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WDP247
July 1994

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Improving the Transfer and Use of Agricultural Information

A Guide to Information Technology

Willem Zijp

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World Bank Discussion Papers

Improving the Transfer and Use of Agricultural Information

A Guide to Information Technology

Willem Zijp

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Washington, D.C.

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and Development/THE WORLD BANK
1818 H Street, N.W.
Washington, D.C. 20433, U.S.A.

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Manufactured in the United States of America
First printing July 1994

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ISSN: 0259-210X

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Library of Congress Cataloging-in-Publication Data

Zijp, Willem, 1948–
Improving the transfer and use of agricultural information : a guide to information technology / Willem Zijp.
p. cm. — (World Bank discussion papers ; 247)
Includes bibliographical references.
ISBN 0-8213-2868-9
1. Rural development—Data processing. 2. Agriculture—Data processing. I. International Bank for Reconstruction and Development. II. Title. III. Series.
HN49.C6Z55 1994
338.1'0285—dc20 94-12763
CIP

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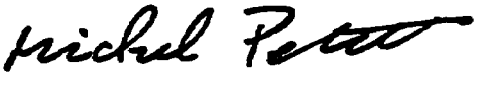
FOREWORD

Farmers feed the world. To do that, they need land, labor and capital. And they need know-how. Farmers in developing countries get much of that know-how from family and friends. Public and private extension are additional sources of information for farmers.

Worldwide, about 6 Billion dollars is spent on public extension every year. Despite major contributions to yield increases and income growth, public extension faces important challenges in the areas of relevance, accountability, governance and sustainabillity. At the same time, an information technology revolution is unfolding. But its impact is greatest in the urban areas of industrialized countries. Rural people in developing countries have not benefitted to the same extent from information technology.

This paper argues that more investment should be made in information technology applications for agricultural development in developing countries. Not only to redress the growing imbalance in information, but also to reduce poverty, increase participation, improve governance, manage natural resources and improve opportunities for women.

Getting Results, the Bank's agenda for Improving Development Effectiveness, stresses the need --in addition to a country focus-- to improve quality of operations, particularly by greater participation and improved implementation. This paper, written on the basis of many years hands-on experience at grass roots level, aims to provide the non-specialists with practical and easily accessible information on present and future applications of information technology in rural development.



Michel Petit
Director
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ABSTRACT

Information is crucial in agricultural production, in addition to land, labor and capital. However, investment in Information Technology (IT) has been mainly in urban areas of industrial countries, despite the potential for cost-effective applications of IT in rural areas in developing countries. Recent developments in IT, that make it particularly relevant for rural development include: reduced costs, increased storage, ease of use, speed, new links between different media, and "info-tainment". The paper also describes limitations to the application of IT, like the need for complementary inputs, organizational change, improved information management, skills development, human involvement, policy changes, social barriers, and the experimental nature of many technologies. Some pitfalls to be avoided are described. The paper provides a rationale, often through examples, for increased investment in IT in agricultural development, particularly in the areas of poverty reduction, increased participation, improved governance, natural resource management and improved opportunities for women. The paper gives a series of examples where IT can be used to make rural development better, cheaper and faster for rural people, borrowers and Bank staff. A number of simple, practical requirements are given in order to get incremental benefits from IT applications. Also, more radical changes are proposed to achieve the full potential from IT, including a cross-sectoral approach to rural development, a more realistic model of technology transfer, and support for empowerment of the poor. The paper ends with a number of next steps, including increasing awareness and skills and increasing investments in IT. Furthermore, the paper has ten annexes on particular information technologies, providing task managers with information on what the technology is, how much it costs, what advantages and disadvantages are, and what the requirements are to make it work. A bibliography is included.

ACKNOWLEDGEMENT

This paper aims to address some priority questions about IT from World Bank staff. The paper has benefitted considerably from their comments. In particular, the suggestions from Chuck Antholt, Robert Schware, Nagy Hanna and George Axinn (Michigan State University) were useful.

The author wishes to distinctly thank Janice Brodman (EDC) for her expertise in the field of information technology, her editorial skills, and for the enthusiasm she brought to this paper.

Sanjiva Cooke's work on the annexes is much appreciated.

The funds provided by the British Consultant Trust Fund and the contributions of Pat Norrish (Reading University) are gratefully acknowledged.

The interpretations, conclusions and recommendations remain the responsibility of the author.

