of ICT rather than increasing knowledge functioning. UNESCO's India specific literature elaborates ICT delivery mechanisms in the field of science, education, culture and communication.[10] The literature review leads us to few observations:

1. Studies describing existing technological infrastructure - that comprises method of connectivity, information access, capturing and presentation devices (hardware and software) - fail to illustrate the appropriateness of technology model to existing social, economic, political and cultural environment such that those applications facilitate reduction of human capabilities deprivations. Technology reviews remain silent on the appropriateness of technology model to the local geophysical environment, robustness, scalability and compatibility specifications, and capacity to meet

[7] Office of Development Studies, UNDP (2002: 1).

[8] UPU (1875–) (annual).

[9] UNESCO (1999).

[10] IBE (2004); International Association of Universities (2002); Mitra, Sugata (2003); Blurton, C. (1999).

current and future level of needs. It is observed that media coverage of ICT for development projects did mention incorrect technology nomenclature to describe application being run in project sites.[11] For, technology review is critical knowledge sharing for learning and improvisation of community interventions, it is imperative that such reviews analyse appropriateness of technology delivery platform.

2. Often, literature on ICT for development draws correlation between economic advances as a result of ICT growth and penetration, such as in telecommunication, particularly in OECD nations, to grassroots ICT interventions to argue for the necessity of ICT infrastructure building for fostering economic growth at the grassroots in the developing economies. While such a correlation is logically justified and proven in few projects (for example, Grameen Bank's Village Pay Phone project[12]), an assumption that providing ICT at the hand of the poor will generate economic incentives for the society is not without its limitations, for most of the projects tend to fail in generating economic incentives adequate enough to justify their financial viability in long run both for the implementers and citizens alike. Analysis of economic incentives can be derived by using a simple cost benefit analysis methodology. Such an evaluation framework, as evident from most of the projects evaluation studies, derive estimates of economic profitability achieved by the project implementers in any given time period by deducting recurring expenditure from the total customer payment. While highlighting economic profitability (or even loss) in evaluation studies is itself a necessary instrument for various reasons other than determining financing model for community ICT projects, such studies by large fails to investigate level of increase in economic opportunities achieved by rural communities, the target beneficiaries and address the issue of exclusion on economic grounds. Hypothesising that a replication of OECD model of providing citizens access to ICT for improving economic environment, enhancing market competitiveness and spurring innovation has, evidently enough, its shortcoming of not being able to equipping citizens with knowledge that enables them to achieve an equitable and sustainable human development. Moreover, unlike the developed nations, rural citizens in India, like other developing economies, lack supportive social, economic, environmental and political capitals (e.g. per capita income, adequate leisure time, information literacy, etc.) to exploit ICT for fostering economic growth. We do not, however, undermine the need to study economics of ICT interventions,

[11] See, media coverage of Akshaya, DGP projects in the project website.
[12] Grameen Bank.

but we recognise that quantitative economical analysis techniques fall short in evaluating the effects of such interventions on wide gamut of human capabilities, at least in a narrow time series. Further, evaluation studies fail to investigate reasons of exclusion in grassroots ICT projects, even in projects, which are not for profit in nature.

3. Studies enumerate services (e.g. e-governance, ICT education, communications, etc.) being provided to the rural citizens, though their impacts on human development are rarely assessed. As mentioned beforehand, a wide amount of literature is produced to study economic impact of ICT interventions, though their impact on informational (e.g. enhanced capacity to produce and publish local content), psychological (e.g. sense of inclusion in the modern social world), social (e.g. enhanced ICT skills) and political (e.g. improved access to government) capabilities has rarely been documented.[13]
4. While studies focus on governance structure of grassroots projects, elaborating the nature of multi-stakeholder partnership formed for project management, such studies omit to mention the impact of governance structure on services. To illustrate, the level of community representation and gender balance in the governance structure bears ramifications on community participation and women's access to ICT infrastructure.

The survey also shows that evaluative studies also largely focused on monitoring the progress in network and infrastructure expansion at the grassroots level, rather than their achievements in expanding knowledge functioning among human agencies. Quintessentially, project studies document at a minimum – a) project goals and motivation; b) implementing agency and management structure; c) social, geophysical, economic and cultural environments; d) technology delivery model; e) information services and socio-economic benefits. Mapping knowledge attributes on human agencies as project outcome is attempted only in few studies. Evaluations are generally carried out by project implementing agencies, consulting organisations, state and central governments, academic institutions, civil society organisations, private sector and intergovernmental agencies. World Bank documents ICT initiatives in India underpinning investment opportunities in urban telecommunication and ICT infrastructure development;[14] technology delivery models;[15] informatisation process in administration;[16] innovation and R&D based knowledge economy[17]

[13] A range of outcome indicators is defined by Gigler, Björn-Sören (2004: 15).

[14] See, InfoDev website http://www.infodev.org for a detailed listing of recent initiatives.

[15] Hay, Keith A.J. (2005), Jhunjhunwala, Ashok (2001).

[16] Bhatnagar, Subhash (2000).

[17] Dahlman, Carl; Anuja Utz (2005).

and social-economic benefits.[18] Evaluation of Gyandoot carried out by Centre for E-governance (2002) at IIM Ahmedabad for World Bank exmplifies evaluation based upon reflects informational capacity building of local citizens.[19]

3.4 Developing an evaluation methodology

The literature review helps us in identifying various sets of variables and their preferred classification according to their relative significance to project outcome. Gigler (2004) identifies four enabling imperatives for infusing knowledge in grassroots development: a) the extent to which the poor have access to information from the formal institutions of the market, state and civil society; b) the ability of the poor to process and evaluate information; c) the extent to which the poor do not only consume, but produce and share information within their community and networks; and d) the extent to which indigenous knowledge plays a role in the lives of the poor.[20] In the foregoing discussion, we have shown the promise of ICT- enabled knowledge gateways in enhancing the local citizens' capabilities reflected in informational, social and human spaces which can be measured using six determinants – proposed by Gigler (2004) - informational, psychological, social, economic, political and cultural - that "contribute in different ways to the enhancement of a person's human capabilities".[21] Enhancements in capabilities empowerment leads to community and social empowerment, which is, reflected through achievements in facets of information, organisational, societal development, economic development, political participation, and cultural identity (Table 3.2).[22]

The limitation of evaluating ICT initiatives on the basis of infrastructural deployment, the number of applications and commitment of resources, rather than their effectiveness in enhancing human capabilities is apparent[23] – hence the need to evolve empowerment-based evaluation methodology. An attempt towards that can be traced in the first e-governance evaluation in 2003, 'India: E-readiness Assessment Report 2003,'[24] though the e-readiness indices have been calculated based on six indicators –special efforts made to promote e-governance in particular sectors, online facilities available to the public, government network coverage, computerisation of records, development of skills among government employees and re-engineering of government processes.[25]

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[18] Cecchini, Simone; and Monica Raina (2002).
[19] Indian Institute of Management, Ahmedabad (2002).
[20] Gigler, Björn-Sören (2004: 10).
[21] *Ibid*, p. 13.
[22] *Ibid*, p. 17.
[23] Madon (2004: 3).
[24] Department of Information Technology (2003: ii).
[25] *Ibid*, p. 25

TABLE 3.2: Indicators for individual empowerment: Human capabilities strengthened

Dimension	Objective	Outcome Indicator
Informational	To improve the access to information and capabilities	Improved capacity to use different forms of ICTs Enhanced information literacy Enhanced capacity to produce and publish local content Improved ability to communicate with family members and friends abroad
Psychological	To support a process of self reflection (critical conscientisation) and problem solving capacity	Strengthened self-esteem Improved ability to analyze own situation and solve problems Strengthened ability to influence strategic life choices Sense of inclusion in the 'modern' world Social Human capital)
Social (Human capital)	To strengthen people's human capital (skills, knowledge, ability to work and good health)	Enhanced ICT literacy and technology skills (i.e. repair computers) Enhanced leadership skills Improved program management skills
Economic	To enhance people's capacity to interact with the market	Improved access to markets enhanced entrepreneurial skills Alternative sources of income Productive assets strengthened Improved employment opportunities Improved income through a) lower transaction costs (less time constraints); b) reduced transport needs; and c) increased timeliness of sales
Political	To improve people's participation in decision-making processes at the community-level and the political system	Improved access to government Information/services (e-government) Improved awareness about political issues Improved capabilities to interact with local governments
Cultural	To strengthen people's cultural identity	Use of ICTs as a form of cultural expression (i.e. design of computer graphics, websites) Increased awareness of own cultural identity

Source: Gigler (2004: 15).

Madon (2004) adopts 'capability approach' in evaluating e-governance initiatives of Kerala IT Mission on three qualitative determinants: administrative reform, governance reform and effects on end-users.[26] Madon (2004) observes, "An important but neglected aspect of e-governance evaluation is the way in which

[26] Madon (2004: 22).

the project has improved the well-being of citizens. Nevertheless, typically, this criterion has been difficult to study because of the ambiguous meaning behind 'well-being'. We evaluate well-being in terms of Sen's capability concept – i.e. the extent to which people have real opportunities to benefit from the project."[27] It is noted that while Gigler (2004) identifies improved capacity to use different forms of ICTs; enhanced information literacy; enhanced capacity to produce and publish local content; improved ability to communicate with family members and friends abroad, Madon (2004) finds empowerment through engagement;[28] acquirement of ability to experience new technologies;[29] enhanced ICT literacy[30] and strengthening of confidence and self-esteem as outcome indicators of informational capability enhancement among personal agencies. Alkire (2002), in the impact assessment of Oxfam's grant for goats in 1992 to the Rural Women's Welfare Organisation (RWWO) in Senghar, Sindh (Pakistan), observed that for the goat-owners "the dominant definition of knowledge seemed to be 'education' or the acquisition of new information. The women also valued the new tacit knowledge about group organisation and collective decision-making under 'empowerment'. New information was gained through the high-quality training provided by or through RWWO in the group meetings. In contrast to other programmes, the training was well remembered and learning was accurate. In addition, knowledge increased in a way that would not be captured by animal health data. For example, participants learned about oral dehydration therapy, about tree-planting and other topics."[31] In addition to evaluation of economic impact of RWWO project, Alkire (2002) identifies other intangible benefits as well (Table 3.3).

'Capability approach', thus, helps in framing broad indicators of ICT initiatives evaluation based on human capabilities strengthening in health, education, employment, and participation;[32] besides enhancing informational, psychological, social, political and cultural capabilities.[33] We have reviewed relative strengths and weaknesses of ICT projects based on a set of enabling agents required for effective functioning of grassroots initiatives and its impact on human development (Figure 3.1). Figure 3.1 graphically portrays

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[27] Madon (2004: 26).

[28] "An important positive implication of this has been the real opportunity provided to these women to associate with government systems and develop a high degree of networking with employees in government". See, Madon (2004: 27).

[29] "For many citizens, the training session have given them a new lease of life and diversion from normal routine". See, Madon (2004: 27).

[30] "For example, as many as 40% of trainees requested that Akshaya host further training in IT and non-IT subjects such as computing, spoken English, basic accounting, garment-making and on other topics. Nearly all of the trainees interviews were sorry to have reached the last module of their course." See, Madon (2004: 27).

[31] Alkire (2002: 257).

[32] Dreze, Jean and Amartya Sen (1995: vii).

[33] Gigler, Björn-Sören (2004: 15).

that provisioning thousands of agri-based, isolated villages with certain enabling factors, termed as 'enabling capacities' (technological, infrastructural, informational and human agency) transform them into connected and cohesive knowledge society, resulting enhancement of human capabilities that is reflected in economic, political, cultural, informational, psychological and social functionings. The two pillars belonging to 'enabling capacities' and 'enhanced capabilities' serve as the basis of evaluation framework. Majority of rural ICT interventions fail to translate 'enabling capacities' into 'enhanced capabilities' as more often than not the motivation, goals and objectives of the implementing agencies are limited to creating economic impact.

Table 3.3: Additional RWWP costs and benefits

	Costs	*Benefits*
RWWO		Reputation
		Institutional knowledge
		Institutional capacity
Local goat group		Job satisfaction
		Existence
		Collective action
Goat owners	Relationship	Relationships
	Leisure	Knowledge
	Motivational and emotional cost if goat dies	Health
		Empowerment
		Religion
Society		Women's status
		Social capital

Source: Alkire (2002: 249).

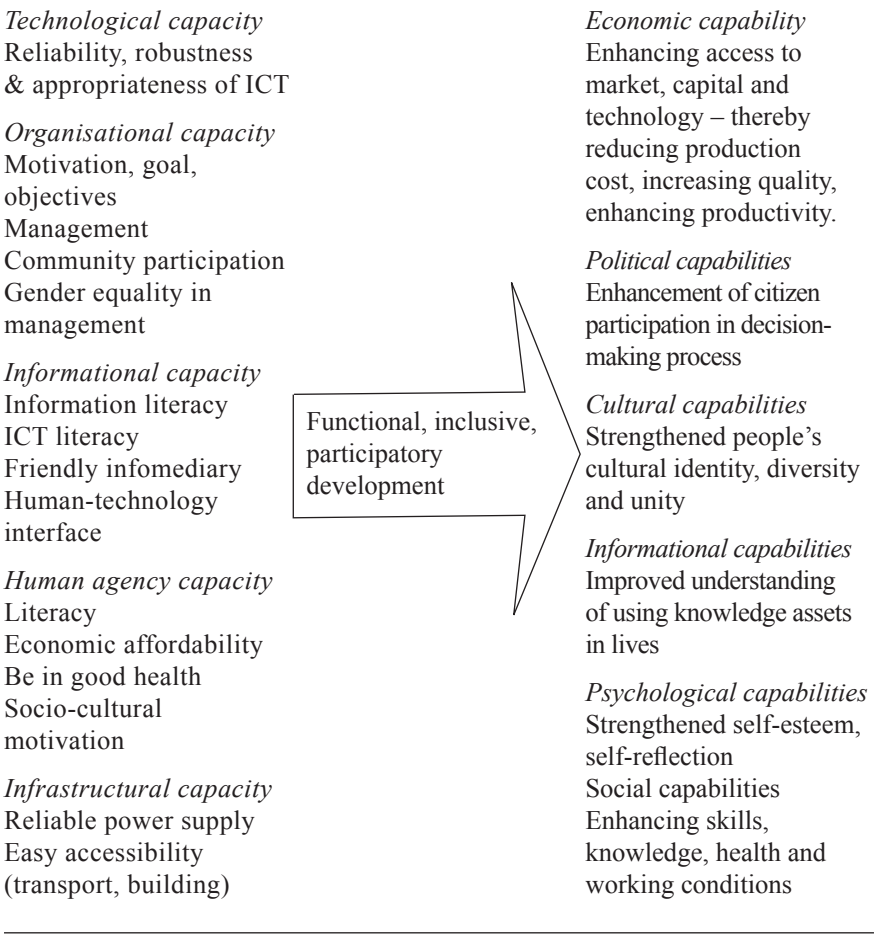
3.5 Developing evaluation indicators

One of the main criticisms against evaluating developmental interventions on the basis of their impact on the capabilities of human agencies is that it requires comprehensive and minute informational and methodological details. Certain indicators are already developed as part of measurement of progress made by societies in sustainable human development.[34] Besides, to measure the impact of knowledge connectivity on human functionings, role of intervening knowledge

[34] One such example is UNDP's HDI as part of the human development measurement.

processes that lead to enhanced human functioning need to be emphasised. To illustrate, an MIS can generate online or print reports of beneficiaries of public entitlement, inform wider public and state agencies, lessening the chances of corruption in improper allocation of village public goods.

FIGURE 3.1: Enabling capacities required by ICT initiatives for enhancing capabilities



The promise of judicious appropriation and exploitation of village public goods, like rationing of basic food and non-food items for citizens belonging to below poverty line can be effectively monitored using that MIS – that runs on a bunch

of application software processing a set of socio-economic data on population being served under the scheme – is fulfilled as, firstly, transparency is enhanced by exposing entitlement information to citizens, village institutions, political parties, electoral agencies, state agencies and the civil society; secondly, voice emanating from consumers on the quality and quantity of entitlements as well as other non-recipient citizens is captured and amplified; thirdly, planning of resources accumulation, allocation, distribution at local, provincial and national level is smoothened. Such dynamic planning using time and space series variables facilitate equitable resources allocation leading to sustainability. What is applicable for allocation of ration items for citizens belonging to BPL is also can be applied for numerous other interventions. In order to imbibe these functionalities, the subsidised rationing system MIS is required to integrate multiple tiers of a complex knowledge system which performs different functions, for different institutions, at different time, in different levels.

The ration MIS knowledge system schema represents several outcomes - enhanced and guaranteed access to commodities, chances to voice their concerns to the state services provider, among others, for BPL citizens; lessening the chances of corruption and improving transparency, dynamic planning for resource distribution for government. In the knowledge schema, such achievements are placed in the third stage; however, such achievements (knowledge) are dependent on a vector of functionings (informational) operating at the second stage where individual capabilities transform certain vector of commodities (data) available in the first stage. In our instance, the vector of commodities that include RDBMS application, socio-economic data incorporating profiles of BPL citizens and other instruments are meaningful for rural communities because it improves administration of the ration distribution process. Nevertheless, the desired functionalities of vector of commodities (in this case data set) are influenced by two conversion factors. First, personal characteristics (e.g. ICT skills, information search skills, typing speed etc.) influence the pattern and process of converting the uses of RDBMS into a functioning (e.g. deriving a list of names of citizens entitled to ration allocation). If the person operating the database has low typing speed, for instance, obtaining a list of ration recipients belonging to a particular age group might be time consuming. Secondly, social characteristics (e.g. infrastructure, institution, public policies, etc.) affect the conversion process.[35] Therefore, if better administration of ration distribution and amplifying citizens voice on system are the intended outcomes of the rationing MIS knowledge system for the local communities (it may be noted that for there may be different outcomes for local, provincial and central governments, village institutions, civil and private food and non-food item suppliers and contractors, etc.), then, the evaluation exercise shall seek to identify critical gaps in the conversion process from the vector of commodities to vector of functionings. Enumerating a comprehensive set of vectors and functionings, that can serve as the evaluation

[35] The analysis draws upon Robeyns (2000: 5-6).

indicators for village knowledge gateways integrating numerous sub-systems like rationing MIS, will exhibit incompleteness and absence of variables specific to local social, cultural, economic and political environments. Nonetheless, based our earlier discussion, we have agreed upon certain pre-defined functionings that human agencies are expected to derive from village knowledge gateways. Table depicts such a set of broad evaluation indicators of gateways.

TABLE 3.4: Selected ICT projects in rural India[36]

Initiatives	*Scale*	*Services*	*Years*	*Implementing agency*
Akshaya, Kerala	617 kiosks	e-Literacy and e-governance	May 22, 2003	Kerala State IT Mission
Bhoomi, Karnataka	Reached most talukas in Karnataka, 30 kiosks, 20 million manual records digitised, SDC	Access to digitised 700,000 land records	Jul 13, 2001	Karnataka Govt.
CIC, North-East	One kiosk in each of 487 blocks of 8 N-E states and Sikkim.	Internet assisted services	Aug 22, 2002	National Informatics Centre, State Govts.
DGP , Kanpur (UP)	15 kiosks with hub in IIT Kanpur	Internet assisted services	Jun 2002	Media Lab Asia, IIT Kanpur
Drishtee	146 kiosks in 6 districts in 5 states	Internet assisted services	2000	Drishtee
e-Chaupal	Reach out 3.5 million farmers in over 31000 villages through 5200 kiosks across 6 states	e-Procurement	Jun 2000	ITC
Rural e-Seva, Andhra Pradesh	200 kiosks with 31 services	e-Governance	Feb 2003	Andhra Pradesh Govt.
Gyandoot, Madhya Pradesh	32 kiosks	e-Governance	Jan 2000	Madhya Pradesh Govt.
IVRP, Pondicherry	12 kiosks	Internet assisted services	1998	MSSRF
Melur, Nellikuppam, Baramati kiosks of N-Logue	200 kiosks	Internet assisted services	From 2000 onwards	n-Logue
Tarahaat	18 kiosks	Internet assisted services	Jul 2000	Development Alternatives

[36] Kerala State IT Mission; Ministry of Development of North Eastern Region; ITC; Rural e-Seva.