1. INTRODUCTION

- Faced with the need to train several thousand irrigation engineers in the coming decade, India undertook a pilot project to use interactive videodisc (IVD) programs for training junior engineers. The videodisc programs provided simulated "hands on experience" on a range of topics, from technical subjects to the interpersonal skills engineers need to work effectively with water user associations. As "stand alone" training programs, the IVD programs could be used whenever convenient for the engineers. The programs generated great enthusiasm among senior as well as junior engineers and were considered by users to be highly effective training tools.

- With programs in five remote areas, the Sudan Area Development Schemes (ADS) needed a way for field personnel to communicate quickly and reliably with the central office. Given the unreliability of telephone and mail links, the program turned to packet radio. The packet radio system proved to offer good and cheap communications links that significantly reduced the time between requests from the field -- for supplies, logistics support, and services -- and central office responses. Packet radio also facilitated local self-help and delegation of decisions to the field while meeting financial control and monitoring requirements at the center.

- In rural Mexico, a local cooperative office uses a microcomputer to get weather updates, and bulletins about dangerous weather patterns, drawn from a new national satellite weather system. The same system gives market prices in the city, which the cooperative uses to help farmers decide when to harvest their crops and take them to market. If there is an influx of particular crops into the market, the co-op will suggest that some farmers postpone their harvest for a few days. By doing so, the co-op helps farmers get better prices for their crops.

These are but a few examples of the role information technology (IT) can play in rural development. While they are not intended to suggest that IT is a panacea for solving development problems, they demonstrate some of the ways IT can be used to benefit rural communities.

The objective of this paper is to enhance awareness and understanding among Bank staff, borrower staff and consultants of the immediate and future contributions IT can make to agricultural extension. The paper aims to provide **practical and easily accessible** information about IT applications to task managers dealing with rural development. It is therefore neither a philosophical study on information in society, nor an essay on details of the technologies themselves. Based on informal reviews of Bank staff needs, this paper is presented in two parts.

The first part of the paper discusses the major issues related to the use of IT in rural development and shows some of the ways IT has been and can be used in developing countries. It seeks to contribute to understanding of the key factors needed to ensure effective use of IT in a developing country context, as well as the pitfalls to be avoided. It also aims to galvanize interest in concrete actions the Bank can take to realize the potential benefits of IT for rural development.

The second part of the paper consists of ten annexes, each of which focuses on a particular technology that can have immediate importance and value for Bank projects. Each annex is produced as a separate, stand-alone document, providing concrete information on the technology under examination. The aim of the annexes is to provide practitioners and Bank staff with a minimum of practical information which they can incorporate into Bank projects, which enables them to write terms-of-reference for IT related studies, and to make it easy to find further information on the particular technology.

WHAT IS INFORMATION TECHNOLOGY?

The term "information technology" ordinarily refers to computer-based technology and telecommunications. This paper expands that definition to include video, radio and some applications of the technologies .

This paper's annexes specifically examine ten information technologies and applications:

- *CD-ROM*
- *Computer networks*
- *Desktop publishing*
- *Expert systems*
- *Geographic information systems*
- *Interactive video*
- *Packet radio*
- *Radio and interactive radio*
- *Satellite communications*
- *Video (linear)*

A summary table in the annex gives description, requirements, advantages, disadvantages, and relative costs of each.

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2. WHY IS INFORMATION TECHNOLOGY IMPORTANT FOR RURAL DEVELOPMENT?

The Importance of Information

The current era has aptly been called the "information age." The importance of information in industrialized countries has become a truism. In the U.S., for example, more than 46% of GNP and 53% of labor income is related to knowledge, communication, and information work (Hanna, 1991). In OECD countries, the information sector accounts for one-third to one-half of GDP and of employment. By the year 2000, this sector is expected to grow to 60% of the European Community GDP (Wellenius).

Yet information is critical not only for industrialized countries, but for the developing world as well. Information is just as important a production factor as the "classic" land, labor and capital. (Antholt 1993) Moreover, information can have a huge multiplier effect on the efficiency and effectiveness with which other resources are utilized. Access to accurate, timely information is crucial ingredient for success of development efforts. Discussing the phenomenon of "information poverty," the U.N. Center for Science and Technology declared:

> The distinction between information 'haves' and 'have-nots' is the basis for the dichotomies between developed and developing, rich and poor....It is within this context that the concept of development might be understood in 'information terms.'

The Economic Commission for Africa echoed this conclusion in a recent report, finding that lack of data was a significant constraint to planning and management of rural development, among other sectors.

The "information poverty" of developing countries is evident in a wide variety of key activities:

- Rural populations have difficulty getting important information in a timely fashion, e.g., market produce prices, bulletins about pest infestations.
- Most information disseminated to rural communities is in written form, making it difficult to access by those with low or no literacy skills.
- Rural communities and organizations have difficulty sharing information and experience among themselves beyond face-to-face contacts.
- Indigenous knowledge is seldom documented and stored, and in some areas is being lost to future generations.

Rural and Remote Areas Benefit Most from Telecommunications

People who live in rural and remote areas tend to grasp immediately the benefits of telecommunications. They know that the only other means of communicating quickly is through personal contact, which is likely to require a time-consuming and expensive trip. Not surprisingly, rural residents tend to use telecommunications more heavily and spend more of their disposable income on telephone calls than do city dwellers. In Alaska and northern Canada, native people spend more than three times as much as their urban counterparts on long-distance calls, even though their average income is generally lower than their urban peers. The only alternative means of getting a message through quickly is to take an expensive trip on a bush plane, since there are no roads in the remote north.

In these northern communities, growth in telephone use has increased so rapidly that telecommunications authorities have had to activate extra circuits in village satellite earth stations much sooner than anticipated. The number of long-distance calls in some Indian villages in northern Canada increased by as much as 800 percent after satellite earth stations replaced high frequency radios. In Alaska, the installation of small satellite earth stations in villages also sparked tremendous growth in telephone use. When local telephone exchanges were installed in some villages, long-distance telephone traffic spurted again by up to 350 percent (Hudson, 1984).

The economic benefits of telecommunications use are thus related to distance. The greater the distance from communities of interest, the greater the savings in travel costs and time. Similarly, benefits per telephone are likely to be greatest where telephone density is lowest. The greatest payoff from telecommunications investment, therefore, may be in rural and isolated areas. For private telecommunications providers, of course, these areas simply do no generate as much total revenue as higher density areas, even with the higher revenue per telephone subscriber. This reality suggests two conclusions: special incentives may be necessary to upgrade telecommunications networks in rural an remote areas; and such facilities must be designed to keep capital, operating and maintenance costs as low as possible.

Source: Rural America in the Information Age.

- Field workers have little access to information about the populations they are to serve and to current research findings, while researchers have poor access to up-to-date information from the field.

- Government officials make plans and decisions on the basis of inadequate information, and have inadequate financial control and monitoring capabilities.

- Inadequate provision of quality communications services to rural areas is a major (but not only) barrier to rural development. Such services would diminish the impact of distance --from markets, decision-making centers, public services, training programs and facilities.

- Developing countries have difficulty exchanging information between one another.

Rural development demands that rural people can get access to information they need in forms they can understand. Without addressing those information needs, other development efforts fail to achieve their potential impact. IT is a particularly important tool for small and medium enterprises in a rural setting. The potential of networking between entrepreneurs in remote areas is still largely untapped.

Results beyond expectations

Putting the results of development communication projects into context makes them even more impressive. While marketing products *and* behaviors *are not synonymous, A.I.D. social marketing projects have typically equalled and have in some cases exceeded expectations of commercial product marketing in the US. These results were achieved despite the complexity of marketing* behavior *rather than* products *--especially when considering the types of behaviors involved and the distribution problems which prevail in most developing countries.*

Source: The Substance Behind the Images: A.I.D. and Development Communication

Of course, there is a question of causality: are people poor because they are not well informed, or does poverty have other dimensions too. In other words, if those same people were better informed, would they no longer be poor?

Underlying information poverty are issues of power and control. An examination of these underlying issues goes beyond the scope of this paper that limits itself to the role of information and of information technology. Information can influence change in power and control, but some changes of power and control are also needed to allow information to play its role.