3.6 Instances of village knowledge gateways in rural India

In rural India, access to ICT is provided using shared public access mode in the form of info-kiosks, a rural version of cyber cafe available in cities. Info-kiosks provide basic communication facilities like internet connection and telecommunication services besides other computing services to the villagers. Majority of info-kiosk projects are heavily concentrated in few states - Delhi, Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra, Kerala, Gujrat, Rajasthan, Madhya Pradesh and Uttar Pradesh. Table 3.4 lists the projects that are reviewed in this paper.

3.7 Akshaya

The *Akshaya* project originates from the Kerala Government's statewide initiative to impart basic computer training to at least one representative from each household as part of its mass e-literacy drive. With an infrastructure of 600 infokiosks, Akshaya is piloted in Malappuram, one of the few socially backward districts in Kerala with 3.6 million people living in some 135 villages and 5 towns, governed by about 100 *panchayats* and 5 municipalities. The literacy rate in the district is almost 90 per cent. The district is characterised by a high degree of vegetation, with hilly terrain, intersected by water bodies.[37] The motivation for the Akshaya initiative came from the state government's e-governance initiative FRIENDS launched in 2000 for providing a combination of over 1000 services including integrated computerised payment systems for citizens at each of the district headquarters in the state.[38] Akshaya was conceived to replicate FRIENDS in the rural areas of Kerala. The project's bottom-up approach stems from the local community's needs to communicate with their migrated relatives in West Asia. Because local computer shops were charging exorbitant prices from the citizens for computer usage, email, chat and phone calls, the *panchayats* approached the sate government to initiate a publicly funded mass computer awareness programme in April 2002. Accordingly, the State Government made an allocation in the tune of Rs. 6 million to roll out an infokiosk centric computer literacy drive in the district. Malappurram was a pilot to experiment the feasibility of running the computer literacy programme throughout the state. With *Akshaya's* successful completion of the first phase of e-literacy campaign, infokiosks started rolling out other commercial services at rates predetermined by the state implementing agency Kerala State IT Mission. Internet connectivity was provided from May 2003 onwards and by the last quarter of 2004, 600 Akshaya infokiosks were connected to internet.

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[37] Malappuram district.

[38] A research study showed that citizens saved an average of 42 minutes per month, and at an average spent about a third of what they originally did on paying bills through travel costs and agents, and that 97.4% of users preferred the FRIENDS counters to the original department counters. See, Madon, S. and Kiran, G. R. (2002).

Akshaya's is operated by the *panchayats* adhering to a public-private partnership model.[39] The kiosks are operated by single private franchisees, selected by the local *panchayat* members based on a set of criteria that include the incumbent's previous involvement with community affairs among others.[40] Moreover, entrepreneurs were entitled to state financial support as loans that enabled them to pay the rent and purchase computer peripherals. In addition, a subsidy of Rs. 120 per head from each household in the district was given to the franchisee towards the training while each trainee paid only Rs. 20, as part of the e-literacy campaign. For an investment of Rs. 0.25 million, each centre was able to procure five computers and other hardware. It is estimated that 85 per cent of the cost of this training as incurred by the entrepreneurs was reimbursed by the state. The subsidy successfully helped in raising a mass awareness about the infokiosk services throughout the district, while making the infokiosks sustainable. The state government manages the Akshaya project through the Kerala IT Mission (KITM); and in the communities, village *panchayats* are responsible for running the kiosks in coordination with the district administration. Private entrepreneurs run the Akshaya centres with technical support from the Akshaya network management team deployed in the district headquarters.

Initially, Akshaya centres were provided with dial-up internet connectivity through BSNL's fixed telephony, to be migrated later on to a faster, reliable and high-bandwidth hybrid wireless network. Uneven terrain, dispersed communities, thick evergreen forests, ravines, hills, rivers, and palm-fringed coasts with various streams and rivers flowing through the district necessitated the deployment of such a wireless network. At the initial stage, each kiosk was connected with a minimum of 16kbps and a maximum of 64 kbps links. The network was expected to support voice, data and video streams while connecting all the public institutions like panchayats, state police, government departments and educational institutions. A wireless umbrella consisting of approximately 40 internet points of presence (PoP) connected to the access network allows the kiosks and Network Operating Centre (NOC) to hook into the internet cloud. A backbone network feeds 2 mbps of bandwidth to the PoPs. Backbone wireless links are connected to the POPs using a combination of 802.11a and VINE.[41] The access network connecting individual subscribers directly to the nearest POPs runs on Airspan's WipLL network standard that supports up to 4 Mbps (3.2Mbps net) of throughput to each subscriber. WipLL is based on a Multipoint Microwave Distribution System (MMDS), a wireless broadband technology for Internet access. WipLL is a high capacity point-to-multipoint wireless wide area networking system that uses IP

[39] Kerala State IT Mission.

[40] ITforChange (2004: 2).

[41] A proprietary wireless network standard developed by the network solutions company Wi-LAN. See, Bandeira, Nuno and Lars Poulsen.

technology and has an operating range in excess of 20 km line of sight (LOS) and around 3 kms of Non Line of Sight (NLOS). MMDS carries voice, video and data services on a single platform. It supports Quality of Service (QoS) and Bandwidth on Demand (BoD).

Akshaya infokiosks offer computer education, e-learning modules designed on school curriculum, local content, internet services, e-governance services like utility bill payment etc. They also provide commercial services like digital photography, desktop publishing, data entry, financial services like banking and insurance and courier services. Activities like community health and bio-diversity mapping are also undertaken. The project demonstrates that a well-organised and effective mass infokiosk movement can enhance social and economic opportunities for rural citizens. With the launch of the e-literacy drive in Mallapuram district, the State government had already developed a sizeable customer base and public enthusiasm and interest around the infokiosks leading to easy adoption of networked infokiosks later on. Despite the constraints posed by geo-physical environment, the innovative experiment with hybrid wireless connectivity solution has resulted into uninterrupted data and voice connectivity in the infokiosks. The services basket containing e-governance applications, information services and value-added commercial services has been beneficial for the local community. Akshaya's community-centric yet private entrepreneur-run model ensures efficient and quick delivery of services.

3.8 Bhoomi

Historically, maintenance of land records system in India has been a prime social activity for landowners, tenants and the state for land reforms, taxes, administration, survey and various other purposes. Land records contain geophysical data of the land e.g. land size, forms and soil, information on crops, irrigation, land use, legal entitlements, liabilities and taxation. State land reform measures, thus, depend much on the land records management system. Further, it helps in protecting the legal ownership, assignment and settlement of land titles. Farmers utilise land records also to obtain bank loans, resolve legal disputes, collection of accurate crop data, insurance and ensuring efficient land markets. The need to reform the land record management system has long been recognised because in its current state, the system breeds bribery and corruption. In this project, the Department of Revenue in Karnataka has computerised 20 million records of land ownership belonging to 6.7 million farmers in the state. Computerisation of land records allowed the farmers to sidestep the village accountants for acquiring a copy of the Record of Rights, Tenancy and Crops (RTC), a process that earlier entailed delays, harassment and payment of bribes. Farmers today can obtain a print RTC copy for a fee of Rs.15 from a computerised land record kiosks (Bhoomi centers) located in 177 *taluka* offices.

National Informatics Centre (NIC) (Bangalore) developed the Bhoomi land records management software. As an online system, the software creates copies of land records within a couple of minutes at the Bhoomi Land Records Kiosk. Farmers receive a computer generated acknowledgement number for further reference after submitting an online request for mutation at the kiosk. This facility ensures speedy processing of the requests. Farmers get land record documents and mutation request status without any intervention from the government officials through touch screen kiosks at the entrance of *taluka*/bloc office. This system brings transparency and accountability in the land records management system, which transformed the manual system of copying Land Record of Rights, Tenancy and Crop Information (RTC). A hub centrally located at the district headquarters operates Bhoomi network. At the block/ *taluka* office, the land records centre, equipped with a client computer, a printer and UPS, delivers the signed land records document on demand or accepts a mutation request process. An Ethernet based local area network (LAN) connects all the clients and kiosks to the hub. Inspired by the success of Bhoomi, the Department of Information Technology of the Government of India has already initiated pilot projects to replicate the electronic land record system in other states - Kerala, West Bengal, Sikkim, Tripura, Punjab, Haryana, Madhya Pradesh, Himachal Pradesh, Uttaranchal, Gujrat, Assam, Orissa, Rajasthan and Pondicherry.[42]

Bhoomi provides an innovative solution to India's age-old problem of land management. This easy to adopt solution lessens farmer's woes of obtaining copies of their land records, while increasing efficiency, accountability and transparency of the government departments. As the system is designed to provide its customers a single, specific solution, the project does not adopt the infokiosk model. However, Bhoomi shows that innovative and killer applications can sustain initiatives like this.

3.9 Community Information Centres

The North Eastern (NE) states are characterised by their isolation from the mainstream, uneven hilly terrain, poor power supply and adverse geo-physical environment unsuitable for creating ICT-based infrastructure. For a long time, citizens of the North East states of India have been cut off from the rest of the country due to poor communication infrastructure. The Indian government's Community Information Centres (CIC) programme aims to "reduce the digital divide by providing Internet access and IT enabled services to the community and also to facilitate citizens interface with the government,"[43] by connecting the seven North East states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura, besides Sikkim and Jammu & Kashmir to the mainland India. Through this project, the Union Ministry of

[42] Ministry of Communications and Information Technology (2004b: 19).
[43] *Ibid*, p. 22.

Communications and Information Technology (MCIT) has set up 486 internet-enabled CICs in 487 block headquarters of these states. The CIC is a joint initiative by the Department of Information Technology, MCIT and National Informatics Centre and the State Governments of eight North-Eastern States. The project is jointly managed by DIT and NIC in New Delhi with the direct managerial involvement of NIC officials at the state and district levels. Two kiosk operators are appointed for running a CIC. NIC initiated the designing and implementation of the project in April 2000, by setting up the first two CICs in Meghalaya on August 12, 2000. It has been then extended to 30 blocks in the North East states and Sikkim and the project was inaugurated on 17 August 2002 with 457 CICs. In Jammu & Kashmir, 139 CICs have been set up in the Block Head Quarters. It is expected that CICs in the 60 block headquarters of Jammu & Kashmir would be operationalised during 2004 - 05.

The CIC centres are generally housed in the buildings of local schools, colleges, and government offices.[44] Two computer operators– cum– instructors, recruited through an interview-based selection process, provide kiosk services to the citizens.[45] It is agreed that while DIT/NIC will provide manpower, connectivity and funding support for the CIC project for five years, respective state governments will take over these responsibilities to evolve a viable business model for making the CICs self-sustainable before August 2007. For achieving this goal, the state governments may collaborate with the private sector for effective service delivery and evolving a self-sustainable business model. CICs are linked to internet through VSAT. Each CIC is equipped with six computers (server and 5 client machines), printers (1 Laser & 1 Dot matrix), a LAN hub, TV, webcam, 2 UPS (1 KVA, 2 KVA), an AC, a generator set and a direct VSAT link. However, kiosks provide local citizens access to ICT infrastructure at the block level. They are also equipped with interactive communication channels for facilitating communications between administration and citizens. Users are charged with nominal fee for internet access that helps the kiosk operators in meeting daily expenses like fuel for generators and stationery. The CICs are located at various altitudes – in Sikkim, for instance, 40 CICs are located at altitudes as low as almost sea level and as high as 10,000 ft. Various activities are undertaken to mobilise the community involvement in kiosk activities (Box 3.1).[46]

Internet connectivity through VSAT emerges as the lone option in the remote and unconnected regions like the North-East India. Sparse low-density population clusters in these Himalayan states render infokiosks financially unviable – hence, state financing ensures public access to telecom and internet connectivity. It is observed, however, that the kiosk operators lack entrepreneurial motivation in their services to the citizens.[47] Unreliable grid electricity supply remains a major

[44] Ministry of Development of North Eastern Region.

[45] Jain, Rekha and Trilochan Sastry.

[46] Ministry of Communications and Information Technology (2004b).

[47] Jain, Rekha and Trilochan Sastry.

operational constraint. Generators, kiosks' power back up systems, remain out of service for want of diesel or even for the unavailability of local technicians for fault-repair. During the night, most CICs are closed because of low electricity supply and little users turn out. Usage of power-intensive hardware like ACs and TVs further aggravates the situation. Solar panels and micro-hydel systems are being currently experimented as alternative power back up systems for the CICs.

Box 3.1: Major activities of Community Information Centres in the North-East India

1. An MOU has been signed between DIT, IGNOU and North-Eastern States for conducting the 'Computer Literacy Programme' of IGNOU on CIC infrastructure established in North-Eastern States. A total 3076 candidates have been trained through this programme.
2. DOEACC has selected 321 CICs for accreditation for DOEACC Course on 'Computer Concepts Certificate'. An on-line exam was held for the CCC programme using NIC's Computer Assisted Paperless Examination System (CAPES) at the CICs.
3. The National Institute of Administrative Research, Mussorie, has been given the task of identifying the needs of the local community by organising workshops/seminars. NIAR has conducted 6 workshops, one each at Guwahati (Assam), Agartala (Tripura), Shillong (Meghalaya), Imphal (Manipur), Itanagar (Arunachal Pradesh) and Kohima (Nagaland). A workshop at Aizwal (Mizoram) is planned in April 2004.
4. A comprehensive monitoring system has been set-up at NIC Headquarters using a Complaint Monitoring Information System. The on-line status of CIC VSATs is monitored on a daily, weekly and monthly basis through reports from NIC hubs. A chat facility has also been set-up for the CIC operators to interact with vendors for trouble-shooting of equipment.
5. Basic services like Internet access; E-mail and Training to the local populace are provided by all the CICs. Several citizen centric services or e-governance service are also offered at the CICs. Some instances are those of E-Suvidha, a one-stop service facilitation centre for the issuance of certificates, forms, etc. by the government; Rural Soft – for the monitoring of government schemes for the common man; Hospital Appointment Booking system to remotely book appointments for medical infrastructure tests or consultations with specialists at the government hospitals in state capitals from the CIC. Several Training and Awareness programmes have also been beamed by the NIC using the Video Broadcast feature of the CIC Network.

(Continued on page 76)

6. Suitable local content has been developed by respective State Governments based on local needs. The implementation of citizen centric services at the CICs and the development of educational content are major achievements of the project. The following citizen centric services have been offered through the CICs to the citizens of the North-Eastern Region:
a. Issuance of certificates of citizenship (by birth), ST/SC/OBC, income, residence status, Valuation, Birth/Death certificate
b. Issuance of certified copies of documents of demarcation of land, demarcation for extraction of forests etc.
c. Issuance of new licenses for video shows, renewal of license for video shows, new licenses for cable operation, renewal of license for cable operation.
d. Permission for using loud speakers/ procession.
e. Information about extremist violence scheme.
f. Application forms for survival certificates, self-employment generation programmes, arms license, new ration cards, grant-in-aid to individual artisans/ ex-trainees, scholarship for disabled, payment of municipality tax, etc.

Source: Ministry of Communications and Information Technology (2004b).

Jain observes that CIC's management structure creates bottleneck for its operation, as she puts, "Since the maintenance was done centrally from Delhi, a CIC that became non operational due to malfunctioning hardware could be out of operation for at least five days. In practice, these periods are higher. Requisition of spare parts continued to be problem as it was centrally done."[48] Infokiosks housed in administrative buildings that are not centrally located or remain closed beyond office hours or during holidays inhibit citizen's access. It is observed that infokiosks nearer to schools generate more revenue from the students and local youth who undergo computer-training programmes and avail kiosk services. On an average, per week CICs attract over a hundred visitors who utilise the internet and other office applications, participate in the training sessions and develop their familiarity with computers and awareness of IT. Most of the CICs generate modest revenues from the nominal charges levied on these services. The CICs are eventually expected to become self-sustaining.

3.10 Digital Gangetic Plane

One of the first few long-distance Wi-Fi projects in the world, the Digital Gangetic Plane (DGP) connects few villages in Uttar Pradesh to internet using wireless network. Media Lab Asia (MLA) and Indian Institute of Technology (IIT), Kanpur started creating the DGP wireless network in April 2002 and the first node was established in June 2002, "to enable low-cost and rapid deployment of portable/

[48] *Ibid*.

mobile voice and data in rural areas".[49] The wireless test bed is undergoing its second phase after completion of its first year of pilot trial in December 2002.[50] Except the nodes in IIT Kanpur and Rajajipuram in Lucknow, rest are located in the villages of Unnao district. Farming is the predominant occupation and majority are either cultivators or agricultural labourers. In urban areas the literacy rate is 70 per cent against 56 per cent in rural. The population density in rural areas is about 600 per sq km compared to 1,500 per sq km. in urban areas. Media Lab Asia seeks to "facilitate the invention, refinement, and dissemination of innovations in the area of information and communications technology that benefit the masses."[51] MLA, a joint initiative of the Indian government and the Media Lab, Massachusetts Institute of Technology in the United Sates, started ICT experimentations in association with various IITs to take the benefits of ICTs to the masses. DGP is managed by the MLA in IIT Kanpur, headed by its director while a project investigator oversees the research, network design and other critical aspects; a project manager supervises its operation with assistance from project engineers, technicians and assistants. IIT academic and administrative community supports the fifteen-member project management team. Some infokiosks and 'infothelas' are operated by project assistants recruited as a part of the project while others are franchised to local entrepreneurs.

The even terrain of Gangectic plain allows unhindered line-of-sight signal transmission for wireless networks despite the presence of tall telecom or power supply towers. DGP's longest multi-hopping wireless link stretches over 80 km, one of the long-range Wi-Fi connectivity demonstrations globally. About eleven nodes are connected to the IIT Kanpur hub housed in the MLA building in IIT Kanpur campus. A 512 kbps leased line at MLA feeds internet bandwidth to the network. For long distance data transmission between the hub and the nodes, three parabolic grid antennas are mounted on the rooftop of multi-storeyed Faculty Building in the campus. In the hub and most of the client nodes, 2.4 GHz 24-dBi parabolic gird antennas are installed in vertical or horizontal polarization. In Bithoor, for example, a remote node 12 km away from IIT Kanpur hub, a parabolic grid antenna is mounted on a tower erected upon a two-storied building called Fab Lab to gain direct line-of-sight to the hub. Height of tower depends mainly on the availability of line of sight and antennae's susceptibility to interference. On an average, 40-meter towers are commonly used and existing telecom towers deployed by BSNL are used for this purpose to bring down capital investments. Radio towers are also constructed on rooftops of multi-storeyed buildings. Besides the fixed info-kiosk installation, few nodes as the one in Bithur, have mobile units called "infothela" that roam around the nearby rural communities surrounding the base station. Each mobile unit, a tri-cycle rickshaw, is equipped with computer, printer, battery back up sufficient enough

[49] Bhagwat, Pravin (2004).

[50] Ministry of Communications Information Technology (2004b).

[51] Ministry of Communications and Information Technology (2004b: 28).

for running applications, webcam, microphone, digital camera and other peripherals. Infothela uses rubber duck omni- directional antenna mounted on its rooftop to establish remote internet connection through the base station. In addition to internet access, the network is customised to offer internet telephony as well. DGP uses H.323 protocol for implementing Voice over IP (VoIP) a protocol that defines standards, procedures and components for communications over packet-based network.[52] IIT Kanpur has developed indigenous power back up systems for frequent power cuts in DGP project site. An inverter charger unit that charges a single Exide Invaqueen 500 battery of 12 V, 13 Ah is developed to run infothela peripherals.[53]

It is observed that the network deployment undertook minimal of community intervention to permeate the spectrum of human activities rural communities in the districts of Kanpur, Lucnknow and Unnao undergo through the appropriate applications development. Applications developed intervene on education, health and livelihoods. *Bimari Jankari* or disease information portal offers healthcare information in Hindi. *Digital Mandi* is a one-stop agro-commodities prices shop for rural farming communities. The portal serves as agricultural knowledge base in Hindi. DGP is largely limited by its approach of being a technological research focused on innovation, experimentation and deployment of Wi-Fi enabled internet connectivity.