The Importance of Information Technology

It is precisely the crucial nature of information that makes the enormous rise in IT power important to rural development. The IT "revolution" delivers tremendous capability -- vast information storage, fast and inexpensive communication channels, links between different media, easy and enjoyable use -- at comparatively low, and steadily declining, costs. However, on its own, this technology will not achieve anything. Information is --in addition to land, labor and capital-- a major production factor. Information should thus be considered in all policy discussions as an agent of change, possibly helped by information technology. Some of the recent evolutions in information technology, which makes IT particularly relevant for rural development include:

- Cost reductions

  The costs of virtually all IT components have plunged. Real costs of computer hardware have dropped an average of 20% a year for over 40 years. (Hanna '91) Computer power per unit cost has increased tenfold every four or five years. Computer software is

available at low cost, with public domain software often offering adequate capability at little or no cost. Storage costs -- from hard drives to optical discs -- have fallen enormously, providing tremendous cost savings for storage of vast amounts of material. The costs for satellite communications have declined dramatically, with the current price tag of an entire land-based reception station now under $5,000.

Costs and Benefits

The results of the FAO/DSC rat eradication program in Bangladesh, using a multimedia approach-- were exceptional: the proportion of farmers controlling rats rose from 10% to 40% in one year. A media campaign costing $ 17,500 and rat bait costing $ 23,400 resulted in wheat harvest savings of $ 850,000. (Mody 1992)

As a result, developing country public and private sector organizations can now afford substantial computer power. Furthermore, the use of IT can bring about cost savings that outweigh the price of the computers. In Indonesia, for example, microcomputers used by customs officials quickly paid for themselves by helping improve duty collection. In Eastern Europe, libraries start using CD-ROM to build their holdings of Western materials at a fraction of the cost that would be required to obtain "hard" (paper) copies.

- Increased storage

Microcomputers, optical discs, and other electronic technology can store vast amounts of material, including text, numerical data, pictures, sound, video. A 120 megabyte hard drive (the minimum standard with most microcomputers) can hold more than 40,000 pages of text. A CD-ROM can hold more than five times as much. You can store more than 54,000 color slides on one videodisc.
Storage capability like this places enormous amounts of information at the fingertips of the user. Some developing countries are using CD-ROMS, for example, to provide rural health care workers with ready access to data on a wide range of health problems.

- Easier, cheaper communication between many people

Advances in telecommunications make it possible to link a large number of people quickly and relatively inexpensively, even in remote areas. In the West Indies, for example, a teleconferencing system linked seven sites in six countries. The system transmits courses for small groups of people in isolated locations, with an emphasis on in-service training. "Students" include teachers, midwives, community workers, and doctors (Tietjen).

- Fast, inexpensive transmission of information to an entire region

Mass media, particularly radio, makes information available at low cost and in remote areas. The Ministry of Agriculture in Turkey, for example, broadcasts radio bulletins on pest infestations. A radio "talk show" in Jordan lets farmers phone in questions to a panel of experts, providing almost real time responses. In almost every developing country today, one might see a farmer going to the field with a hoe, a hat and a radio. Interactive radio training programs can reach large numbers of people at costs as low as $.40/person/course/year.

In the Mahaweli district of Sri Lanka community radio producers actively involve local people in program making using small easily portable, professional standard audio cassette tape recorders. (Pickstock 1993)

- New links between different types of media

Some IT can now provide access to virtually any information that can be converted into electronic form -- data, text, video, still pictures, graphics. This versatility makes IT programs easy to use, even for those with low or no literacy or numeracy skills. Some telecommunications systems can now transmit all of those forms of information.

Interactive videodisc (IVD) programs, for example, can present excellent quality video, pictures, graphics, text, and data. IVD has been used in Malaysia to train workers in safe handling of dangerous substances. In Saudi Arabia, a company using IVD to train electricians found that attrition dropped from 50% with classroom training to 8% with IVD training (Brodman, 1993)

- Ease of use

IT programs have become far easier to produce. Even a nonprofessional can use desktop publishing, for example, to produce highly attractive printed materials with a professional "look and feel." Amateurs -- even those who are illiterate -- easily learn to use video camcorders to produce effective video tapes. In Philippines, for example, a community used video to convince the government to help them re-channel a river and prevent flooding. Multimedia computer systems now have "authoring" programs available that make it easy for teachers to produce lessons combining video, pictures, text and graphics.

"Easy access" is even more evident for the user. Touch screens make multimedia systems highly accessible even to illiterate users. Voice recognition, while currently limited, is developing quickly and will make microcomputer-based equipment extremely easy to use for all audiences. Messages delivered with video are immediately understood by all types of audiences. Virtually every type of IT is moving quickly to

become not only "user friendly" but also "user controlled" so that the user can easily make the technology serve his needs and style of use.