3.11 Drishtee

Since 2000, Drishtee has established 146 infokiosks in six districts in five states of Haryana, Punjab, Madhya Pradesh, Rajasthan and Bihar. (Box 2) Drishtee is a private company, previously known as Cyber Edge, contracted to develop application modules for the *Gyandoot* project by Dhar district administration in Madhya Pradesh. Experiments with *Gyandoot* helped Drishtee to pilot an infokiosk initiative in Sirsa district in Haryana, and subsequently replicate in various rural and semi-urban areas. *Drishtee* staffs operate the hubs at the districts while its franchisees manage the infokiosks. Kiosks are housed in *panchayat* buildings or in *haats* or *bazaars,* roadsides and other easily accessible areas. On an average, they cover 20000 to 30000 rural inhabitants in approximately 25 to 30 villages in 15 to 20 *panchayats*. Kiosks serve villages with population of 500 to 900, though it is observed that a base of 2500 customers is necessary for achieving financial sustainability.[54] Each kiosk, equipped with computers, printers and other devices, is connected to district hub through an intranet by dial-up. An intranet software package facilitates information exchange within the villages.

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[52] The H. 323 protocol is defined by the ITU – T Study Group 16. See, ITU T.

[53] Based on interview with Mohan K. Misra, Project Engineer, Media Lab Asia.

[54] World Bank (2003).

Box 3.2: Status of Drishtee kiosks

Buxar (Bihar):	*District hub set up*
	4 kiosks operational
	9 kiosks in pipeline
Madhubani (Bihar):	*District hub set up*
	14 kiosks operational
	8 kiosks in pipeline
Sirsa (Haryana):	*First Drishtee district*
	District hub set up in January 2001
	20 kiosks operational
	22 kiosks in pipeline
Morena (Madhya Pradesh):	*District hub set up*
	6 kiosks operational
Jalandhar (Punjab):	*District hub set up*
	2 kiosks operational
	2 kiosks in pipeline
Jaipur (Rajasthan):	*First Drishtee partnerships*
	100 kiosks operational
	26 kiosks in pipeline
Planned States:	Maharashtra
	Tamil Nadu
	Orisaa
	Uttar Pradesh

Source: Drishtee.

Kiosks are operated on a commercial basis by a local youth with a minimum of secondary education. Kiosk operators are imparted with intensive training by Drishtee to operate user-friendly software and applications. A fee of Rs. 10–15 (US$0.20-0.30) is charged for different services provided to citizens. Kiosk franchisees are required to pay a one-time license fee of Rs. 10,000 (US$216) and 20 percent of his income as a commission to Drishtee, besides bearing the cost of paper, maintenance, electricity, and telephone bills. Kiosk operators generate revenue by functioning as a petition writer and as a licensed vendor of government judicial stamps. Drishtee's projection shows that each kiosk owner will earn a net income of at least Rs. 12,000 (US$260) per month after the end of its first year of operation.[55] The infokiosk establishment process in districts includes an information needs assessment survey among the local communities and consultations with the

[55] *Ibid*, p. 2.

local government bodies. *Drishtee's* information services portfolio consists of e-governance applications like land records, mailing software, market information, matrimonial services, on-line grievance postings, local transport schedule and commercial services through the village *haat* channel. *Drishtee's* portal offers value-added services to the consumers, though slow connectivity and poor power supply have been major deterrents in up scaling the system. Partnership with local governments ensures streaming of public services through such privately funded commercial project to the rural citizens. In so doing, Drishtee infokiosk model exhibits the tenets of public-private partnership - working together to deliver both governmental and private services efficiently to citizens in rural areas while generating revenues to maintain the economic viability of the operation, at the same time.[56]

3.12 e-Chaupal

e-Chaupal is a nation-wide infokiosk-based e-procurement network set up by ITC Limited, one of India's largest companies, for collecting high-demanding farm produce like soya, coffee and prawns, directly from the end producers. The agri-market in India is characterised by small land holdings, weak market infrastructure and market transactions involving numerous intermediaries. Farmers often end up selling their products at exploitative rates to the intermediaries. Since June 2000, e-choupal infokiosks automatise the farm merchandising process by enabling farmers to sell their produce at ITC collection shops at competitive market rates. *e-Choupal,* now India's largest infokiosk initiative, covers 31,000 villages through 5200 kiosks across six states (Madhya Pradesh, Karnataka, Andhra Pradesh, Uttar Pradesh, Maharashtra and Rajasthan).[57] Madhya Pradesh alone hosts 1045 e-chaupals, spread over 6,000 villages, covering 600,000 farmers. The reach of e-chaupal, however, varies. The e-chaupal in Khasrod in Madhya Pradesh, for example, serves about 500-700 farmers in ten villages whereas the e-Chaupal in Dahod serves about 5,000 farmers in ten villages. On an average, an e-chaupal serves about 600 farmers in the soy cropping area, fewer in wheat, coffee, and shrimp producing areas. Besides Madhya Pradesh, e-chaupal has been rolled out in Uttar Pradesh, Andhra Pradesh, and Karnataka. While creating the infokiosk based agricultural trading solution, e-Chaupal stressed on two aspects:[58]

- The delivery of real-time information independent of the transaction. In the mandi system, delivery, pricing, and sales happen simultaneously, thus binding

[56] *Ibid.* p. 1.
[57] ITC.
[58] Annamalai, Kuttayan and Sachin Rao (2003).

the farmer to an agent. e-Chaupal was seen as a medium of delivering critical market information independent of the *mandi*, thus allowing the farmer an empowered choice of where and when to sell his crop.

• Facilitate collaboration between the many parties required to fulfil the spectrum of farmer needs. As a communication mechanism, this goal is related to the commitment to address the whole system, not just a part of the system.

Local farmers, selected and trained by ITC, operate the kiosks. Called *Sanchalaks,* the infokiosk operators play a very critical role in the system as they act as intermediaries between ITC and the farmers. ITC decided to recruit farmers as *sanchalaks* because Indian farmers who have been betrayed by institutions and individuals for generations, can be most trustworthy in the rural society and they can provide space for housing the infokiosk infrastructure. The entrepreneur-farmers are also required to make some investments towards the operational costs (between Rs. 3000 to 8000 per year) for electricity and phone line charges for dial up connectivity. ITC experimented with increasing the throughput of dial-up connectivity to the infokiosks. Though it has been able to give an average of 40 kbps of bandwidth, infokiosks are faced with slow and disruptive connectivity due to a poor telecom infrastructure at the village level. To provide a better download speed to the kiosks, ITC decided to adopt VSAT connectivity, supplying the kiosks a throughput rate of up to 256 kbps, though it may cost around Rs. 120,000 per installation. As villages often face a shortage of power supply, each e-chaupal is equipped with a battery-based UPS (uninterrupted power supply) backup. The back up enables the kiosks to use the system at least twice a day – in the morning to check the prevailing *mandi* prices and again in the evening to check the rate ITC would be offering the next day. Recently, ITC has started supplying solar battery for charging batteries in the absence of daylong power supply.

It should be noted that ITC has been straightforward in installing expensive IT infrastructure even in the remotest places. It is a manifestation of the integrity of rural value systems that not a single case of theft, misappropriation, or misuse has been reported among the 2000 e-chaupals. Online information is made available through the kiosks in local languages free of cost. Like Bhoomi, e-choupal is an innovative IT-based solution to age old problems faced by the Indian farmers. Through making a rather simple portal based information dissemination channel accessible through the infokiosks, e-chaupal has been able to provide farmers better prices for their products. The engagement of local farming communities in e-chaupal businesses, especially the involvement of entrepreneurial farmers as *sanchalaks,* demonstrates the community participation component of this project.

3.13 Gyandoot

Started in January 2000, Gyandoot ('knowledge messenger' in Hindi) is a rural infokiosk-based e-governance service delivery model initiated by the state government of Madhya Pradesh in Dhar district[59] The project aims to create a cost-effective, sustainable and replicable rural internet delivery model for improving government services for the poor, involving citizen's cooperatives, government and the community.[60] The district of Dhar, where Gyandoot is implemented, exhibits all the characteristics of a typical tribal and backward district of India. It has a population of 1.7 million people, with a literacy rate of 53 per cent and 60 per cent people living below the poverty line. With main tribes of Patelyas, Bhils, and Bhilalas, 54 per cent of population in the district is tribal. Dhar has altogether 13 development blocks, 7 *tehsils*, 676 *gram panchayats*, 1557 villages and 10 semi-urban areas. Gyandoot is managed by three entities – the 'Gyandoot Samiti', an NGO, the government and the kiosk managers. 'Gyandoot Samiti' has been formed to manage the project with the District Collector as President, a government official as the Secretary and various departmental heads as members of the Samiti. The operational team of the Gyandoot Samiti consists of a Project Manager, an Assistant Project Officer, a Technical Head (the District Information Officer) and four computer operators.[61] The kiosk managers (called *Soochaks)* are local young men and women, with high school, graduate or even post graduate level of education. *Soochaks* operate either through *panchayats* or as private entrepreneurs. As of January 2000, out of 35 infokiosks, 20 were initiated by *panchayats* and the rest by local entrepreneurs. *Panchayat*-run infokiosks were provided with space, telephone and electricity connection and furniture. It has been observed that *soochaks* operating in *panchayat* owned kiosks lay more stress on delivering Gyandoot-specific services compared to entrepreneurial *soochaks.*[62]

The design of the services was finalised on the basis of a preliminary survey and several meetings between local communities and the government. Villagers demanded information services on *mandi* rates, copies of land records and a system for lodging their grievances. The project is largely built on the Wired Warna project, and it has facilitated the development of a complete suite of services and applications modules. The hardware is procured and given to the Gram Panchayat under agreement with the Zila Panchayat. The entire expenditure for the Gyandoot network has been borne by Panchayats and private entrepreneurs. Each Gyandoot infokiosk caters to approximately 15 Panchayats, surrounding 25 to 30 villages, covering 20000 to 30000 villagers. Infokiosks are generally located in the *panchayat* buildings, in *haat* and *bazaars* and other easily accessible areas*,* reaching over half a million villagers living in 311 *panchayats* and over 600 villages. Gyandoot has been able to deliver 22 services out of 44 services it had designed initially. The 2002 survey shows that

[59] Jafri *et al.* (2002: 7).
[60] Rajora (2002: 66-67).
[61] Jafri (2002: 3).
[62] Gyandoot (2002: 17).

villagers use only 13 main services, e.g. *mandi* prices, income certificate, domicile certificate, caste certificate, land holder's passbook, rural Hindi mail, grievance redressal, forms of government schemes, employment news, advisory module, driving license, *khasra nakal avedan* and board examination results.

Most of the infokiosks are connected to the Intranet server through dialup lines, which are slow and disruptive. Only seven of the kiosks are connected through a CorDECT WLL based system. Though WLL connectivity is more reliable than dial-up, it is also slow and prone to delivery fluctuations. A survey shows that while dial-up connectivity terminates twice or thrice daily, CorDECT WLL also develops interruption in connectivity. In Dhar, the Gyandoot Samiti has registered itself as the Local Service Providers (LSP) to provide WLL connectivity to the infokiosks. Besides slow connectivity, power breakdown is frequent and lasts for a several hours. A plan to acquire solar powered batteries for the kiosks to support their power requirements for four hours at the cost of about Rs.75, 000 per unit was also undertaken. Though Gyandoot originally planned to provide 44 services, the project provided only few of the projected services. A prescribed amount for each service is collected. While the project has succeeded in raising awareness about ICTs amongst the rural community at large, especially the young people, Gyandoot has failed a revenue generation model. Insufficient revenue generation led the *soochkas* to start offering computer solutions (such as job work, training) beyond the objectives of Gyandoot. It was also found that citizens and government officials perceived improvement in work efficiency, accountability and shift in corruption level. Lack of reliable power supply and connectivity led to the partial or complete closure of many infokiosks. It is observed that the kiosk operators have been the major beneficiaries from this project, compared to other stakeholders. The overall usage rate of Gyandoot services has been low; especially since it failed to attract the rural poor. Only middlemen and medium to large-scale, educated farmers have benefited from the market price service of Gyandoot. The information and application services related to schemes for the socially and economically backward citizens have not received adequate attention in Gyandoot. Information on these schemes should be regularly posted, as possibly this is one area where more rural citizens could benefit. Manual processing of documents in government line departments has resulted in delays in the delivery of e-governance services at the infokiosk level. Thus, the *informatisation* process at the service center does not create a better, faster and smart governance service through Gyandoot. This is clearly evident from the fact that despite having online grievance registration system, government departments failed to respond to them, resulting in a considerable delay in the grievance redressal mechanism.

3.14 Rural e-Seva

The rural *e-Seva* initiative was built on Andhra Pradesh government's experiments with the urban e-governance projects like TWINS in Hyderabad and Saukaryam

in Vishakhapatnam Municipality, introducing customised electronic delivery of government to citizen services. Rural *e-seva* is implemented in the West Godavari district of Andhra Pradesh to enforce effective governance machinery by delivering e-governance services at the community level through infokiosks. With a total population of 3.8 million, the West Godavari district is quite a prosperous agri-based rural economy. Literacy rate in the district stands at 74 per cent, and as much as 80 per cent of the population lives in rural areas. Seventy two per cent of the workforce is engaged in agriculture and allied activities. The density of population (490 per square km) is the highest both for rural and urban areas. The district has 46 administrative blocks.

e-Seva involves the state and local government authorities as the implementing and managing agency and community based organisations and private entrepreneurs as the operating bodies for the infokiosks at the community level. Out of 47 e-Seva centres in the district, 16 are operated by women's self-help groups, 12 by young men's self-help groups, 14 by groups of people from disadvantaged castes and five are run by individuals supported by central government's employment generation scheme. Concerned local government departments assist the selected private entrepreneurs in getting government subsidies and/ or loans to run the kiosks. In addition, 36 kiosk operators have been allowed to run their kiosks in government-owned building for a nominal fee. The *e-Seva* Steering Committee, comprising of government officials, convenes meetings with the kiosk operators every month to review the services and community needs. Apart from the nodal *e-seva* centres, located in the same villages/ towns where the block development authorities sit, 120 Rural Service Delivery Points are set up in village telephone booths connected with a subsidised dial-up internet connection given by BSNL to provide the local community with selected *e-Seva* services.

Services of the e-seva centres are designed to bring the values of good governance to the rural communities. A bouquet of services has been developed for the inhabitants in this region. A bill payment facility through *e-Seva* centres attracts significant revenue for the kiosks. Since 2003, more than Rs. 400 million has been collected in electricity bill receipts. Plans to facilitate the collection of telephone bills and local government taxes through the e-Seva centres are also underway. Basic government documents like birth, income, caste certificates are also made available through the centres for a nominal amount, as all such records are now available digitally. Citizens also make requests for copies of land records online, though the copies are distributed through offline channels by the revenue department. The online grievance redressal system is quite popular, as its progress is also monitored online. A rural *e-Seva* website www.westgodavari.org is being developed to provide comprehensive information to the local residents and act as a gateway to the services that e-seva centres offer. Application-specific software modules are being developed for certification, complaints, land records, auctions etc. Apart from e-governance services, the centres also provide value-added socio-economic and commercial knowledge services. Commercial services offered include

digital photography, photocopying, printouts, desktop publishing, internet browsing, computer education etc. The *e-Seva* initiative demonstrates that viable infokiosk services, community-centric approach and value-added business services enhance the success-potential of infokiosks, despite the problems of slow connectivity. It also reiterates that there are takers of e-governance services at the rural community level, but services at various levels of government departments need to be reengineered to facilitate governance services delivery through infokiosks.

3.15 Information Village Research Project

Since early 1998, the M S Swaminathan Research Foundation's Information Village Research Project (IVRP) has been facilitating knowledge sharing using both traditional and new media to increase rural livelihood opportunities in the Union Territory of Pondicherry in Southern India.[63] The project was largely motivated from the Foundation's Biovillage Project that aims to equip the community with the technical expertise of exploiting natural resources sustainably. IVRP's network was started with a hub centre at Villianur in February 1998 and by July 1998; three more villages – Kizhur, Mangalam and Pillayarkuppam – were linked to the hub through a wireless network. With approximately 20 per cent of the families living on less than US$1 per day, poverty levels among the rural communities in this region are high.[64] Tamil, Telugu, Malayalam and Hindi are the main local languages. Flat terrain with trees (average height below 40 ft.) eases line of sight data transmission through wireless network. MSSRF, Chennai oversees IVRP, managed locally by a team consisting of a project manager, computer technicians and volunteers. While benefiting from MSSRF's scientific and technological guidance, the project organises monthly volunteers' meet to appraise project development and mobilise rural communities. Evolution of IVRP involved long-term information needs assessment that showed the community's predominant dependency on neighbourhood shopkeepers, the marketplace or the agri-vendors as information sources. The survey further revealed relatively high penetration of broadcasting media e.g. radio and television vis-à-vis low teledensity in the community.[65]

Evolution of the IVRP network infrastructure was rather gradual and a result of a bottom-up community-centric approach based upon the community needs and its willingness to manage and volunteer for the infokiosks. This can be gauged from the fact that out of the 12 infokiosks connected to the network hub, one was established in 1998, followed by two in 1999, three in 2000 and two in 2003.[66] Initially, the project started experimenting with VHF radio-enabled voice

[63] MSSRF (1998: 131).

[64] Senthilkumaran S. and S. Arunachalam (2002: 2).

[65] MSSRF (1998: 131).

[66] Interview with Mr. Jayakrishnan, Project Technician, Information Village Research Project, MSSRF.

communication to connect community field workers with experts to facilitate knowledge sharing. Community needs for text-based livelihoods knowledge necessitated upgrading the radio communication network to an internet connected infokiosk network. IVRP implements a direct sequence spread spectrum (DSSS)-based wireless data transmission network for connecting infokiosks located in ten neighbouring villages to the hub located in Villanur. Parallel to that, a two-way voice and data communication facility using VHF wireless radio facilitates communication within the villages. The radio network connects four villages – Thirukanchipet, Pillayarkuppam, Poornangkuppam, Kizhur – to the hub centre Villianur.[67] A 64 kbps VSAT installation (service provided by Bharati) at the hub feeds internet bandwidth to the whole network. Majority of access centres are fitted withy solar panels for charging the back-up system.

In its impact assessment report MSSRF (2004) observed that, "Knowledge Centres facilitate information/knowledge empowerment and technology empowerment by providing access to a variety of information, thereby enabling the community to develop in different areas like education, employment, government schemes and in developing and enhancing computer skills and so on. Use of the Tamil language in all the operations, and using Tamil scripts in the computer applications, serves the purpose of the Centres, i.e., promoting the use of knowledge Centres and encouraging interactivity between different information systems and their intended beneficiaries – the rural population"[68] Information services provided by the infokiosks include information on government entitlements, employment opportunities, weather forecast, health and current market prices. Rural yellow pages, available both online and in print versions, provide directory information. A Tamil bi-monthly newsletter *Nammavur Seidhi* (news from our village) is widely circulated among the villagers. Some of the infokiosks located in coastal villages use public address system to disseminate weather forecasts retrieved from internet for the local fishermen. Through innovative partnerships with local institutions, IVRP has been able to devise and offer specialised knowledge services to the community. A partnership with Azim Premji Foundation, for example, helps the centres to impart coaching in Kannada, Tamil, Hindi and English language learning, mathematics, science and social sciences using multimedia CD-ROMs for training primary students in local languages.[69] IVRP is also prone to frequent interruption in power supply and poor connectivity. Though the project has been successful in developing a knowledge base for the development of local community in local languages, absence of e-governance services has limited the scope of its business viability.

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[67] MSSRF (1998: 131).

[68] MSSRF (2004: 7).

[69] Azim Premji Foundation (2005).

3.16 TARAhaat

Development Alternatives, an NGO focusing on sustainable development, initiated *TARAhaat* to bring internet to rural India. It is a franchisee-based business model attempts to generate revenue streams by marketing information services through a portal and infokiosks, focusing on locally relevant content and applications. Eight infokiosks called *TARAkendras* were established in the Bhatinda District of Punjab. With assistance from the District Rural Development Agency, these kiosks have been operational since early 2001. *Tarakendras* connect to the internet using dial-up connectivity, resulting in low speed downloads at the infokiosks. Small diesel fuelled generators are used as power backups. At the non-technical level, there have been instance of social and cultural issues posing operational challenges to TARAhaat infokiosks, for example:

A franchisee in Bathinda region, for example, suffered early vandalism and threats because the villagers felt that her TARAkendra would disrupt their peaceful existence. She countered this by seeking district authority intervention to quell the threats, and then campaigned to inform fellow villagers about the benefits of computer education and Internet access. She later received a written apology from those responsible for vandalising her TARAkendra.

The three girls who own and operate the Punavali Kalan franchise near Jhansi belong to one of India's higher social classes. Some villagers were reluctant to visit the TARAkendra because they considered it just one more way to increase the power vested in the higher class. The franchisees have managed to overcome this initial resistance through door-to-door visits with the villagers. Several people showed up when personally invited to visit the TARAkendra and see the "new type of TV" for themselves. In Bathinda, the Pacca Kalan franchisee found villagers hesitant to send their daughters to the TARAkendra because they thought the girls might be harassed there, especially by boys from surrounding villages. The franchise owner offered personally to guarantee the girls' well-being during visits with their parents. This has mitigated initial fears, and now roughly 25 per cent of the kendra's visitors are girls. As is common practice in the Punjab area, TARAkendras around Bathinda run separate classes for boys and girls.

TARAhaat kiosks use dial-up or VSAT for internet connectivity. Most of kiosks in Bundelkhand and Bhatinda region (Madhya Pradesh) face frequent and long power cuts. Diesel-run generators are used as alternative power source. Infokiosks deliver online and offline information services on livelihoods opportunities, education, governance and other domains retrieved from *TARAhaat's* mother portal www.tarahaat.com, a local language-enabled, self-explanatory animated portal that reaches even low and semi-literate village population. Service specific application modules customised for targeted communities include, *TARAdhaba* for providing connectivity; *TARABazar* to provide access to products for rural households, farmers, SSIs; *TARAvan* to deliver ordered goods at remote locations; *TARAdak* to connect rural population with their

distant relatives; *TARAgyan* to develop education and training modules for rural youth; *TARAguru* as a decentralised university for mentoring and consultancy; *TARAscouts* for collecting information to be put on the portal; *TARAvendor* for marketing the *TARABazar* products and *TARAcard* that allows people to consume goods on credit. TARAhaat's commercially viable locally relevant content and applications attract rural communities to avail infokiosk services.

3.17 Conclusion

Project goals and objectives, besides the project management structure, level of community participation and pattern of gender balance in project management determine intended project outcomes. Jensen and Esterhuysen (2001) recommend setting up of a permanent steering committee for guiding and advising the establishment and operationalising the community infokiosk. The steering committee consisting of community representatives will constitute a smaller core group, a management committee, for overseeing the daily operation.[70] Technological capacity is pivotal in appropriating access to knowledge specific to local organisational, informational, social and economic capacities. We have identified reliability and robustness of data and voice connectivity and appropriateness of knowledge capture and delivery mechanisms as primary determinants of technological capacity. Technological capacity is by large judge by performance and reliability, user satisfaction, industry recognition and adherence to standards. Though India champions in usage and production of ICT globally, grassroots interventions seldom demonstrate locale-specific adaptation of ICT. Not only locale-specific extremes demand fabrication of hardware and software devices according to geo-physical environments, but also it may require extraordinary mechanisms for citizens with different levels of educational attainment, informational capacity, initiation, age groups, gender and physiological and psychological states. Informational capacity depends on information literacy which is, according to Association of College and Research Libraries (2000), "a set of abilities enabling individuals to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information."[71] Gigler (2004) further puts, "The concept of information literacy is very much related to information technology skills, but includes a broader area of competency, such as i) the capacity to access the needed information effectively and efficiently; ii) the capacity to evaluate information and to incorporate selected information into one's own knowledge base; and iii) the capacity to process and share information effectively with others. This concept stresses that people need skills in order to be able to access information effectively and efficiently through ICTs, such as

[70] Jensen, Mike and Esterhuysen, Anriette (2001: 15-16).

[71] Association of College and Research Libraries (2000); Quoted in Gigler (2002).

for example the ability to use search engines, websites, e-mail or list-serves. Furthermore, it is of importance that people know how to assess the quality of the retrieved information. A very relevant measurement for this will be whether or not a person is able to contextualise the retrieved information and integrate selective parts of it into her/his existing knowledge base. Finally, information literacy includes the ability i) to distinguish between alternative information sources; and ii) to summarize the main ideas from the gathered information, sharing it with others within and outside the community. Another important indicator for enhanced informational capabilities is the capacity of the poor not only to consume content, but also to generate and share their own content through the development of their own websites or by posting material on other sites." Knowledge sharing for local development, thus, essentially builds on information literacy. (Table 3.5)

The need for adopting a holistic approach for project design, implementation and evaluation, based on citizen's capabilities development is underscored. The foregoing discussion shows that rural ICT projects have experimented with only few internet connectivity options – dial-up, VSAT and wireless access systems including CorDECT WLL, 802.11b Wi-Fi, DSSS and hybrid broadband MMDS/ WipLL wireless access systems. Majority of rural infokiosks are connected by dial-up, which gives up to a maximum of 56 kbps throughput. The review illustrates that barring few interventions like Dhar district in Madhya Pradesh, infokiosk projects in North India, particularly those in the states of Madhya Pradesh, Rajasthan, Uttar Pradesh, Bihar, Orissa and Bihar use slow and disruptive dial-up connection. High infrastructure cost, low returns on investment and lack of awareness prevent infokiosk initiative to experiment with alternatives access systems. Wireless access systems are largely experimented in Southern India while large-scale VSAT deployments can be seen in CICs in Northeast. It is observed that ICT projects using high-bandwidth wireless solutions are able to provide reliable, fast and interactive multimedia services.

CORDECT WLL infrastructure is concentrated in Southern India. Few projects like the DGP and Akshaya have experimented with Wi-Fi and hybrid wireless networks respectively. However, wireless networks have failed to work in the DGP and IVRP because of low backhaul connectivity. CoRDECT WLL wireless network provide relatively better bandwidth and stable connectivity. VSAT seems to be attractive options for remote and unconnected areas. Bhoomi and e-Chaupal initiatives show that highly functional applications and innovative reengineering processes can make all the difference to the success of ICT based projects. The review also shows that an emphasis on livelihood-based knowledge services, as being practised by IVRP does not attract rural masses to the infokiosks. On the other hand, emphasis on e-governance services and commercially viable value-added services primarily through the government driven infokiosk initiatives are appreciated. A rightful combination of both the development and business centric approaches can attract rural population and spur development.

Community involvement is imperative for the success of any infokiosk project. Gyandoot's failure can partly be attributed to the lack of participation of the rural population, especially those belonging to tribal and disadvantaged groups, and low-income communities. It is observed that community participation is generally ensured by infokiosk's partnership model. Various strategies are adopted by different implementing agencies – government, private and civil society organisations – in involving local communities. Since, infokiosk operators represent local communities; they are invariably selected from the local villages. Infokiosks can be managed either by community based organisations or private entrepreneurs – however, both approaches have their own advantages and disadvantages. The Akshaya initiative recruits private entrepreneurs to ensure maximum financial benefits and efficiency. However, Gyandoot's experience shows that kiosk operators operating in *panchayats* owned kiosks give more stress on delivering Gyandoot-specific services compared to entrepreneurial *soochakas*. e-Chaupal experience with local farmers as kiosk operators is encouraging. The IVRP model shows that social motivation can encourage people, especially the women, to volunteer for running infokiosks, though it is difficult to sustain the momentum. In essence, community-based organisations or representatives of the local communities should manage kiosks. However, it is essential to provide financial incentives to the kiosk operators. To be successful, an infokiosk model should be built upon the principles of mutli-stakeholder partnership – involving government, private and civil society organisations. If infokiosks have to play a role in improving citizen's access to government services and in increasing the outreach of state initiated development programmes, government involvement is crucial. Partnership with local government agencies, like *panchayats,* enables the infokiosk model to integrate essential e-governance services in the bouquet of services they offer. Similarly, civil society organisations focus on community involvement while private institutions increase efficient service delivery, financial sustainability, innovativeness and technology solutions.

TABLE 3.5: Comparison of selected ICT projects in India

Initiatives	*Areas*	*Technology*	*Services*	*Business model*	*Stakeholders*	*Comments*
Akshaya	Malappuram district, Kerala	Hybrid wireless network, reliable power supply	E-learning, utility services, local content, value-added commercial services, community resource mapping	Franchisee-based, government supported, revenue generating	Initiative of Government of Kerala, private entrepreneur run model	Robust connectivity and power supply, attractive service bouquet, community engagement
DGP	Kanpur and Unnao districts, Uttar Pradesh	Wi-Fi (802.11b) network,	Livelihoods information services,	Funded research initiative	Initiative of Media Lab Asia, IIT Kanpur	Low bandwidth, research-based approach, low community participatio; Low demand for services
Drishtee	Haryana, Punjab, Madhya Pradesh, Gujrat and Orissa	Dial up connectivity, unreliable power supply in few states	Locally relevant e-governance, business content	Franchisee based, revenue generating model	Initiated by Drishtee, a private comopany Private entrepreneur run	Low connectivity and unreliable power supply deter service provisioning, e-governance based applications raise service demand
e-Chaupal	Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Karnataka	Dial-up and VSAT connectivity/ unreliable power supply in few areas, solar powered battery as back-up	E-procurement module for local agri-business, farm knowledge base	Franchisee based, revenue generating model	Initiative of ITC, a private company Private entrepreneur run	Low connectivity does not deter farmers in availing innovative solution to incentivise rural livelihoods
Gyandoot	Dhar District, Madhya Pradesh	Dial-up/ CorDECT WLL, unreliable power supply	Local content, utility services, Hindi email, information	Franchisee-based, low revenue generation	Government managed private entrepreneur run model	Poor connectivity & power supply, unviable services lead, low community involvement
IVRP	Pondicherry district, Union Territory of Pondicherry	Low bandwidth wireless network, hybrid media, unreliable power supply	Livelihoods knowledge services, value-added commercial services	Donor grant-based, community-centric model	Initiative of M S Swaminathan Research Foundation	Low usage as commercially unviable content, poor connectivity, unreliable power supply, High community participation
Rural e-Seva	West Godavari district, Andhra Pradesh	Dial-up/ CorDECT WLL, reliable power supply	E-governance services, development information, value-added commercial services	Franchisee-based, modest revenue generation	Government managed CBO run model	Locally relevant e-governance services, community involvement, efficient backend support by govt departments
Tarahaat	Bhatinda district, Punjab	Dial-up connectivity, power cut, diesel run generator as balance of systems	Commercially viable applications in local languages	Franchisee based, revenue generating model	NGO managed private entrepreneur run model	Community centric and NGO managed model, with locally relevant services, poor connectivity and unreliable power supply

4

ICT Diffusion in Rural India: Current Trends and Emerging Options

Prof. MS Swaminathan observed at the first Policy Makers' Workshop held in New Delhi that, "connectivity and content are the two pillars on which the entire structure of a nation-wide infokiosk movement rests."[1] Though a technological issue, connectivity is affected equally by social, economic and cultural environments as well. The term 'connectivity' denotes the networking capabilities within information processing devices to exchange data – as it is transmitted through internet and intranet connecting computing devices, radio and television broadcasts delivering audio and/or video content to millions of radio, television and other compatible receivers, data transmission through telecom networks and transmission of radio signals within numerous devices. Nevertheless, it is the information and knowledge conveyed by such invisible networks that creates an enabling situation for human development. Information is originated from sources diverse - individuals and institutions, available in numerous languages and dialects and presented in a variety of formats – text, numerals, picture, drawing, audio, video, to name a few (Box 4.1).

Backhaul connectivity and electricity are the building blocks for setting up and running an infokiosk. Besides connectivity and electricity, hardware and software, the availability of public space for housing the infokiosk set up and access facilities are other critical success factors for scaling up the infokiosk movement.

[1] Swaminathan (2004: 4).

Box 4.1: ICT functionalities

Capturing technologies: Input devices that collect and convert information into digital form. Such devices include keyboards, mice, trackballs, touch screens, voice recognition systems, bar code readers, image scanners and palm-size camcorders.

Storage technologies: Devices to store and retrieve information in digital form. Among these are magnetic tapes, floppy disks, hard disks, RAM disks, optical disks (such as CD-ROMs), erasable disks and smart cards (credit-card sized cards with memory and processing capacity for financial transactions or medical data).

Processing technologies: Creating the systems and applications software that is required for the performance of digital ICT.

Communications technologies: Producing the devices, methods and networks to transmit information in digital form. They include digital broadcasting, integrated services digital networks, digital cellular networks, local area networks (LANs), wide area networks (WANs, such as the Internet), electronic bulletin boards, modems, transmission media such as fibre optics, cellular phones and fax machines, and digital transmission technologies for mobile space communications (the new Low Earth Orbit satellite voice and data services).

Display technologies: To create a variety of output devices for the display of digitised information. Such devices include display screens for computers, digital television sets with automatic picture adjustment, set-top boxes for video-on-demand, printers, digital video discs (which might replace CD-ROM drives and audio CD players), voice synthesizers and virtual reality helmets.

Source: Hamelink, Cees J. (1997: 9).

The issue of reliable power supply to infokiosks needs special attention before planning any ICT-based interventions in rural areas. Interruption and low voltage in power supply de-motivate the users from availing infokiosk services. Experimentation with alternative low-cost energy sources such as solar power has been successful, but it cannot be relied upon. Investments in inverters and battery or diesel run motors as power back-ups add to the service costs. The choice of technology shall accommodate India's variegated geo-physical environment. With upland plain in the south, flat and rolling plain along the Ganges, desert in Rajasthan and mountainous region in Himalayas,

diverse geo-physical conditions exist across the country. Overall, the climate varies from tropical monsoon in the South to temperate in the North, from high rainfall regions in the North East to dry areas in West and North West. Networking infokiosks in rural and remote areas will depend on both climatic and terrain conditions. Climatic conditions also affect the performance of wireless networks. However, the latest technologies in the markets have been equipped with tools to overcome with difficulties posed by adverse geo-physical conditions.

4.1 Telecom connectivity

Both the internet and telecom connectivity enable millions of infokiosks to capture and share knowledge relevant for local development. Though the country has the sixth largest telecom network in the work today up from 14th in 1995 and despite the remarkable increase in teledensity from 0.8 per 100 in 1994, to presently around 8 per 100, rural India lags far behind urban India in telecom connectivity. During 2002-03, the all India rural and urban teledensity stood at 1.49 and 14.32 respectively (Table 4.1). The interstate disparity in teledensity is also wide – South and North India has higher teledensity compared to the East and North-East regions (Table 4.2). Reforms in the telecom sector since 1991 and subsequent policy changes through the National Telecom Policy – 1994 and 1999 resulted in a rapid growth in the country's teledensity. Growth of cellular phones has been phenomenal – about 2 million new subscribers are added every month to the network.[2] Cellular phones contribute as much as 34 per cent of the total telephone subscription rate and if WLL mobile phones are included, the share stands at 44 per cent.

TABLE 4.1: All-India rural and urban teledensity

Years	*Rural*	*Urban*
1998-99	0.51	6.92
1999-00	0.68	8.33
2000-01	0.93	10.16
2001-02	1.21	12.20
2002-03	1.49	14.32

Source: Answer to Rajya Sabha un-starred question 1723, dated 18/12.2003, Quoted in, NASSCOM and UNDP (2004).

[2] Telecom Regulatory Authority of India (2004: 5).

TABLE 4.2: State-wise teledensity

No	*States*	*Total Villages*	*PCOs 30.12.04*	*PCOs 30.11.04*	*Teledensity (31.12 04)*		
					Urban	Rural	Total
1	Andaman & Nicobar	201	198	1005	19.83	8.97	12.74
2	Andhra	29460	24827	208376	27.49	2.83	7.85
3	Assam	24685	21209	20331	16.49	0.60	2.13
4	Bihar	41077	38475	54114	14.75	0.52	2.01
5	Chattisgarh	19720	14665	8082	6.08	0.51	1.68
6	Gujrat	18125	15328	135066	27.30	2.65	12.06
7	Haryana	6850	6811	34905	27.26	2.68	10.16
8	Himachal Pradesh	16925	16587	9399	63.89	6.72	12.54
9	J & K	6764	4940	15299	16.40	0.71	4.72
10	Jharkhand	31703	26950	15102	8.48	0.47	2.28
11	Karnataka	27066	27066	210407	29.16	2.47	11.80
12	Kerala	1468	1468	85258	41.97	9.74	17.85
13	Madhya Pradesh	51806	38849	50864	16.09	0.65	4.83
14	Maharashtra	42467	34184	262320	24.52	2.44	9.50
15	North-East-I	7125	4335	4729	13.82	1.15	4.06
16	North-East II	7020	3496	4736	11.42	1.51	3.32
17	Orissa	46989	45753	30636	18.01	1.01	3,65
18	Punjab	12687	12687	44131	49.57	5.31	21.86
19	Rajasthan	39483	26873	64240	19.90	1.43	5.78
20	Tamil Nadu	17899	17899	154444	22.74	2.60	10.91
21	Uttaranchal	15610	11799	12321	17.22	1.60	5.72
22	Uttar Pradesh (E)	79792	76005	92048	16.54	0.49	3.88
23	Uttar Pradesh (W)	23604	21268	56319			
24	West Bengal	38337	37306	39285	13.89	1.00	2.78
25	India	607491	524606	2023923	25.90	1.69	8.59

Source: Department of Telecommunications (2005: 110, 112).

4.2 Internet Connectivity

In India, the Videsh Sanchar Nigam Limited (VSNL), the state-owned ISP started providing internet service to the public in August 1995. A rapid growth of the subscribers' base followed soon after the end of the state monopoly and the liberalisation of the ISP licensing regime in November 1998, allowing private companies to provide license fee

services. While there were only 140,000 subscribers in March 1998, it grew by 200 per cent per year between March 1999 and March 2001, amounting to 280,000 to 3,000,000. However, the subsequent growth rate of internet has been on the decline ever since. Presently, less than 10, 000 Indian villages have seen the presence of internet.[3] NASSCOM and UNDP (2004) show that India has about 3.5 million internet users as on 31 March 2003[4] Total international bandwidth availability currently stands at approximately 12 Gbps which includes 1.4 Gbps through satellite medium. International bandwidth through submarine cable available is in order of terabits per second and operators are having spare international bandwidth. Public ISPs Bharat Sanchar Nigam Limited (BSNL) and Mahanagar Telephone Nigam Ltd (MTNL) posses sufficient international bandwidth for internet service as they are able to upgrade the same as per the increase in demand of the customers. BSNL has the largest proportion of the optical fibre laid and lit in the country (approximately 412,000 lakh km) for backbone network as well as access network. While the company is providing bandwidth available on demand in most of the cities, it is poised to provide bandwidth on demand all over the country on completion of the 11 rings proposed in Sanchar Sagar project phase-III. In addition the private telcos such as Bharti, Reliance & Tata have laid approximately 86,000 route km of fibre network in the country.[5] Low internet penetration, however, poses relatively low bandwidth demand. Distribution of internet subscribers so far is concentrated in few cities and regions (Table 4.3).

Dial-up remains the most commonly used internet access method, although its use in businesses dropped to 54 per cent in March 2005 from 60 per cent in March 2004 while access through cable link increased from 16 per cent to 23 per cent during the same period, and that of DSL increased from two per cent to six per cent.[6] It is argued that the already existing optic fibre infrastructure of 670,000 km that has reached the *taluka* level can help in building data and voice infrastructure in a majority of the villages.[7] Both telecom and internet connectivity can ride over this unused infrastructure. Using VoIP, infokiosks allow villagers make telephone calls through the internet at lower prices. In addition, 30,000 Bharat Sanchar Nigam Limited (BSNL) exchanges located around the country can provide broadband connectivity to the infokiosks in surrounding villages with a data speed of 20 Gbps each.[8] Selection of appropriate internet access option primarily depends on the bandwidth requirement of the infokiosk or the network of infokiosks – which in turn depends on the services deliverable through the infokiosk. Email, text-heavy website download, chat, and similar text-based applications constitute infokiosk's core services, though rural communities have also registered a demand for audio and video applications.