- "Info-tainment"

  Information must not only be available, but the intended audience must want to use it. IT makes it possible to combine information with entertainment to make learning more enjoyable and relevant, raising both achievement and retention. From social marketing programs via radio and television, to multimedia programs that present learning in a "game skills" format, IT generates enthusiasm for learning material that might otherwise be ignored. In India, for example, interactive videodisc training programs intended for junior water engineers were eagerly used by their seniors.

Interactive Video Versus Live Instruction

Some research highlights from the US Army, IBM, Xerox, United Technologies, WICAT, and Federal Express:

Learning Gains	*56 % greater*
Consistency of Learning	*50-60 % better*
Delivery Variance	*20-40 % less*
Training Compression	*38-70 % faster*
Learning Curve	*60 % faster*
Content Retention	*25-50 % higher*

(Adams, 1992)

The industrialized world is taking advantage of the opportunities afforded by IT. It is essential, in a time of tightening resource constraints and escalating needs, for developing countries to be equally adept in utilizing that power. As one expert noted:

> ...the microcomputer represents the first significant technological advance that a developing country can assimilate and exploit with a relatively low capital investment and without prior knowledge...in other technologies.... If a developing country fails to take advantage of the opportunity that [microcomputers] represents, its level of development in relation to developed countries will be significantly lowered. (Mortensen)

However, rural areas in the US and Europe continue to lag behind urban centers in awareness and utilization of IT and in demand for telecom services and IT applications. For instance, 75% of all British LANs (Local Area Network) are in or near London. (Schware, pers. comm.) Hence, an interesting research topic would be an analysis of the experiences with other IT introductions in both the industrialized and developing world (like radio, television, cinema) in terms of rural versus urban investments, policies and uptake.

Before going into the details of IT applications for possible World Bank funding, it seems prudent to balance the obvious potential of IT for rural development with some of its limitations.

3. WHAT ARE THE LIMITATIONS OF INFORMATION TECHNOLOGY?

IT offers enormous new opportunities. IT alone, however, is not enough. Indeed, IT is only a tool, which used effectively and complementary to other inputs, can contribute to development. Other inputs are often needed in order to realize potential benefits. IT also has pitfalls which must be understood and avoided.

Complementary inputs required

In order for IT to deliver the kinds of benefits discussed above, the following inputs and/or conditions are likely to be necessary:

- Organizational change

  IT alone will not solve the problems of inadequate use of information and poor decision-making. In order for managers and others to use information to improve decisions, they must have the incentive and the skills to do so. Consequently, there is often a need for organizational change to fundamentally alter the incentive structure --introducing more accountability -- and to ensure decision-makers have the skills to analyze and apply the information. There also may be a need to alter the way budgetary priorities are set to ensure adequate financial commitment to such skills-building. However, IT can --and has played-- an important role in increasing accountability of public services vis a vis their clientele.

- Improvement in information management

  Adoption of IT will not automatically improve data management. IT will not, for example, convert "bad" data into "good" data. The standard dictum is: "garbage in, garbage out" (GIGO). Data quality needs to be ensured and problems resolved. Nor will IT solve data management problems related to inadequate understanding of users' information needs, obstructed flows of needed information among organizations, information that is provided in inappropriate formats. These information management issues need to be explicitly addressed in order to ensure effective use of IT.

- Skills development

  Effective use of IT usually requires training. Training in the use of the technology can vary greatly in scope, ranging from ten minutes to several weeks. Training in maintenance and repair may also be required. In addition, many users need training in analytical skills to enable them to analyze and apply the data effectively. The reality is

also that many policy-makers require more familiarity and skills in IT potential and actual use.

Information services have become a greater part of economic activity in modern economies. This growth is partly the result of the increased value of these services relative to other economic activity, and partly a reflection of lower unit costs of IT services. Mody and Dahlman explain that the first influence can be thought of as shifting the demand curve for IT services outward. The second is a shift in the supply curve down the demand curve. This difference between shifting the demand curve and shifting the supply curve highlights the potential and the limits of IT diffusion in developing countries. Unless the demand curve begins to shift outward or the demand for information is highly price elastic, IT will continue to play a limited role in developing countries. (Mody and Dahlman, 1992)

- Human involvement

  Some information management and communications processes require human involvement. Although IT provides important value in extension, for example, it cannot replace face-to-face contact between extension agents and farmers. The mix of IT and person-to-person communication will depend on the agent's judgement about the sophistication of the farmer, his/her needs, and the farmer's own perspectives about what is needed. Training is another example, wherein some topics and audiences need IT applications to be complemented by face-to-face training.

IT also has limited usefulness in analysis that must be based on data that are rapidly changing, inconsistent and unpredictable. In such cases, human experience is needed. As one observer noted in considering farm management, IT can be a valuable tool, but "will never replace farmers' decision-making" (Nitsch).

- Policy

  Supportive policies, backed by substantial public investment are crucial for the diffusion of IT, particularly in rural areas. Without them, IT can be used at local level, often in fragmented, isolated efforts, but inevitably falling behind rapidly accelerating urban networks of IT users. Equally inevitable will be the rural exodus, often draining rural areas from the type of young, dynamic people that would have a critical role to play in the informatization of rural areas

- Social

  Cultural and psychological barriers exist, as they do in any situation facing change. The exist both in developing and industrialized countries and curtail the diffusion of applications.

- Prototypes

  Many initiatives and applications are still in an experimental stage. Sometimes the results leave something to be desired, as was the case in the promotion of video text in Ireland and France. Sometimes it is too early to tell, particularly because the prototypes still need a lot of outside handholding and adjustment.

Social Barriers to New Information Technology

When the printing press was introduced in the s, it did not immediately displace earlier forms of information technology. Indeed, monastic scribes continued to reproduce the key religious texts by hand; and the new printers produced mainly the same books, such as the Bible, that were readily available to the tiny minority of the population who was literate. Hand copying continued to be competitive until the early 17th century; and in the region of Paris and Orleans alone, about 10,000 scribes held onto their jobs. Often these scribes copied printed books when the first edition ran out, since it was more economical to meet residual demand by hand. Ultimately, the bourgeois printers prevailed; and gradually overcame Church censorship to produce controversial secular material that is the basis of modern society. Similar problems were experienced in the Ottoman Empire, where the introduction of printing was long resisted by devout Moslems.

The parallel between the introduction of printing and that of informatics is very clear. As in the case of print technology, informatics:

- ***co-exists alongside earlier information technology;***
- ***initially produced very similar outputs;***
- ***has high initial setup and learning costs;***
- ***is constrained by a lack of literacy;***
- ***is viewed by many as a threat to job security, civil liberties and social discourse; but***
- ***will in the long run generate equally fundamental social and economic change.***

Source: *Turkey - Informatics and Economic Modernization*

Pitfalls to be avoided

IT can have negative as well as positive impacts. By understanding the pitfalls it is possible to avoid them.

- "If it comes from the computer it must be right." Information technologies and mass media can confer a halo effect on false information. As a result, it can give biased or inaccurate information an aura of veracity.

- Adoption of IT can become "technology driven" rather than "needs-driven." If adopters obtain IT without knowing why and how they want to use it, the result can be an expensive headache, with equipment that cannot serve the organization's needs. A common symptom of this problem is the adoption of hardware before the organization has clarified the ways in which they will apply IT. Another symptom can be the adoption of technology that is "higher tech" -- and much more expensive -- than necessary. For example, in some cases satellite remote sensing may be utilized when aircraft and observation balloons can do the same job at lower cost (Palmedo). It is essential that information systems be designed in response to users' information needs and their patterns of information use.

> *"Public agencies are very keen on amassing statistics --they collect them, add them, raise them to the n^{th} power, take the cube root and prepare wonderful diagrams. But, what you must never forget is that every one of those figures comes in the first instance from the village watchman, who just puts down what he damn pleases."*
> *(Sir Josiah Stamp, quoted in Hassan, Hutchinson)*

- There is a danger of "information overload." Telecommunications and e-mail not only facilitate communications, they can encourage more communication than can be processed. For example, IT not only can enable Task Managers to keep in close contact with borrowers, it can also enable farmers to contact Task Managers directly. Such direct communication could be useful if only a few farmers were to take advantage of it, but if many farmers wanted to have direct input, a Task Manager could quickly be overwhelmed.

- On-line databases can be expensive and difficult to use, requiring the user to know the particular program protocols, be able to maneuver through vast amounts of information, and understand the proprietary business arrangements. The result can be expensive, unsatisfactory, and incomplete.