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[3] OneWorld South Asia (2004: 1).

[4] NASSCOM and UNDP (2004: 23).

[5] Ministry of Communications and Information Technology (2004: 7-8).

[6] Department of Telecommunications (2005).

[7] *Ibid.* p. 1.

[8] OneWorld South Asia (2004: 30).

TABLE 4.3: Distribution of internet subscribers in states and union territories

No	State/ Union Territory	As on 1.3.2002	As on 31.3.2003
1	Andaman & Nicobar	703	1112
2	Arunachal Pradesh	380	1010
3	Andhra Pradesh	234571	219218
4	Assam	9899	14440
5	Bihar	11999	18895
6	Chandigarh	60228	38458
7	Chattisgarh	7827	9275
8	Goa	17494	19449
9	Gujrat	153515	195072
10	Haryana	12116	17015
11	Himachal Pradesh	3483	6410
12	Jammu & Kashmir	-	10235
13	Jharkhand	11386	14199
14	Karnataka	263020	259121
15	Kerala	109170	136458
16	Mizoram	743	959
17	Manipur	630	1026
18	Meghalaya	1455	5285
19	Madhya Pradesh	65307	89501
20	Maharashtra	770634	948264
21	Nagaland	452	2536
22	Orissa	17303	22343
23	Pondicherry	8984	14275
24	Punjab	69499	69938
25	Rajasthan	102588	121322
26	Tripura	816	1194
27	Tamil Nadu	331840	329624
28	Uttaranchal	10902	19801
29	Uttar Pradesh	96828	120006
30	Sikkim	928	965
31	West Bengal	132013	142663
32	Delhi	732962	650209
	Total	3239675	3500278

Source: NASSCOM and UNDP (2004: 23)

TABLE 4.4: Various options for connecting infokiosks to the internet

Backbone	*Access methods*	*Speed (Kbps)*	*Connection types*	*Comments*
Telephone	Dialup	56 Kbps	Runs over analogue telephone lines designed for voice, not data transmission	Limited, disruptive speed. Support text applications only.
	ISDN	128 Kbps	Digital connection over a conventional telephone line	Popular with urban cyber cafes, not used in infokiosks
	DSL	512 Kbps – 8 Mbps	Digital twisted pair (for broadband use) or POTS line for connecting to telephone exchange.	Broadband connection, suitable for running multimedia applications, e-learning. Unavailable in rural areas.
Satellite	VSAT	400 Kbps download	Modem is used to send upstream data requests, and a dish receives data from a satellite.	High latency, costly. Appropriate for remotely connected areas.
Cable	Cable modem	512 Kbps – 52 Mbps	Television coaxial cable connects Internet. It offers very high speed.	Infrastructure available only in cities
Optical fibre	Optical fibre	51.84 Mbps – 13.271 Gbps	Variety of connection types used.	Highly used in cities, limited use in rural areas.

Out of above-mentioned options, lack of DSL and cable modem infrastructure prevented their exploitation in ICT projects in rural areas. Connectivity options implemented for connecting to internet have so far shown mixed results. Wire linked terrestrial connections comprise access through traditional telephone line, secure leased line linked to telephone exchange. Radio frequency based wireless links can be established between the infokiosk or network of infokiosks and the internet point of presence. Lack of telecom infrastructure in the rural areas of developing economies, low investment and possibility of easy deployment has proven wireless internet connectivity more advantageous than the establishing of wireline links for connecting infokiosks. The evolution of wireless network standards, such as Wi-Fi, has created the possibility of connecting infokiosks to an internet backbone through wireless link. Best (2003) argues that Wi-Fi makes it possible for "small entrepreneurs to provide Internet and voice services within their own communities by purchasing inexpensive basic radio equipment and transmitting on unlicensed frequencies. Collections of these local operators, collaborating (and interconnecting) with larger internet and basic service operators, begin to weave together a patchwork of universal access where little or no telecommunications services existed before.

Each mini-telecommunications operator could provide services within its local community just by purchasing the basic radio equipment and transmitting on these unlicensed frequencies. The model is inexpensive, responsive to local needs and realities can grow organically and is fully scalable. In addition, most of these technologies enable broadband access. As the number of local providers increases, so does the overall capacity of the network. Each new operator increases the number of pathways between any two points."[9]

Jhunjhunwala (2004) *et al.* opine that 85 per cent of the villages can be instantly connected by creating wireless hotspots linked to internet backhaul created by optic fibre.[10] Recently, the Andhra Pradesh government has announced to deploy optical fibre-based broadband network for connecting every village within next two years. However, deploying such a network is not technologically and economically viable in most states. This will not, however, replace the need of wired networks; wireless networks are connected to a wired network for taking internet bandwidth to the last mile. Nevertheless, the use of wireless network as an internet delivery mechanism is a viable alternative – both technologically and economically – as increasing copper and digging costs will incur high capital investment for linking infokiosks through copper line that accounts for 80 per cent of investment for creating a telecom network.[11] Furthermore, extreme climate conditions, uneven terrain intersected by watery bodies make digging and laying data cables very expensive (See Table 4.5).

TABLE 4.5: Comparison between wired and wireless connectivity

Wire line connection	*Wireless connection*
Deployment of wired infrastructure costly	Initial deployment can be costly, though it is cost effective in log run
Top-down, supply-driven, enterprise-owned and less scalable, easily deployable	Bottom-up, demand-driven, community-owned and scalable,
Does not facilitate mobility	Offers high-degree of mobility
Prone to interference from radio signals and least signal loss	Susceptible to radio interference and signal loss
Damage due to natural hazards, but not easy to repair	Damage due to natural hazards, but easy to repair

Moreover, broadband wireless networks are capable of carrying high-bandwidth voice calls over their data pipe. Peer-to-peer web-based voice and messaging services - Yahoo!, MSN, NetMeeting etc. and low-cost prepaid VoIP services offered by Skype, Onlnstant show the potential of decreasing

[9] Best, Michael (2003: 107, 112).
[10] OneWorld South Asia (2004: 30); Mission 2007 (2004: 3).
[11] Tenet (2000: 7).

long distance telephony costs. Shakeel *et al.* (2001) show that for areas unconnected from telecommunication infrastructure and the power grid, stand alone internet connection through VSAT and alternative energy supply can be an affordable solution, if low cost low power consuming hardware and low cost VSAT connection can be provided to the infokiosk. Pilot projects experimenting with such stand-alone solutions have been successful in other developing economies.[12] According to the VSAT Services Association of India, at the end of December 2003, there were 11 VSAT service providers with 33,000 VSAT terminals in the country.[13] With the availability of cheaper and faster wireless network standards, VSAT connectivity and various other emerging technologies, providing internet connectivity to 600,000 villages becomes technologically feasible. In the following section, we review various connectivity options available for connecting infokiosks.

4.3 Connecting rural India to internet

At the end of June 2005, the total number of fixed lines in India stood at 47.70 million and mobile phone reached 57.38 million, marking the total telephony subscribers in the country to around 105.08 million. The current tele-density levels stand at 9.70 (TRAI, 2005).[14] Despite the phenomenal growth of telephony in rural India, connecting infokiosks through telephone lines is unreliable, as dial up connectivity produces slow bandwidth for the end users in rural areas.

4.3.1 Dial-up connection

A large number of infokiosks in rural India use dial up for connecting to internet. Dialup connectivity has been used in ICT for development projects of Gyandoot (Madhya Pradesh), rural e-Seva (Andhra Pradesh), TaraHAAT, Drishtee, e-Chaupal and Unesco's ICTPR etc. It gives a maximum of 57600 kbps using a standard modem. Speed, however, varies depending on the telephone line. Reliable modems that will not disconnect on encountering static in poor quality lines could be used. If there is only one phone line in the infokiosk, generally it is shared between the telephone, fax machine, and modem hooked to the computer. The sharing of a single phone connection requires scheduling of telephone usage and internet connection. It is ideal for infokiosks, which are providing telephony services to have a second telephone line attached to a modem for providing dedicated internet access

[12] Shakeel, Hani *et al.* (2001).
[13] Telecom Regulatory Authority of India (2004a).
[14] Telecom Regulatory Authority of India (2005).

to users. Infokiosk can be also connected using a dedicated leased phone line, also called a dedicated circuit linking the school to the phone company or Internet Service Provider's internet gateway. In such a connection, dialup modems are replaced by Channel Service Units/ Digital Service Units, a better adapter. Speeds vary from 56,000 bits per second (56 kb) to T1 (1.56 million bits per second), depending on the wireline and the data transfer method. The Integrated Services Digital Network (ISDN), for example, is built over conventional copper wire phone lines, enabling simultaneous data and voice access at a rate of 128 Kbps. High speed Digital Subscriber Line (DSL) runs on technology similar to ISDN, but the service is limited to urban areas only.

4.3.2 Cellular network

Connection through cellular network has grown exponentially in urban areas. Penetration of cellular phones in rural India has been very fast – as on November 30, 2004, total usage including WLL (460.5 lakh) has already overtaken the fixed line phones (445.1 lakh).[15] The recent reach of cellular networks in rural areas by tele-companies like BSNL in the public sector, and Reliance Infocomm and Tata Teleservices in the private sector in few rural areas enables rural citizens to connect to the internet through mobile phones. Reliance Infocomm's pan-India CDMA2000 1x network, for instance, allows internet access to the users through Reliance IndiaMobile, FWP and the R-Connect Card from PCs, laptops and other computing devices, with a maximum possible download speed of 144 kbps. In this process, Reliance India Mobile and the data function as wireless modem as well as a mobile phone. The third generation cellular service is capable of providing high-speed (144 kbps to 2 megabits per second) connections to mobile phone users.[16]

4.3.3 Internet access through satellite

Satellite-enabled internet connectivity is costly – hence few ICT pilots have so far experimented with this type of connectivity. The Information Village Research Project (IVRP) in Pondicherry, ITC e-Chaupal and Community Information Centre project in North-East examples of the few projects that have. In the last few years, technological developments and competition have brought down the prices of satellite internet connectivity dramatically. Very Small Aperture Terminal (VSAT) with antenna is used to communicate with the satellite. The Government of India's Broadband Policy 2004 allows VSAT operators to act as

[15] PIB (2004).

[16] Reliance Infocomm (2004).

ISPs, to provide internet services. According to the new Policy, licensees will be allowed to provide services based on VSAT and DTH, to transmit data up to 2Mbps, instead of an earlier limit of 512 kbps in a Closed User Group domestic VSAT network.[17]

4.3.4 Internet through wireless distribution network

Wired network uses physical cabling like optical and copper cable that establishes internet connection between local telephone exchange or PoP and infokiosk. However, the non-existence of wired network infrastructure in villages explains the need for using wireless networks. Extreme climate conditions, uneven terrain intersected by watery bodies make digging and laying data cables very expensive. Hence in India, out of six million villages, only about four million villages are equipped with only one or two telephone connections. One million villages have do not possess even a single telephone connection.[18] Wireless network is thus seen as the only viable option to connect India's six million plus villages. Wireless networks will create a network of internet-connected infokiosks within the 15- 20 km of the optic fibre node, covering as much as 85 per cent of the villages (Taskforce report on rural connectivity, p. 3). For the remaining 15 per cent villages, satellite connectivity is recommended as the alternative backhaul connectivity option. Wireless network technologies available in market include LANs in the Wi-Fi family, Wi-MAX, wireless in local loop based CorDECT WLL and wireless broadband services like LMDS and MMDS.

a. CorDECT WLL

CorDECT WLL is a fixed wireless access system that supports both the internet and telecom infrastructure building at the community and enterprise level, by facilitating the integration of both voice and data communication. It is argued that CorDECT WLL is a very cost-effective connectivity option that provides a simultaneous toll-quality voice service and internet access at a speed of 35 or 70 Kbps.[19] The system is based on the DECT standard specification from the European Telecommunication Standards Institute (ETSI). The collaboration among Midas Communications Technologies, Indian Institute of Technology, Madras and US based Analog Devices Inc. helped the development of this system.

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[17] Ministry of Communications and Information Technology (2004: 10).

[18] Department of Telecommioncations.

[19] Tenet (2000: 1-1).

In CorDECT WLL, the demand for telephone connectivity in rural India has also been addressed; besides allowing access to the internet. In this system, the data from the Customer Premises Equipment (CPE) flows to the PSTN gateway through several network equipments. The Wallset with Internet Port (WS-IP) is the standard CPE that helps the subscriber connect telephone, fax machine, speakerphone, cordless phone or even a modem. Through device allows the subscriber's computer to establish a dial-up internet connection at a speed of 35 or 70 Kbps. It can, however, support simultaneous voice and 35 Kbps internet connections. In the absence of mains electricity supply, WS-IP can run using its inbuilt battery and battery charger or optionally by a solar panel. Wallset is a similar device but without the internet port, giving subscribers only telephone connectivity. Multiwallset IP gives four telephones and one Ethernet connection for shared internet access.

The WS-IP makes a virtual or physical connection to the Compact Base Station (CBS), the radio interface between the WS-IP (or, WS or MWS-IP) and DECT Interface Unit (DIU). CBS' are equipped with antennae – either directional or omni-directional, depending upon the coverage area. The maximum LOS between a subscriber unit and a CBS is 10 km and it typically supports approximately 35 - 70 subscriber units. A Relay Base Station (RBS) is used to enhance the coverage area of CBS. The CBS connects to the Base Station Distributor (BSD) or a DIU, through physical cabling. BSD, a compact and locally powered device, interlinks CPE and DIU using physical or wireless media, when the distance between the devices is quite large. The DIU functions as a gateway switch between the subscribers' network and the PSTN. Finally, the iKON Remote Access Switch (RAS), commonly fitted within the DIU, terminates the PPP connections generated by the subscriber units and the requests for IP packets are then routed to the internet. To provide the last mile connectivity, the DIU along with the RAS is deployed nearer to the subscribers than the exchange. It is imperative to have LOS connection between the antenna of the CPE and CBS/ RBS for wireless data transmission. A typical CorDECT WLL system consists of one DIU with one or two RAS units, up to 20 CBS', and up to 1000 WS-IPs or WS.[20]

n-Logue, a private company, manages the overall network and also responsible for system deployment, partner liaison and promotion of its entrepreneurial business model. To provide internet and telephone connection through the system to the infokiosks, n-Logue has partnered with private ISPs like Satyam Infoway, which provide an average of 64 kbps internet connection while telephone connection is provided by various public and private telcos. N-Logue is also the sole supplier and marketer of all hardware and software for

[20] Tenet (2000: 15).

the system – through arrangements with respective manufacturers of various system components. The hardware specific suppliers are:

Midas Communications - CorDECT Technology
Banyan Networks - RAS
HCL – Branded PC

Infokiosks with WLL connectivity are also provided with a whole range of customised applications for running on the system. All kiosks provide access to common applications like web browsing, email, voice mail, video mail, chat and video chat. The applications, available in local languages, target the infokiosk users in villages:

Specifically designed by Tenet Group, computer education modules include online exercises and practice sessions, tests and additional lessons. Blue Book, a 6-day self-paced learning course designed for children 6-9 years old, introduces the computer to the children. Also available is Blue Plus, a course module running for twenty-six days that includes more details and practice sessions. For students aged 10-17 years, the Green Book module teaches the basics of internet browsing and e-mail use, and familiarises the student with applications such as CK Shakti, a local language office suite, in 10 days. Green Plus is yet another course for teaching the basics of the internet. Red Book, the all-inclusive computer education course running for 2 months focuses on teaching the intricacies of the CK Shakti office suite, and is meant for those aged seventeen and more, who are interested in enhancing their job skills or improving their businesses. A 10-month long Online Testing Tutorial is developed to impart English language teaching for ninth and tenth graders helping them to prepare for higher education exams.

iSee, jointly developed by TeNeT Group and Oops Pvt. Ltd, is a multiparty video conferencing software capable of running on low bandwidth networks with speed as low as 12 kbps. The application facilitates remote medical consultations, interactions between government officials and rural citizens. Apart from video-conferencing with doctors, rural people can use infokiosk's web camera for sending pictures for diagnosis and retrieve health information from portals in local languages like WebHealthCentre.com, specifically designed for n-Logue's kiosks. Partnerships with public health, agricultural and government have enabled n-Logue to develop domain specific services for the kiosk users. Tamil Nadu Agricultural College and Research Institute is such a partner which provide expert advice on better farming practices to local farmers through emails and video-conferencing. Infokiosk operators provide weather information, market prices and information on farming practices as well. In Karnataka, infokiosks allow access to the state Bhoomi land records.

b. Wi-Fi

Wi-Fi as a wireless LAN has long been been adopted in developed nations, especially in America and Europe.[21] WLANs implementing wi-fi, popularly known as wi-fi hotspots, offer seamless connection to desktops, notebook computers, portable devices like PDAs and other handheld devices. Originally developed for connecting devices within a radius of few hundred meters, wi-fi-enabled networks provide last mile connectivity in the rural areas. Wi-fi poses itself as an attractive technology solution for achieving universal connectivity in the developing countries, because it can act as the last mile distribution network using unlicensed spectrum bands. Experiments by Media Lab Asia with high gain antennas and radios have shown the possibility of connecting two remote nodes as long as 40 km apart.[22] Further, it is argued that wireless network technologies, particularly connectivity options within the Wi-Fi family, can provide solutions to the challenges of sustainability of community networking projects, by promoting grassroots and bottom-up entrepreneurial and innovative community infokiosks.[23]

The nomenclature Wi-Fi refers to a wide range of standards developed by the IEEE, an international organisation which develops standards on electrical and electronic technologies.[24] The standard's availability in the public domain has helped the creation of open source software and moreover indigenous development of hardware for network building, configuration, design and maintenance is possible.[25] Purbo observes that rural communities can deploy wi-fi hotspots - very small, demand-driven, scalable and bottom-up and operated by locally trained volunteers or entrepreneurs - without being dependent on the government for licenses, or the investors for the investment and telecom operators for network management.[26] Most popular wi-fi standards used for creating wireless rural infokiosk network are 802.11b and 802.11a; though the former is relatively cost-effective compared to the latter. In India, the Digital Gangetic Plain implements various Wi-Fi connection architecture – connecting infokiosks in Kanpur and Unnao district in Uttar Pradesh.

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[21] Wi-Fi stands for Wireless Fidelity. The term originally refers to the 802.11b standard. See, Woodside, Simon (2003).

[22] Business Line (2003).

[23] Prahalad, C.K. and A. Hammond (2002: 48).

[24] IEEE (802: 11).

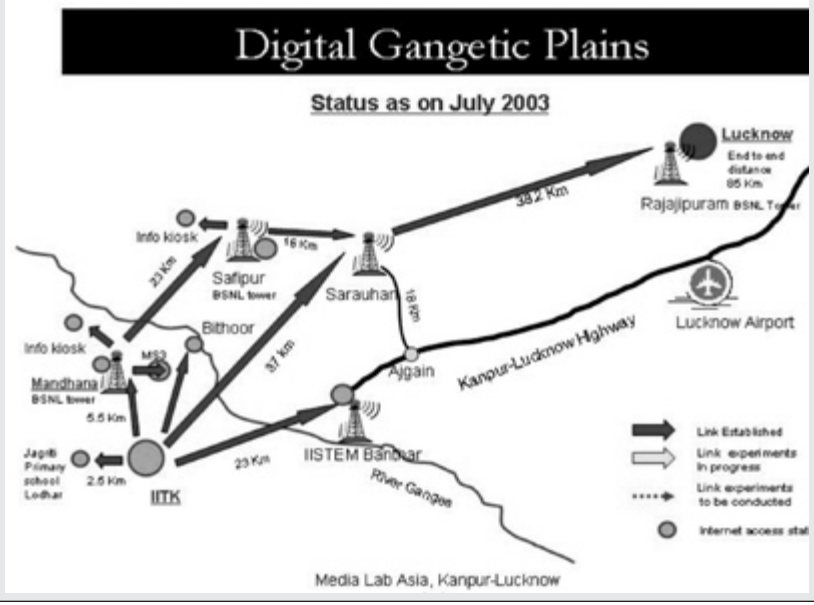
[25] Woodside, Simon (2003: 1).

[26] Purbo, Onno W.

4.4 Case study: Digital Gangetic Plains

Digital Gangetic Plain implements various Wi-Fi connection architectures – connecting infokiosks in Kanpur and Unnao district in Uttar Pradesh. The project is one of the world's first demonstrations of long-range Wi-Fi and it has been successful in establishing a multi-hopping link over 80 km. Until July 2004, a total of eleven nodes had been connected to the IIT Kanpur hub. The longest single-hop node that has been established so far connects Sarahun and Lucknow, within a distant of 38 km, and 75 km by multi-hopping. We illustrate the Wi-Fi enabled rural infokiosk network using the DGP model, which consists of, the hub at IIT Kanpur connected to the internet backbone; hub broadcast data packets using access points through antennae; nodes that receive the data packets using bridges through antennae; and mobile access points that hook onto the node's internet pool.

The nodes (infokiosks) established in about nine locations are connected to the IIT Kanpur hub, which is connected to a 512 Kbps internet data pipe, fed through the internet leased line of IIT. At the hub, a transceiver (or transmitter and receiver) called access point, supports several nodes to receive, buffer and transmit data between the WLAN and internet PoP at IIT. To broadcast data signals through wireless medium, antennae are mounted at the top of the multi-storied Faculty Building. Directional parabolic grid antennae (2.4 GHz 24 dBi directional parabolic grid antenna of HyperLink Technologies) are used to transmit the signals towards respective receiving nodes. All the links between IIT and nodes are point-to-point connections.



The access point (Cisco Aironet 350 AP) can support data rates of 1, 2, 5.5 and maximum of 11 mbps operating in 2.4 – 2.4853 GHz. For connecting various network devices, low loss coaxial cable is used to minimise signal loss. The node at Bithur, located at an aerial distance of 12 km, establishes a direct point-to-point link with the hub at IIT as an antenna, similar to that of IIT, mounted atop the two-storied Fab Lab building, receives the data to transmit it to transceiver for decoding. In Bithur, a bridge (Cisco Wireless 350), capable of data transmission between two networks up to 40 km apart, acts as the transceiver. Data decoded by the bridge provide internet bandwidth to the computers at the Fab Lab in Bithoor and also to 'Infothela,' a roaming public internet access point.

Infothela is a manually driven cart, fitted with a computer, printer, scanner, batteries, and network devices. A digital camera, webcam and microphone are also given for these mobile units. It roams among the local communities of Bithoor, raising awareness about computer and internet among local inhabitants, especially the youth. Infothela can connect to internet while roaming within the radius of few hundred meters of Fab Lab. For mobile devices, like 'infothela', network interface cards (Notebook computers use the PCMCIA cards and ISA or PCI is used in desktops or fully integrated devices within handheld devices) act as a transceiver to establish internet link using small pigtail rubber duck antennae. This is an example of point-to-multi-point communication method, allowing a number of remote clients – mobile and stationery – to hook into the hub's internet facility. For long distance Wi-Fi links, line-of-sight links between high-gain antennae mounted on a height sufficient to avoid signal distorting elements like vegetation, buildings or similar objects are set up. The DGP uses BSNL's radio towers to set up antennae.

In addition to the internet based data service, the network is customised to offer telephone services as well. The Public Call Office set up in Sarahuan offer local villagers make and receive calls anytime anywhere. The DGP uses H.323 protocol for Voice over IP (VoIP) telephony defined by the ITU – T Study Group 16. This protocol defines standards, procedures and components for communications over packet-based network. The DGP demonstrates that it is possible to create mini wireless internet hotspots in villages using Wi-Fi. With faster and cheaper versions of Wi-Fi arriving in the market place, the possibility of equipping existing infrastructure with a variety of access devices or upgrading to faster data network has emerged. Using and maintaining Wi-Fi equipment is easy, even high school graduated students with training can troubleshoot any difficulties. One of the prime advantages of Wi-Fi is that it allows the network builder to choose from a wide range of hardware and software products.

c. Fixed broadband wireless access

Fixed wireless has become popular recently as it is capable of offering broadband data transfer facility. Though the data transfer happens in a wireless mode, the access method is called 'fixed wireless' because it refers to wireless communication between two or more office buildings. Though the term 'fixed wireless' is a new one, the technology is used for several years. In general, specific frequencies are allocated for a given user – the frequency may range from 900 MHz to 40 GHz.

Local multipoint distribution service (LMDS) as a fixed broadband wireless access system provides high-speed internet access, real-time audio-video download facility, video conferencing, interactive video and VoIP. The data transfer rate LMDS can support ranges from 51 to 155 mbps downstream and 1.54 mbps upstream over a distance of up to about 8 km. Though LMDS transmitter sends signals in a point-to-multipoint fashion, the signals are transmitted back point-to-point. LMDS operates in the high frequency range but low-powered wave range in a very short distance. LMDS architecture resembles that of the Wi-Fi network – it propagates radio signals emanated by the transmitter through the antenna located at the hub towards the LoS receiver antenna at the node. The system can employ either TDMA or FDMA as the access methods and QPSK or QAM is used as the modulation technique.

MMDS uses a somewhat similar technology to what LMDS implements; but it transfers data at a greater distance of up to 56 km. Originally, MMDS was being used for television broadcasting through wireless medium. Later improvements have made MMDS a robust wireless access method, as the wireless substitute of cable modem and DSL connection, capable of providing high-speed internet access along with real-time multimedia streaming. MMDS opens up the possibility of creating rural broadband wireless networks with a connection speed of 1.5 mbps upstream and 300 kbps downstream. It transmits in the 2.1 GHz and 2.5 GHz through 2.7 GHz frequency range. The MMDS infrastructure consists of its hub generally located at a high point and radio signal is transmitted from the hub in a point-to-multipoint fashion. At the node side, a directional antenna, sometimes referred to as a pizza box antenna, because of its very appearance, is focused line-of-sight facing the beaming antenna at the hub. Computers at the node receive the signal via the MMDS wireless model that is connected to the antenna by a cable.

d. Wi-MAX

Wi-MAX is called for products that conform to the IEEE 802.16 standards. This point-to-multipoint broadband wireless access, Wi-MAX Wi-MAX is faster and has a longer range than Wi-Fi. It does not necessarily conflict with

Wi-Fi, but is designed to interoperate with it and may indeed complement it; and provide a wireless extension to cable and DSL for last mile broadband access. The range that Wi-MAX covers is up to 50 km of linear service area range and allows users connectivity without a direct line of sight to a base station. Wi-MAX seems to be a very promising connectivity option as it is still in the development process.

e. Cable connection

The Broadband Policy 2004 recognises the need to revamp cable TV industry for providing last mile infrastructure as it reaches more people than even the telephone copper infrastructure.

Selection of appropriate wireless connectivity option is largely guided by bandwidth demand of the rural communities and geo-physical environment. A technology-needs assessment, preceded by the community information needs assessment will reveal the service requirements of the community and appropriate delivery mechanisms through the wireless networks. The need to further assess the relative advantages and disadvantages of a given connectivity option for a particular rural community is emphasised. We have identified several parameters to compare these access options. Cost is, however, a key factor before making capital investment in technology for the rural communities in India, though it can not be said to be a purely technological parameter – but the cost of devices can be amounted to technological features and manufacturing costs.

Since wireless networks operate in a limited range of frequency, most of the networks can carry an optimum amount of data and/or voice traffic. CorDECT WLL has limited scalability in increasing bandwidth, compared to Wi-Fi based systems. Both the systems, however, can support current population base in Indian villages. Because of its limited frequency allocation and channel utilisation, 802.11b based Wi-Fi networks can support only a very limited number of subscribers – an 802.11b access point supports about 15-20 nodes simultaneously on a sharing basis.[27] A typical CorDECT WLL system consisting one DIU with one or two RAS units, up to 20 CBS' can support 1000 users simultaneously.[28] LMDS/MMDS can support 16,000 telephone calls, 200 video channels and a large subscriber base simultaneously. CorDECT WLL base system requires more capital investment for deployment than the Wi-Fi based system. Both the systems require line of sight and point-to-point links for better data transfer (Table 4.6).

[27] Wi-Fi Alliance.

[28] Tenet (2004: 15).

TABLE 4.6: Comparison of connectivity Options

Connectivity options	*Application (pt-to-pt; Pt-to-multipt)*	*Frequency Band*	*Bandwidth (through-put) link rate*	*Availability in market*	*Range*	*Comments*	*Implementation In rural infokiosks*
Dial-up	Telephone line based connection local exchange	NA	Average 10 Kbps	Available	Usually 8-10 km	Outdated and un-reliable option for infokiosks	Gyandoot, TARA-haat etc.
VSAT			64 Kbps – 2 Mbps	Available			
802.11b	WLAN (Wi-Fi)	2.4 GHz	5.5 - upto 11 Mbps	Variety of HW/SW avail-able at vaious prices	100 – 200 M pt-to-multipt, 20 km pt-to-pt possible	Most popular in Wi-Fi family, reduced data rates at long range, relatively inefficient spectrum use	Most used for connecting village infokiosks, Digital Ganjetic Plane
802.11g	WLAN	2.4 GHz	22 – 54 Mbps	Available	-	Evolution of 802.11b, faster stan-dard in 2.4 GHz	Not implemented
802.11a	WLAN	5 GHz	6 – 54 Mbps	Available	30m Pt-to-multipt	Products released late 2000, costlier, less energy efficient than .11b	Not implemented
802.16a	WiMAN (Wi-MAX)	2-11 GHz	70 Mbps	Products being tested, should be available soon	Typical 7 km 30- 50 Km possible	Fixed broadband wireless access, Long distance wireless backhaul for connecting infokiosks	Not implemented

Connectivity options	*Application (pt-to-pt; Pt-to-multipt)*	*Frequency Band*	*Bandwidth (through-put) link rate*	*Availability in market*	*Range*	*Comments*	*Implementation In rural infokiosks*
802.16b	Wi-MAN	5 - 6 GHz			Typical 7 km 30- 50 Km possible	Allows mesh net-working,	Not implemented
CorDECT WLL	Wireless local loop,	1880 – 1935 MHz	32 Kbps ADPCM & Internet at 35/70 Kbps	HW/SW marketed by N-Logue, supplied by several companies	10 Km, 25 Km possible with repeaters	Specifically designed for rural areas in developing countries, thin datapipe doesn't allow greater speed, not interoperable with similar networks	Various states in North and South India

4.5 Infokiosk hardware and software

Infokiosks are equipped with connectivity, telecom services, local area network, audio-video, laminator, photocopier and binding systems hardware. Applications software infokiosks install for running most of the services consist of applications on education and training, call accounting system, internet/web, computer use management system and other common office applications. For an infokiosk, a computing device is a prerequisite and despite the continuing decrease in price, computers are beyond the reach of a majority of the village communities.[29] Indigenous developments, like the Simputer, show some promise in bringing down the cost of the devices. The Simputer (Simple Computer) is a low-cost, portable alternative to personal computers, with simple and natural, user-friendly interfaces based on sight, touch and audio. Simputer is available on a wide price range starting from Rs. 10,000 with a variety of integrated applications.[30]

4.5.1 Software and applications

One of the world's largest software producers and exporters, India has developed a variety of software applications – open source and proprietary – that can meet the software needs of a village infokiosk. Recent breakthroughs in language technologies research by various public, private and civil society institutions depict a promising scenario for the creation of localised content. A text editor and spell checker integrated with OCR software, an application for digitising content by scanning of print texts, is being developed by STQC for digitising the content available in major Indian languages like Devanagari (Hindi and Marathi), Bangla, Telugu, Malayalam, Gurmukhi and Tamil.[31] This application will help in digitising print content easily to build web-based digital libraries.

The Resource Centre for Indian Language in Hindi and Nepali Language of IIT Kanpur has developed the Machine Aided Translation System (MAT) to automatise English to Hindi translation. Available in the public domain (at http://anglahindi.iitk.ac.in), the system is being beta tested for the translation of complex sentences in English to Hindi as well.[32] The development of machine translation facility in other Indian languages is underway. The NCST has developed a localised LINUX called INDIX, capable of supporting six languages – Hindi, Sanskrit, Marathi, Kannada, Tamil and Malayalam. INDIX and Open Type Fonts are freely available in public domain for downloading and further modifying. The Ministry of Communication and Information Technology's TDIL portal is

[29] Ministry of Communications and Information Technology (2004: 14).
[30] See, Simputer website at http://www.simputer.org.
[31] Ministry of Communications and Information Technology. (2004: 28).
[32] See, http://anglahindi.iitk.ac.in.

a gateway of news and information on research, innovation and development of Indic language tools being carried out under the auspices of the Government of India.[33]

Localised FOSS development and advocacy by local and national free software groups have created awareness of FOSS applications, as an alternative to proprietary software, among the public. The government, UN agencies, civil society organisations have formed a partnership for the development of appropriate software tools that facilitate multimedia content creation and knowledge exchange through infokiosks at the grassroots. One such example is eNRICH, developed jointly by the National Informatics Centre and UNESCO. According to UNESCO, eNRICH is a "fully customisable knowledge management solution for communities to find their way around the maze of information and knowledge resources, and to voice community issues and create relevant content of their own. It enables communities to quickly and easily build their own gateway to the web and other multimedia resources- tailored to meet specific local needs due to its local content and availability in local languages. Being a "ready-to-use" tool, it reduces the challenges faced by many communities in using new ICTs. It is simple, consistent and adaptable and works in local languages and in multiple media. In short, by providing "easy access" to relevant information resources, it allows local communities to effectively expand and manage their knowledge." An improved and open source version of eNRICH, openeNRICH, is being developed jointly by National Informatics Centre, OneWorld South Asia and UNESCO. However, rural infokiosks are yet to be equipped with necessary documentation, training and appropriate technology platform for running such enabling applications contributing directly towards poverty alleviation efforts through knowledge sharing.

4.6 Energy solutions for infokiosks

Lack of reliable and universal electric supply in most of the Indian villages is a major barrier in scaling-up of the infokiosks. On an average, most of the villages receive only a few hours of electricity in a day. As of 31st March 2004, 4.9 lakh villages have been electrified.[34] A recent NSSO survey shows that in 2002, more than three-fourth of villages (77.6 per cent) have access to electricity, while about 12 per cent of villages have access to some forms of non-conventional sources of energy.[35] It also shows the level of inter-state disparity in rural areas – at least five states have much lower access to electricity compared to the all-India average – Assam (55.4 per cent); Bihar (51.8 per cent); Orissa (50.7 per cent); Arunachal

[33] See, TDIL website at http://www.tdil.mit.gov.in

[34] Ministry of Finance (2005: 179).

[35] Ministry of Statistic and Programme Implementation (2003).

Pradesh (41.3 per cent) and Jharkhand (24.0 per cent). As a whole, the region of East India suffers from a shortage of electricity.[36] Despite the increased productivity of the power sector and almost the tripling of gross per capita power consumption in the last two decades, an improvement in the power supply of remote and rural areas is required urgently.[37] The National Electricity Policy of 2004 has set an objective of providing electricity to all households in the next five years and ensuring that the entire demand of power supply is met by 2012. A recent NSSO survey shows that non-conventional sources of energy – like biogas, solar energy, wind energy and combinations of these technologies - have been a major source of rural electricity supply. Out of these, hydel and wind power generation have emerged as the major large-scale renewable and environment-friendly sources of energy.[38] The same survey shows that out of every 1000 villages, 117 villages harness power supply from some forms of non-conventional energy sources like bio-gas and solar energy.[39] However, the availability of non-conventional energy resources varies from state to state – such energy is available in 100 per cent of villages in Lakshadweep, 44.8 per cent of Chandigarh's, 21-29 per cent in the states of Goa, Kerala, Maharashtra and Madhya Pradesh. Wind energy sources are widely used in Mizoram, solar energy in Punjab, Lakshwadeep, Nagaland, Meghalaya and Tripura; and biogas in practically all states. Out of 81, 660 non-electrified villages, almost 50 per cent belong to two states – Bihar and Uttar Pradesh. The electrification of around 18,000 villages through conventional means is difficult due to the extreme terrain.[40]

The small and medium sized entrepreneurs (SMEs) in rural India utilise gasoline-fuelled power generators or renewable energy sources as alternatives to the grid power supply. We review here some of the most popular renewable energy solutions that can be exploited for powering the infokiosks equipments. An alternative power supply system for infokiosks will comprise a power generator, batteries as power reservoir and battery charger (or UPS). Power generator for this back-up power system can be petrol or diesel run generator, solar panel, wind turbine, mini hydel turbine etc. An alternative fossil-fuelled power system for the network will comprise a generator, a battery charge controller, a bank of batteries, an inverter, safety disconnects, fuses, a grounding circuit, supporting structures, and wiring. Apart from the generator, three other components – inverter, batteries and charge controllers – will generally require high maintenance and investment costs. Nevertheless, usually if a generator is used, these additional components are not required and a medium capacity generator can run all the equipments in a hub or node.

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[36] *Ibid*, p. 20.
[37] ITU (2004: 14).
[38] Ministry of Finance. (2005: 179).
[39] *Ibid*, p. 23.
[40] ITU (2004: 14)

Batteries are required for most off-grid energy solutions, since these store power and supply to the network uninterruptedly. There are two types of batteries commonly used – lead acid batteries and nickel cadmium batteries. Lead acid batteries are mostly used in the automobile sector. It is available locally in Indian rural areas as well. Nickel cadmium batteries, on the other hand, are for household use. For implementing solar or wind based energy supply, larger 'wet' NiCad are ideal as they require little maintenance and are fully dischargeable.[41] To charge batteries, any source of power supply – AC mains, generator, photovoltaic cells, or other non-conventional energy sources – can be used. On an average, batteries have normal life of 4-8 years. Maintenance of batteries in rural Indian villages is difficult.[42] Inverters are required to convert DC current to AC required in most of the network equipments including computers. Few alternative measures of power supply to the rural wireless networks are described below:

Solar power: Photo-voltaic (PV) cells are used to produce direct current (DC) by converting solar energy radiation. A solar panel consisting of several PV cells connected together can produce electricity ranging from few watts to several thousand watts. Typically, a 0.5 sq. meter of PV panel produces about 75 watts of electricity in good sunlight. The longevity of the average solar panel is 20 – 30 years. Installation of the solar panel seems viable power supply solution for low consumption. In IVRP, normally one or two computers are run on solar power, in the absence of mains power supply. The main drawback of a solar panel is that it requires favourable sunlight and temperature for functioning well. In the rainy season, which lasts for three to four months at least in East and North-Eastern India, the output from PV panels remains low. In India, many companies provide solar energy solutions. The research and development in solar energy systems, however, is continuously improving the system. Solar generators, as marketed by Bangalore-based Karnataka Renewable Energy Development Ltd, provide an output of 150 w to 600 w of power. A solar generator in the capacity of 450 – 600 w can run a computer connected to a network. It costs approximately Rs. 1,80,000 As the cost of photovoltaic panels drop with the constant improvement of technology, solar energy solution has some advantages: electricity from solar panel can be fed into the system directly without storing it; it can be used for any purpose – from running pumps to heating water, not necessarily to run the infokiosks equipments.[43]

Wind energy: Using wind turbines, it is possible to tap the kinetic energy of wind to produce electricity. Since it depends on a highly volatile flow of wind, the

[41] Kassiri, Omid K (2003: 74).
[42] Asia-Pacific Telecommunity.
[43] *Ibid*, p 70.

generation of electricity is similarly much floatable. Wind energy systems do not require frequent maintenance, but it is difficult to procure locally trained manpower for maintenance work. Wind energy solutions can be considered especially for hilly areas where wind velocity is relatively high, extending electric grid is extremely difficult. Stand-alone wind turbines can be installed in hubs and nodes. A tiny roof top wind power generator can charge a 12 or 24 V battery to generate 750 or 1500 watt of power supply. Such generator can produce 65 kwh of electricity per month in an average wind speed of 19.3 km per hour.