- "Glamorous" technologies can win undue portions of limited resources. For example, TV sometimes gets so much attention and funding that resources for radio programs drop, with a consequent deterioration in the overall service.

- Problems of urban bias. IT has been used almost exclusively to benefit urban areas. The technologies will exacerbate inequality between urban and rural areas if there is not clear, explicit commitment of IT resources to serve rural needs. Furthermore, within urban and rural areas, IT can increase the gap between rich and poor if only elites are able to adopt the technologies. In most countries, IT tends to serve those with greater

wealth and access to power and to bypass the poor and disadvantaged unless there are explicit efforts to distribute IT benefits equitably.

- Programs carried by IT can undermine traditional culture. Mass media programs, particularly TV, can convey values that contradict the traditional culture, yet appear to embody "advanced" society

- Inattention to issues of institutionalization can lead to unsustainable IT adoption. Without ensuring that the requirements for ongoing IT use are met, effective IT use will not outlive outside support. Projects that introduce IT need to build in organizational capability to maintain the technology, to provide incentives for effective use, and provide budget allocations for recurrent costs, such as maintenance and training.

4. WHY IS INFORMATION TECHNOLOGY IMPORTANT TO WORLD BANK RURAL DEVELOPMENT PRIORITIES?

Like their counterparts in industrialized countries, developing country governments often allocate a major segment of IT resources to military and urban applications. IT investments largely bypass rural areas. The rationale is generally based on an assumption that IT is too sophisticated and therefore inappropriate for rural areas. World Bank investments reflect this urban bias. Of the Bank's $1 billion annual project expenditures on IT, very little is targeted for applications supporting rural development.

A recent World Bank information management and technology strategy report states that "member countries are increasingly treating information management and technology -- informatics -- as an essential resource that affects the pace and outcome of development efforts in all economic sectors." (IBRD, 1992). Indeed, the Bank's allocation of funds amply testifies to the importance of IT in Bank projects. Almost 90% of the Bank's projects have an IT component. Furthermore, the rate of growth in lending for IT (excluding telecommunications) is six times that of total Bank lending. However, only a small proportion is specifically targeted at rural and agricultural development.

Pressing rural development needs make it imperative for the Bank to increase IT investments on rural development as well. Without such investment, successful achievement of these Bank priorities for rural development are at risk. These objectives include not only increasing production, but also: reducing poverty, increasing participation, improving natural resource management, improving governance, and improving opportunities for women. IT investments in rural development will not only improve successful achievement of Bank priorities, they may also create other positive externalities, such as stemming the exodus from rural areas.

It is important to note that the benefits of IT are often difficult to measure and, as a result, are underestimated. As an example, one analysis of telecommunications investments found that their benefits were 40 to 80 times greater than conventional calculations had suggested. As in extension and adult education, it is difficult to justify investments and costs in IT when the potential benefits may be significant, but speculative, and sometimes fail to materialize. It is thus important for IT practitioners --as it is for extension and adult education-- to demonstrate successes convincingly.

Reducing poverty

Current problems. As the U.N. noted, economic poverty stems in part from information poverty. The impact of inadequate information affects the entire rural development sector. Government agencies lack information needed for efficient distribution of agricultural

products, for ensuring food security, for providing warning and protection against flood and drought damage, for natural resource management.

Extension services frequently conduct planning without sufficient facts about their client base. It has been documented (Swanson et al, 1989) that public extension world-wide allocate about 58% of their resources to serve the needs of the larger scale, more progressive, commercial farmers. Private sector firms also concentrate most of their technology transfer efforts on the needs of the commercial farm sector, which can pay for purchased inputs. Consequently, the resource poor and subsistence farmers who make up more than 75% of the world's farmers are only receiving, on average, about one-third of extension's resources. (FAO, 1989) Rural development assistance workers of all types, including extension workers, often lack access to current, accurate information. Many farmers lack information on appropriate new technologies, prices for required inputs, domestic and international market prices, impending insect infestations. Rural banks often lack the capacity to appraise and monitor loans, especially small loans. Researchers in rural institutions lack access to international findings. Rural educators lack access to current materials, and use outdated, sometimes irrelevant, materials.