Micro-hydro power: Rotating turbines installed in flowing water can generate electricity in various ranges. Micro-hydro power systems can produce power ranging from 1 kw to 100 kw. Power generation using a low-cost micro-hydro power system for community wireless networks depend essentially on the availability of water. This system does not necessitate the building of a dam or a reservoir of water. A major disadvantage of such a system is that it stops generating electricity as soon as the river dries up. Except for the initial capital investment, mini-hydro power systems are almost maintenance-free and they fulfil the modest power requirements of communities. The rural hamlets belonging to Himalayan states can potentially harness power from wind or hydropower. The use of wind energy as mentioned above is prevalent in the hilly states of Mizoram. Many rural communities in the Himalayan regions have already successfully installed micro-hydro plants in the streams flowing nearby. In the absence of an electricity grid, the usefulness of such systems in electrifying community wireless networks shall be explored and tested.

4.7 Conclusion

The technology platform of rural infokiosks includes a vast array of hardware and software tools and applications. Until now, a majority of such products have been merchandised by the multinational corporations or domestic companies, and have been developed keeping in mind the needs of global business and customers. As such, technology development that suits rural environment is yet to take place. It is widely recognised that the technology platform in infokiosks needs to be adaptive to the community needs.[44] Backbone connectivity infrastructure laid by private and public sectors like BSNL, Railways, Power Grid Corporation, GAIL, Tata Teleservices, Reliance etc. shall be leveraged for providing internet connectivity to rural infokiosks. It is suggested that appropriate connectivity options be explored from a wide range of options including Wi-Fi, Wi-MAX, VSAT, WLL (CDMA, CorDECT), VSAT and numerous other emerging options, taking into account community needs. Connectivity option adopted should be capable of providing adequate bandwidth, convergence of technology for voice, data and video and provision for interoperability with similar other networks, allowing

[44] Bridges.org.

other applications to plug in to the infokiosks network and upgrading the network easily to higher bandwidth and newer applications. As rural areas will continue to face problems of unreliable power supply, the use of non-conventional sources of energy for infokiosks should be encouraged. While technology transfer and sharing of best practices will help in promoting the usage of alternative sources of energy, a concerted effort of government, academic and research institutions and the private sector dealing with non-conventional sources of energy would be required.

Reform in telecom and internet services can boost competitiveness resulting in the reduction of access charges. Low cost, rugged, indigenous hardware shall be designed for rural infokiosks. Capacity building of the local technicians engaged in operating, maintenance and fault repairing of the infokiosk hardware needs to be undertaken. For importing hardwares for rural infokiosks, levies and duties are to be rationalised. For allowing growth of wireless networks as a last mile connectivity option, frequency spectrum policy should be promotional in nature, revenue considerations playing a secondary role. Pricing and allocation should ensure that available spectrum is utilised optimally. Operators can sell out unused spectrum band to third party. Significant chunk of available spectrum is being used by defence, police and para military forces. A concrete action plan needs to be put in place to upgrade and modernise the technology being used by these forces to ensure efficient and optimal utilisation of spectrum and release the surplus resource available for use by civilian purposes. Necessary funds would have to be made available for this purpose. Spectrum pricing also needs to ensure the introduction and promotion of spectrum efficient technology.

The Universal Service Obligation Fund mechanism shall accommodate the option for financing the infokiosk roll out, especially in areas where such initiatives are not revenue generating. Government shall seek to encourage the setting up of infokiosks through other means as well. These include waiver of license fee in full for the RSP; allocation of spectrum frequency free of charge; waiver of service tax from the rural subscribers; income tax benefits on investments made in rural areas, or for companies which provide a predominant part of their services in rural areas.

An open and transparent franchise policy for the rural areas is to be developed to enable the franchisee to provide telecom facilities on revenue sharing basis. As the majority of Indian population – as much as 72 per cent - lives in rural areas, it is imperative that the developmental focus be towards improving the quality of life of the rural population. The focus towards rural development in India has almost been historical, and soon after independence, the Indian government has articulated intervention strategies in rural sector development, as evident from the Planning Commission's Five Year Plans, operational since 1952, besides other policies and programmes developed by various central and state government agencies. Development practitioners have since long documented the

positive impacts of communication tools in development projects. Development communication exploits a wide variety of media – both traditional and modern. Traditional communication through oral and dramatic performances, print media and broadcasting has helped development agencies in educating rural citizens on social issues. The emergence of new information and communications technology, however, has unfolded unprecedented opportunities for development agencies and rural citizens alike to participate in and contribute towards the poverty alleviation efforts in rural contexts.

5

Bibliography

Akshaya. Website. Online: http://www.akshaya.net/ [Accessed on 26.08.04].

Alkire, Sabina (2002). Valuing freedoms: Sen's capability approach and poverty reduction. New Delhi: Oxford University Press.

All India Radio. Website. Online: http://allindiaradio.org/about1.html [Accessed on 26.08.04].

Allardt, E (1993). 'Having, loving, being: An alternative to the Swiss model of welfare research'. In, Nussbaum, Martha and Amartya Sen (1993: 88-94).

Anand, Sudhir and Amartya Sen (1994). Sustainable human development: Concepts and priorities. HDR Background Paper. Online: http://hdr.undp.org/ [Accessed on 08.09.04].

Andrews, Frank M. and Stephen B. Withey (1976). Social indicators of well-being: Americans' perceptions of life quality. New York: Plenum Press.

Annamalai, Kuttayan and Sachin Rao (2003). ITC's e-Chaupal and profitable rural transformation: Web-based information and procurement tools for Indian farmers. *What works case study*. Michigan Business School and Kenan-Flagler Business School. Online: http://www.digitaldividend.org/pdf/echoupal_case.pdf [Accessed on 26.08.04].

Antweiler, C. (1998). Local knowledge and local knowing: An anthropological analysis of contested 'cultural products' in the context of development. *Anthropos* 93: 469-494.

Argyle, Michael and Maryanne Martin (1991). 'The psychological causes of happiness'. In, Argyle, Michael; F. Strack and N. Schwartz (1991). *Subjective well-being: An interdisciplinary perspective*. Oxford: Pergamon Press.

Asia-Pacific Telecommunity. APT Study Question 3.3. Rural wireless communications strategies for developing countries rural communications in India: Technology options. Online: http://www.itu.int/ITU-D/pdf/fg7/apt004.doc [Accessed on 08.09.05].

Association of College and Research Libraries (2000). Information literacy, competency standards for higher education. Chicago: American Library Association.

Audience Research Unit (1996). All India Radio 1995: Facts and figures. New Delhi: AIR.

Azim Premji Foundation. Website. Online: http://www.azimpremjifoundation.org/ [Accessed on 26.08.04].

Bandeira, Nuno and Lars Poulsen. Broadband wireless network overcomes line-of-sight (LOS) constraints and lowers deployment cost. Online: http://www.wi-lan.com/library/VIPwhitepaper.pdf [Accessed on 12.10.04].

Basu, Ashok (2005). Power sector reform: A watershed legislation. In. *The Hindu survey of Indian industry* 2005. Chennai: The Hindu.

Bates, A W (2001). National strategies for e-learning in post-secondary education and training. Paris: International Institute for Education and Planning.

Best, Michael (2003). "The wireless revolution and universal access". In, *Trends in Telecommunications Reform*. Geneva: International Telecommunication Union.

Bhagwat, Pravin (2004). Digital Gangetic Plains (DGP): 802.11-based low-cost networking for rural areas 2001-2004: A report. Kanpur: IIT. Online: http://www.cse.iitk.ac.in/~bhaskar/papers/dgp-report.pdf [Accessed on 12.10.04].

Bhatnagar, Subhash (2000). Information and communication technology in development: Cases from India. New Delhi: Sage.

Björn-Sören Gigler (2004). Including the Excluded- Can ICTs empower poor communities? Towards an alternative evaluation framework based on the capability approach. Paper for 4th International Conference on the Capability Approach 5-7 September, 2004 University of Pavia, Italy. Online: http://www.unipv.it/deontica/ca2004/papers/gigler.pdf [Accessed on 08.09.04].

Blurton, C. (1999). "New Directions of ICT-Use in Education" In, *World Communication and Information Report1999*. Paris: UNESCO. Online: http://www.unesco.org/education/educprog/lwf/dl/edict.pdf [Accessed on 12.10.04].

Braybrooke, David (1987). Meting needs. Princeton: Princeton University Press.

Brentano, Franz (1973). Psychology from an empirical standpoint, *trans*. Antos C. Rancurello, D. B. Terrel, and Linda McAlister. New York: Humanities Press.

Bridges.org. The real acess/ real impact framework for improving the way that ICT is used in development. Online: http://www.bridges.org/real_access [Accessed on 12.10.04].

Brundtland, G. ed. (1987). Our common future: The World Commission on Environment and Development. Oxford: Oxford University Press.

Business Line (2003). Kanpur-Lucknow wireless corridor — Media Lab rural thrust paying off. *March 18, 2003*. Online: http://www.blonnet.com/2003/03/18/stories/2003031802280700.htm [Accessed on 26.08.04].

Businessworld (2005). The Marketing whitebook 2005. New Delhi: Business World.

Carl, Dahlman and Anuja Utz (2005). India and the knowledge economy: Leveraging Strengths and opportunities. Washington, D.C.: World Bank.

Carson, Rachel (1962). Silent spring. Boston: Houghton Mifflin.

Castells, Manuel (1999). Information technology, globalization and social development. Discussion Paper No. 114. Geneva: UNRISD.

Cecchini, Simone and Monica Raina (2002). Warana: The case of an Indian rural community adopting ICT. In, Information Technology in Developing Countries. Online: http://www.iimahd.ernet.in/egov/ifip/apr2002/article3.12,1.htm [Accessed on 26.08.04].

Cecchini, Simone and Scott,Christopher (2003). Can information and communications technology applications contribute to poverty reduction? Lessons from rural India. Online: http://www.developmentgateway.org/download/181634/cecchini_scott_ICT.pdf [Accessed on 26.08.04].

Chambers, Robert (1995). 'Poverty and livelihoods: Whose reality counts?' *IDS Discussion Paper 347*.

Chowdhury, N. (2000) 'Information and communications technologies and IFPRI's mandate: A conceptual framework.' Sept. 18, 2000. http://www.ifpri.org/divs/cd/dp/ictdp01.pdf [Accessed on 26.08.04].

Clarke, Matthew (2003). e-Development: Development and the new economy. Helskinki: United Nations University, World Institute for Development Economics Research. *Policy Brief no. 7*.

Craig W.J., T.M. Harris and D. Weiner, eds. (2002). Community participation and geographic information systems. London: Taylor & Francis.

Cummins, Robert A. (1996). 'The domains of life satisfaction: An attempt to order chaos'. *Social Indicators Research*. 38/3: 303-28.

Datta, S. K. and Gurdev Singh (1998). "Relevance and sustainability of co-operatives in the current economic scenario." In, Sanjeev Chopra, ed. Co-operatives: Policy issues for the SAARC region. Dehra Dun: Book World.

Davitt, T. E. (1968). 'The basic values in law: A study of ethico-legal implications of psychology and anthropology'. *Transactions of the American Philosophical Society.* 58/5.

Department of Information Technology (2003). India: E-readiness assessment report 2003: for states/ union territories and central ministries/ departments. New Delhi: Department of Information Technology. Online: http://www.mit.gov.in/ereadiness/2003/CHAPTER2_15-31.PDF [Accessed on08.09.04].

Department of Information Technology (2004). Guidelines for technical and financial support for establishment of state wide area network (SWAN). New Delhi: Department of Information Technology. Online: http://www.mit.gov.in/policyguidelinesforSWAN.pdf [Accessed on08.09.05].

Department of Telecommunication (2005). Annual report 2004 – 05. New Delhi: the Department, Online: http://www.dot.gov.in/annualreport/english.pdf [Accessed on 31.10.06].

Department of Telecommunications, Ministry of Communications & Information Technology (2004). Annual report 2003 – 04.

Diener, Ed., Suh, E. M., Lucas, R. E., and Smith, H. E. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin*, 125, 276-302.

Digital Dividend. Website. Online: http://www.digitaldividend.org [Accessed on 26.08.04].

Digital Gangetic Plane. Website. Online: http://www.iitk.ac.in/mladgp/ [Accessed on 26.08.04].

Digital Opportunity Channel (2005). Chidambaram prioritises building infrastructure for pro-poor growth. Online: http://www.digitalopportunity.org/article/view/103929/1 [Accessed on 31.01.06].

Doordarshan (2005). About Doordarshan. Online: http://www.ddindia.gov.in/ [Accessed on 31.01.06].

Doyal, Len and Ian Gough (1993). A theory of human need. Basingstoke: Macmillan.

Drew, E. and F. G. Foster, Eds. (1994). Information technology in selected countries. Tokyo: United Nations University Press. Online: http://www.unu.edu/unupress/unupbooks/uu19ie/uu19ie00.htm [Accessed on 08.09.04].

Dreze, Jean and Amartya Sen (1995). India: Economic development and social opportunity. Delhi: Oxford University Press.

Dreze, Jean and Amartya Sen (2002). India: Development and participation. New Delhi: Oxford University Press.

Drishtee. Website. Online: http://www.drishteefoundation.org/about.htm [Accessed on 31.01.06].

Duncombe R. and R. Heeks (1999) 'Information, ICTs and small enterprise: Findings from Botswana', *IDPM Manchester Working Paper No. 7*. Manchester: IDPM.

Economic Commission for Africa (1999). An overview of ICT trends and policy in Afica. Addin Ababa: UNECA. Online: http://www.un.org/Depts/ece.ad [Accessed on 15.06.05].

Ehrlich, Paul R. (1971). The population bomb. New York: Ballantine Books.

eSevaOnline. eSeva Website. Online: http://www.esevaonline.com/ [Accessed on 26.08.04].

Finnis, John (1980). Natural law and natural rights. Oxford: Clarendon Press.

Fromm, Enrich (1949). Man for himself, an enquiry into the psychology of ethics. London: Routledge & Kegan Paul.

Galtung, Johan (1980). The true worlds: A transnational perspective. New York: Free Press.

Goetz, Anne Marie and Rob Jenkins (2002). Voice, accountability and human development: The emergence of a new agenda. Occasional paper for HDR 2002. New York: UNDP. Online: http://hdr.undp.org/docs/publications/background_papers/2002/Goetz-Jenkins_2002.pdf [Accessed on 26.08.04].

Goulet, Denis (1995). Development ethics: A guide to theory and practice. London: Zed Books.

Grace, Jeremy; Charles Kenny and Christine Qiang (2001). ICT and broad-based development. Washington, D.C.: World Bank Global Information and Communications Technology Department.

Grameen Bank. Website. Online: http://www.grameen-info.org/ [Accessed on 26.08.04].

Grameen Telecom. Website. Online: http://www.grameentelecom.net/ [Accessed on 26.08.04].

Grasso, Marco and Enzo Di Giulio (2003). Mapping sustainable development in a capability perspective. Online: http://cfs.unipv.it/sen/papers/Grasso_DiGiulio.pdf [Accessed on 31.01.06].

Grenier, Louise (1998). Working with indigenous knowledge: A Guide for researchers. Ottawa: IDRC.

Griffin, James (1996). Value judgement: Improving our ethical beliefs. Oxford: Clarendon Press.

Grisez, Germain, Joseph Boyle and John Finnis (1987). 'Practical principles, moral truth and ultimate ends'. *American Journal of Jurisprudence.* 32: 99-151.

Guha, Ramchandra (2005). "Savaging the civilized: Varrier Elwin, his tribals, and India". In, *The Ramachandra Guha Omnibus*. New Delhi: Oxford University Press.

Gupta, S. P. (2002). India vision 2020. New Delhi: Planning Commission.

Hafkin, N. (2002) 'Gender issues in developing countries: an overview', paper presented at the United Nations Division for the Advancement of Women (DAW) Expert Group Meeting on Information and Communication Technologies and their Impact on and Use as an Instrument for the Advancement and Empowerment of Women, Republic of Korea, 11–14 November 2002. *Quoted in,* Anita Gurumurthy. *Gender and ICT*: *Overview report*. Brighton: Institute of Development Studies. 2004.

Hamelink, Cees J. (1997). New information and communication technologies, social development and cultural change. Geneva: UNRISD.

Hay, Keith A.J. (2005). Expanding broadband access in rural india: The role of alternative telecommunications networks. Washington D. C.: World Bank.

Hindu (2005). Broadband link for all villages in two years. *The Hindu*, 4 th January, 2005. Online: http://www.hindu.com/2005/01/04/stories/2005010403960800.htm [Accessed on 31.01.06].

IBE (2004). India national report on the development of education. *International Conference on Education*, 47th session, Geneva, 8-11 September 2004 . 75 p. Online: http://www.ibe.unesco.org/International/ICE47/English/Natreps/reports/india.pdf [Accessed on 15.06.05].

IEEE 802.11. Website. Online: http://grouper.ieee.org/groups/802/11/index.html [Accessed on 26.08.04].

IIRR (1966). Recording and using indigenous knowledge: A manual. Silang, Cavite, Philippines: REPPIKA, International Institute of Rural Reconstruction.

Indian Institute of Management, Ahmedabad (2002). Gyandoot. Online: http://www.iimahd.ernet.in/egov/documents/gyandoot-evaluation.pdf [Accessed on 26.08.04].

InfoDev. Website. Online: http://www.infodev.org [Accessed on 31.01.06].

International Association of Universities (2002). "Open Educational Resources Emerge on the Web" In, Newsletter of the International Association of Universities. Dec 2002 Vol 8 n 5 http://www.unesco.org/iiep/eng/newsletter/2000/jule00.pdf [Accessed on 26.08.04].

ISS (2000). Status of panchayati raj in the states & union territories of India, 2000. Institute of social and Sciences, New Delhi: Concept Publishing.

IT for Change (2004). Pro-poor access to ICT: Exploring appropriate ownership models for ICTD initiatives. Bangalore: IT for Change. Online: http://itforchange.net/media/askhaya.pdf [Accessed on 26.08.04].

ITC. e-Chaupal website. Online: http://www.itcportal.com/agri_exports/e-choupal_new.htm [Accessed on 15.06.05].

ITU (2000). New technologies for rural applicaztions. Final report of ITU-D Focus Group – 7. Online: http://www.itu.int/ITU-D/fg7/ [Accessed on 08.09.05].

ITU (2004). Case study India: Enabling rural India with information and communication technology initiatives. Online: http://www.itu.int/digitalbridges/docs/casestudies/India.pdf [Accessed on 08.09.05].

ITU T. ITU T Study Group 16 activities: Website. Online: http://www.itu.int/ITU-T/studygroups/com16/index.asp [Accessed on 08.09.05].

IUCN (1980). World conservation strategy: living resource conservation for sustainable development. Gland, Switzerland: IUCN/UNEP/WWF.

Jafri, A., Dongre, A., Tripathi, V.N., Aggrawal, A. and Shrivastava, S. (2002) Information Communication Technologies and Governance: The Gyandoot Experiment in Dhar District of Madhya Pradesh, India, *ODI Working Paper 160*, London: ODI.

Jaggi, Anil (2003). Information and communication technology and poverty reduction in rural India. 27th-28th November, 2003, Bangkok, Thailand. UNESCAP. Online: http://www.unescap.org/rural/ICTEGMNov2003/India-AnilJaggi.doc [Accessed on 26.08.04].

Jain, Rekha and Trilochan Sastry. Socio-economic impact of rural telecom : Implications for policy. Ahmedabad: IIM Ahmedabad. Online: http://www.iimahd.ernet.in/download.php?downloadid=157 [Accessed on 31.01.06].

Jensen, Mike and Anriette Esterhuysen (2001). The community telecentre cookbook for Africa recipes for self-sustainability: How to Establish a Multi-purpose Community Telecentre in Africa. Paris: UNESCO. Online: http://unesdoc.unesco.org/images/0012/001230/123004e.pdf [Accessed on 26.08.04].

Jhunjhunwala, Ashok (2002). Challenges in rural connectivity for India. May 15, 2002. Online: http://www.bytesforall.org/9th/html/challenges_ashok.htm [Accessed on 26.08.04].

Jhunjhunwala, Ashok (2001). Connecting rural areas of developing countries: A case for India. Presentation. Washington, D.C. World Bank, November 12, 2001. Online: http://www1.worldbank.org/prem/poverty/voices/globcoal/ajpres.htm [Accessed on 26.08.04].

Kassiri, Omid K. (2003). Options for sustainable energy generation in the developing world: financing mechanisms, technologies and policies. PhD Thesis. Cambridge, MA.: Massachusetts Institute of Technology.

Kaushik, P. D. (2005a). "Panchayati Raj – civil society and ICT initiatives". In, Bibek Debroy and P. D Kaushik, *eds*. *Energising rural development through 'Panchayats'*. New Delhi: Academic Foundation.

Kaushik, P. D. (2005b). "Panchayati rajmovement in India." In, Bibek Debroy and P. D Kaushik, *eds*. *Energising rural development through 'Panchayats'*. New Delhi: Academic Foundation.

Kaushik, P D. (2005c). "Rural development: Decentralisation and rural markets". In, Bibek Debroy and P. D. Kaushik, *eds. Energising rural development through 'Panchayats'*. New Delhi: Academic Foundation.

Kayani, R and A. Dymond, (1997). Options for rural telecommunications development. World Bank technical paper no. 359. Washington D.C.: World Bank.

Keniston, Kenneth (2002). Grassroots ICT projects in India: Some preliminary hypothesis. *ASCI Journal of Management* 31 (1 & 2).

Kenny, Charles (2002). The costs and benefits of ICT for direct poverty alleviation. Wold Bank. P. 6 Online: http://www.infodev.org/library/Kenny/povpap7.pdf [Accessed on 31.01.06].

Kenny, Charles and Carter Eltzroth (2003). Broadcasting and development: Options for the World Bank. Washington D.C.: The World Bank.

Kerala State IT Mission. Website. Online: http://www.keralaitmission.org [Accessed on 31.01.06].

Kishwar, Madhu (1996). A half step forward: The thwarting of economic reforms in India? *Manushi*, 92-93 (Jan-April 1996), 58-59.

Krech, David; Richard S. Crutchfield and Norman Livson (1969). *Elements of psychology. 2nd edn*. New York: Alfred Knopf.

Krishnamoorthy, R (2005). Towards power for all: Interview with R. Krishnamoorthy, CMD, PFC. In, *Geography and you.* 5: No. 1 & 2, January – Feb ruary 2005: 38

Kumar, Keval J (2005). Mass communication in India. Mumbai: Jaico Publishing.

Lane, Robert E. (1969). Political thinking and consciousness. Chicago: Markham Publishers.

Lasswell, Harold D. and Allan R. Holmberg (1969). 'Towards a general theory of directed value accumulation and institutional development'. In, Ralph Braibanti, *ed. Political and administrative development.* Durham, N.C.: Duke University Press.

Madon, S. and G R Kiran (2002). Information technology for citizen-government interface: A study of FRIENDS project in Kerala. World Bank Global Knowledge Sharing Program.

Madon, Sirin (2003). Evaluating e-governance projects in India: A focus on micro-level implementation". *Working Paper Series No 124*. Department of Information Systems, LSE.

Madon, Sirin (2004). Evaluating the developmental impact of e-governance initiatives: An exploratory framework. In, M. P. Gupta, *ed. Towards E-Government*. New Delhi: Tata McGraw-Hill.

Malappuram District. Website. Online: http://malappuram.nic.in/ [Accessed on 31.01.06].

Mansell, R. and R. Silverstone (1996). Communication by design: The politics of information and communication technologies. Oxford: Oxford University Press.

Max-Neef, Manfred (1989). 'Human scale development: An option for the future'. *Development dialogue*. 5-81.

Meadows, D. L., et al. (1972). The limits to growth: A report on the Club of Rome's Project on the Predicament of Mankind. New York: Potomac Associates.

Meera, Shaik, N. Anita Jhamtani and D.U.M. Rao (2004). Information and communication technology in agricultural development: A comparative analysis of three projects from India. Overseas Development Institute (ODI), *Agren Network Paper* No.135. Online: http://www.odi.org.uk/agren/papers/agrenpaper_135.pdf [Accessed on 31.01.06].

Ministry of Communications and Information Technology (2004a). Broadband Policy 2004. Online: http://pib.nic.in/archieve/image/broadband_policy04.pdf [Accessed on 31.01.06].

Ministry of Communications and Information Technology, GoI (2004). Annual Report 2003 – 04. New Delhi: MCIT.

Ministry of Development of North Eastern Region. Website. Online: http://northeast.nic.in/ [Accessed on 31.01.06].

Ministry of Finance (2003).Economic survey 2002-2003. New Delhi: Ministry of Finance.

Ministry of Finance (2004). India economic survey 2005. New Delhi: Ministry of Finance.

Ministry of Finance (2005). "Infrastructure: Power" In, *India Economic Survey 2004-2005*.

Ministry of Health and Family Welfare (2000). National Family Health Survey 1998 – 99 (NFHS – 2). Mumbai: International Institute of Population Sciences.

Ministry of Information & Broadcasting. Website. Online: http://mib.nic.in [Accessed on 31.01.06].

Ministry of Statistics and Programme Implementation (2002). Household consumer expenditure and employment: Unemployment situation in India. *Report no. 484*. NSSO.

Ministry of Statistics and Programme Implementation (2003).Report on village facilities. *Report no. 487*. New Delhi: NSSO.

Mission 2007 (2004). Report of Taskforce on rural connectivity. Online: http://www.mission2007.org [Accessed on 26.08.04].

Mitra, Sugata (2003). The virtual university: models and messages: Lessons from case studies. Paris: UNESCO. Online: http://www.unesco.org/iiep/virtualuniversity/files/net_varsity.pdf [Accessed on 26.08.04].

Molina, M.J., and F.S. Rowland (1974). "Stratospheric sink for chlorofluoromethanes: Chlorine atom-catalyzed destruction of ozone", Nature 249, 810-812, 1974. Online: http://www.unep.org/ozone/pdf/stratopheric.pdf [Accessed on 26.08.04].

Mountain Voices. Website. Online: http://www.mountainvoices.org/Testimony.asp?id=33 [Accessed on 15.06.05].

MSSRF (1998). Annual Report 1997 – 98. Chennai: MSSRF.

MSSRF (2004). Impact of ICTs in rural areas (India): Phase II - Information Village Research Project terminal report (2000-2004). Chennai: MSSRF.

Murray, H. A. (1938). Explanations in personality. New York: Oxford University Press.

Myers, D. G. and Diener, E. (1995). "Who is happy?" In, *Psychological science*. 1995 (6); 1.

Narayan, Deepa et al. (2000). Voices of the poor: Can anyone hear us? New York: Oxford University Press for World Bank.

NASSCOM and UNDP (2004). Promoting ICT for human development in Asia: Realising the Millennium Development Goals in Asia. New Delhi: NASSCOM and UNDP.

National Science Board (2004). Science and engineering indicators 2004. Online: http://www.nsf.gov/statistics/seind04/ [Accessed on 15.06.05].

National Taskforce on Information Technology and Software Development, Government of India. Information technology action plan. New Delhi: Government of India, 1998. Online: http://it-taskforce.nic.in/infplan.htm [Accessed on 26.08.04].

NIC. Rural informatics in India – An approach paper. Online: http://ruralinformatics.nic.in/files/4_9_0_273.doc [Accessed on 31.01.06].

Nielson, Kai (1977). 'True needs, rationality and emancipation'. In, Ross Fitzerald. *Human needs and politics*. Oxford: Pergamon Press.

Nonaka, I. and H. Takeuchi (1995). The knowledge-creating company: How Japanese companies create the dynamics of innovation. Oxford: Oxford University Press.

Norris, Pippa and Dieter Zinnabauer (2002). Giving voice to the voiceless: Good governance, human development and mass communcation. Background paper for HDR. New York: UNDP. Online: http://hdr.undp.org/docs/publications/background_papers/2002/Norris-Zinnbauer_2002.pdf [Accessed on 26.08.04].

Nussbaum, M (2000). Women and human development: The capabilities approach. Cambridge: Cambridge University Press.

Nussbaum, M and A. Sen, *Eds*. (1993). The quality of life. Oxford: Clarendon Press.

Nussbaum, M and J. Glover, *Eds*. (1995). Women, culture and development: A study of human capabilities. Oxford: Clarendon Press.

OECD (2003). Digital delivery of healthcare. In, OECD Information technology outlook 2004. Paris: OECD, 2003.

Office of Development Studies, UNDP (2002). Global reports: An overview of their evolution. Online: http://www.sdnp.undp.org/gpgn/progress.php [Accessed on 15.06.05].

Ohio State University. Precision agriculture website. Online: http://precisionag.osu.edu/ [Accessed on 15.06.05].

OneWorld South Asia (2004). Mission 2007: The march towards a knowledge revolution – Needs, challenges and Mechanisms. Workshop Report. New Delhi: OneWorld South Asia and M S Swaminathan Research Foundation.

OneWorld South Asia (2005). Mission 2007: Overcoming the pilot syndrome. New Delhi: OneWorld South Asia and M S Swaminathan Research Foundation.

OpenMed. Website. Online: http://openmed.nic.in [Accessed on 15.06.05].

Pal, Joyojeet (2003). The developmental promise of information and communications technology in India. Contemporary South Asia 2003 12 (1). http://www.sims.berkeley.edu/~joyojeet/Pal.pdf [Accessed on 26.08.04].

Paul, John; Robert Katz and Sean Gallagher (2004). Lessons from the field: An overview of the current usage of information and communication technologies for development. Digital Dividend/ World Resources Institute. p. 5-11. Online: http://www.digitaldividend.org/pdf/lessons.pdf [Accessed on 15.06.05].

Penguin India Reference Yearbook 2005. New Delhi: Penguin Books, 2005. p. 494.

Pentland, Alex; Richard Fletcher and Amir A. Hasson (2002). A road to universal broadband connectivity. In Proceedings of the 2nd International Conference on Open Collaborative Design for Sus-tainable Innovation, Bangalore, India, Dec 2002. Online: http://cba.media.mit.edu/publications/articles/02.00.pentland.pap.pdf [Accessed on 26.08.04].

PIB (2004). Year-end review 2004: Ministry of Communications and Information Technology. Online: http://pib.nic.in/release/release.asp?relid=6161 [Accessed on 15.06.05].

Planning Commission (2002). National human development report 2001. New Delhi: Planning Commission.

Prahalad, C.K. and A. Hammond, (2002). "Serving the world's poor, profitably". *Harvard Business Review*, September 2002, Vol. 80 Issue 9, p 48.

PRIA (2002). The non-profit sector in India. New Delhi: PRIA. Online: http://164.100.97.14/ngo/conference/ngo-pria.pdf [Accessed on 31.01.06].

Publication Divison (1998). India: A reference annual. New Delhi: Publication Division.

Purbo, Onno W. A Glimpse on 10+ Years Experience in Building A Financially Sustainable Community Based Digital Divide Bridge in Indonesia. Online: http://sandbox.bellanet.org/~onno/build-divide-bridge-6-2003.doc [Accessed on 12.11.05].

Qizilbash, Muzaffar (1996). Capabilities, well-being and human development: A survey'. Journal of Development Studies. 33/2: 143-62.

Rajora, Rajesh (2002). Bridging the digital divide: Gyandoot – the model for community networks, New Delhi: Tata McGraw-Hill Publishing.

Ramani K V and Mavalankar Dileep (2005). Health systems in India: Opportunites and challenges for improvements. Working Paper No. 2005-07-03. Ahmedabad: Indian Institute of Management.

Ramsay, Maureen (1992). Human needs and the market. Aldershot: Avebury.

Rao, Vijayendra (2005). "Symbolic public goods and the coordination of collective action: A comparison of local development in India and Indonesia," in Pranab Bardhan and Isha Ray (ed.) The contested commons: Conversations between economists and anthropologists. (forthcoming). Online: http://www.cultureandpublicaction.org/bijupdf/SymbolicPublicGoods.pdf [Accessed on 31.01.06].

Rawls, John (1971). A theory of justice. Cambridge, Masss.: Harvard University Press.

Registrar General and Census Commissioner (2001). Census of India, 2001.

Reliance Infocomm (2004). Reliance Infocomm introduces full suite of ISP services. Online: http://www.relianceinfo.com/webapp/Infocomm/jsp/media/PressRelease.jsp?id=100 [Accessed on 31.01.06].

Robeyns, Ingrid (2000). An unworkable idea or a promising alternative? Sen's capability approach re-examined. Center for Economic Studies Discussion paper 00.30. University of Leuven.

Rokeach, Milton (1969). Beliefs, attitudes and values. San Francisco: Jossey-Bass.

Rural eSeva. Website. Online: http://www.westgodavari.org/ [Accessed on 15.06.05].

Ryff, Carol D. (1989). 'Happiness is everything, or is it? Explorations on the meaning of psychological well-being'. *Journal of personality and social psychology*. 57/6: 1069-81.

Schwartz, S. H. (1992). 'Universals in the context and structure of values: Theoretical advances and empirical tests in 20 countries. *Advances in experimental social psychology*. 25: 1-65.

Sen, Amartya (1982). Choice, welfare and measurement. Oxford: Basil Blackwell.
(1985). Commodities and capabilities. Amsterdam: Elsevier.
(1987). On ethics and economics. New York: Basil Blackwell.
(1999b). Development as freedom. New Yor: Knopf Press.
(2002). What can Johannesburg achieve? Mimeo. WSSD.

Senthilkumaran, S. and Subbiah Arunachalam (2002). "Expanding the village knowledge centers in Pondicherry" *Regional development Dialogue*,Vol 23,No:2, Autumn 2002.

Shakeel, Hani; Michael Best, Bruno Miller and Sam Weber (2000). Comparing urban and rural telecenters costs. MIT Media Laboratory, E-Development Group

Sillitoe, P.; Dixon, P-J. and Barr, J.J.F. (2000). Indigenous knowledge methodology. A discussion paper. pp.303. Department of Anthropology, University of Durham and Centre for Land Use & Water Resources Research, University of Newcastle.

Simhan T E, Raja (2004). A low cost telemedicine kit for rural areas. Online: http://www.thehindubusinessline.com/2004/05/19/stories/2004051902011900.htm [Accessed on 15.06.05].

Simputer. Website. Online: http://www.simputer.org [Accessed on 15.06.05].

Singhal, Arvind and Everett M. Rogers (2001). India's communication revolution: From bullock carts to cyber marts. New Delhi: Sage Publication.

Solution Exchange. Website. Online: http://www.solutionexchange-un.net.in/ [Accessed on 31.01.06].

Srinivasan, V. K. and Suresh, S. (2005). Road network: Innovative funding modes. In, The *Hindu survey of Indian industry* 2005.

Sukumar, S. and N. R. Narayana Murthy (2003). "Influence of ICT on the development of India's competetiveness" In, *The global information technology report. 2002-03: Readiness for the networked world*. Davos: World Economic Forum.

Swaminathan, M. S. (2004). "Foreward". In, OneWorld South Asia. *Mission 2007: The march towards a knowledge revolution – Needs, challenges and Mechanisms. Workshop Report*. New Delhi: OneWorld South Asia and M S Swaminathan Research Foundation.

Swaminathan, M. S. (2004). "Foreword." In, OneWord South Asia (2004).

Tata Computer Based Functional Literacy Programme. Website. Online: http://www.tataliteracy.com/tata_solution_overview.htm [Accessed on 26.12.05].

Telecom Regulatory Authority of India (2004). Recommendations on growth of telecom services in rural India: The way forward. New Delhi: TRAI. Online: http://www.trai.gov.in/recom3oct05.pdf [Accessed on 31.01.06].

Telecommunication Regulatory Authority of India (2004). Recommendations on accelerating growth of internet and broadband penetration. New Delhi: TRAI, 2004. p. 10. Online: http://www.trai.gov.in [Accessed on 31.01.06].

Tenet (2004). CorDECT: Wireless access system. Chennai: Tenet.

TRAI (2004a). Recommendations on broadband India: An integrated policy for accelerating growth of internet and broadband penetration. New Delhi: TRAI. Online: http://www.trai.gov.in/Recommendations%20on%20Internet%20and%20Broadband%202004-04-29%20FINAL.pdf [Accessed on 31.01.06].

TRAI (2005). Growth in telephony continues in June, 2005. Online: http://www.trai.gov.in/pr11jul05.htm [Accessed on 31.01.06].

UN (1992). Agenda 21: The United Nations Programme of Action From Rio. New York: United Nations.

UN (2005). The millennium development goals report. New York: United Nations.

UNDP (1990). Human development report 1990. Online: http://hdr.undp.org/reports/global/1990/en/ [Accessed on 26.08.04].

UNDP. Human development reports website. Online: http://hdr.undp.org [Accessed on 26.08.04].

UNESCO ((1999). World information and communication report 1999-2000.Paris: UNESCO. Online: http://www.unesco.org/webworld/wcir/en/index.html [Accessed on 15.06.05].

UPU (1875). Postal statistics. Berne: Universal Postal Union.

US Department of Education. No Child Left Behind Act (NCLB) website. Online: http://www.ed.gov/nclb/landing.jhtml [Accessed on 15.06.05].

Ward B and R. Dubos. (1972). Only One Earth: The Care end Maintenance of a Small Planet. New York: W.W. Norton and Co.

Warren, D; Slikerveer, L. and Brokensha, D. (1995). 'Introduction'. In, The cultural dimension of development: Indigenous knowledge systems. London: Intermediate Technology Publications.

Wi-Fi Alliance. Creating a wireless network. Online: http://www.wi-fi.org/OpenSection/design.asp?TID=2 [Accessed on 15.06.05].

Wigand, Rolf, T., *et al.* (1997). Information, organization and management: expanding markets and corporate boundaries. Chichester, Wiley. 1997.

Wilson, W. 1967. 'Correlates of avowed happiness'. *Psychological Bulletin*. 67: 294-306.

Woodside, Simon (2003). Wi-Fi for rural communities: from open, to internet, in three acts. Online: http://www.developmentgateway.org/node/133831/sdm/blob?pid=5611 [Accessed on 28.06.04].

World Bank (2003). Drishtee telecenter initiative. Online: http://poverty2.forumone.com/files/14646_Drishtee-web.pdf [Accessed on 31.01.06].

World Bank. Indigenous knowledge website. Online: http://www.worldbank.org/afr/ik/ Accessed August 12, 2005 [Accessed on 12.08.05].

World Health Organization. CSR Website. Online: http://www.who.int/csr/en/ [Accessed on 12.08.05].

Index

Taking ICT to Every Indian Village

Opportunities and Challenges

by Atanu Garai and B. Shadrach

"It is no exaggeration to say that India lives in its villages. This is why Mahatma Gandhi once said that Gram Swaraj is the pathway to Purna Swaraj. This publication is a timely one and will help to impart momentum to Mission 2007: Every Village a Knowledge Centre, so that rural knowledge connectivity becomes the flagship of the programmes to be organised to commemorate the 60th Anniversary of India's Independence on August 15, 2007."

M S Swaminathan
Chairman, National Commission on Farmers, Government of India

"This is an invaluable book. Of the many inequalities that separate rich and poor in our world inequalities in access to information are among the most fundamental. They hold back human development, restrict opportunity and perpetuate local and global patterns of development that marginalise the poor. This book shows through practical examples how the knowledge divide can be narrowed in the interests of human development."

Kevin Watkins
Director, Human Development Report Office, UNDP

"*Taking ICT to Every Indian Village* is a clear-eyed, thought-provoking treatment of a very important but complex subject. The authors offer an innovative analytical framework that nicely interweaves the dynamics of knowledge, empowerment, technology, and sustainable development in order to illuminate the challenges and opportunities of bringing the information revolution down to the grassroots level. Highly recommended for anyone interested in ICT4D initiatives in India or in the developing world more generally."

William J. Drake
President, Computer Professionals for Social Responsibility

"The Internet is the next-generation communication network. Over the last decade, pilot projects have demonstrated viable applications in areas ranging from education to entertainment. The time for trials and demonstrations has passed. Bringing high-speed Internet connectivity to every Indian village would improve the quality of life for a sizeable portion of mankind, and this book moves us toward that goal."

Larry Press
Professor of Computer Information Systems, California State University

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