Opportunities from IT. In Ireland, the Irish Farmers Association provides a popular database that helps farmers share information on input and produce prices (Blokker). In rural Costa Rica, small coffee growers use telecommunications to get marketing information from central cooperatives in the capital, which have computer links providing information on national and international coffee price fluctuations (Annis, 1992). In Mexico *campesino* federations are using microcomputers to assess and monitor rural credit programs, and thereby negotiate more effectively to improve these programs. IT can also make it more feasible for rural financial institutions to handle processing and monitoring of very small loans.

Some of this potential has begun to be realized across a spectrum of rural development assistance efforts in agriculture, education, health, family planning, and infrastructure development. There are growing efforts, for example, to use IT to make information more accessible to extension workers and farmer-service centers. One project put huge amounts of information on crop protection and pest management (equal to 400,000 abstracts) on a CD-ROM. The CD-ROM can be made available to those serving farmers, at relatively low cost.

Reducing poverty will also require focussing on the development of common standards and specifications for IT systems. The development of such demonstrators and common specifications should be linked to ongoing investment in agriculture, health, education and institution building.

In India, selected training institutes use IVD programs to provide high quality training to Indian irrigation engineers in technical and management areas. IVD's ability to combine video, still pictures, graphics, and text, makes this type of technology effective for training a wide range of people, even those who are illiterate and uneducated.

In the Philippines, the need to improve communications between rural health workers and other health professionals led to the use of packet radio. With these radios, field workers can easily communicate with health centers, obtaining information on treatment of cases and sending requests for drugs.

Often rural services need to be able to deliver different services to sub-segments of the rural population. IT can help by enabling services to disaggregate and analyze large amounts of information about the rural population. The success of Indonesia's National Family Planning Agency is due in part to its innovative use of microcomputers to identify and analyze differing preferences for alternative birth control devices among different populations, and to manage distribution efficiently.

Increasing effective participation

Current problems. Lack of participation has two important aspects. The first is insufficient local input. It has become clear that rural development requires more than government intervention. Local individuals and organizations must also participate, both by providing information and by undertaking certain activities. It is therefore essential that rural people who must support development projects feel "ownership" of those efforts. Building such ownership requires broad participation and good two-way communication of information.

From a monolithic to a pluralistic approach

With only slight exaggeration, one could claim that the World Bank and other donors have supported rural extension services:

- ***With ONE "message" (usually production recommendations, often by maximizing inputs);***
- ***From ONE information source (usually from narrow-sectoral research institutes);***
- ***Through ONE channel (usually through a poorly trained, motivated and equipped male extension agent);***
- ***To ONE audience (usually younger, male, healthy, literate and credit-worthy farmers);***
- ***Paid by ONE source of funding (usually public)***

Remarkable results have been achieved by this monolithic approach. However, MULTIPLE messages, sources, channels, audiences and funding should enable quantum improvements in the generation, transfer and utilization of information. Optimal IT application enables, but also requires, a more pluralistic approach.

Feedback from the rural population is also important because rural people are not only recipients of information, but also creators of knowledge based on their own and others' experience. For example, regular communications of farmers' interests from the Colombian Rice Growers Federation to researchers has been credited with helping to rapidly improve rice yields in the 1960s and 1970s (Kaimowitz). There is substantial evidence that without two-way information flows development efforts fail. A case in point is an agricultural extension project in a North African country. The project was initially highly successful because

there was a good two-way flow of information: technical information from the Ministry to the field; information on needs and results from farmers to the Ministry. When the strong top-down nature of the government structure eventually blocked the bottom-up flow of information in the project, its effectiveness plummeted (Palmedo, 1987).

The second problem related to limited participation is lack of pluralism. In many developing countries, control over decision-making tends to be concentrated in particular subgroups of the population. If rural development is to be successful, it is essential to ensure that feedback channels are available to the wide range of players --women as well as men-- in rural areas. Knowledge and information from all of these groups are crucial to ensuring that development projects are relevant to the needs of the population, that their benefits are distributed equitably, and that those in positions of power are held accountable for their decisions. Studies have shown, for example, that access to multiple sources of information is key to extension agents' effectiveness (Engel, 1990).

Despite increasing recognition of the importance for "two-way" communication for successful development efforts, there are few channels providing "feedback loops" from the diverse groups in a rural community to agriculture researchers, extension agencies, development assistance organizations and government offices. Giving a "voice" to these multiple and disparate entities has been extremely difficult. To the extent that there is feedback, it generally comes from farmers who are affluent, politically influential, educated, motivated to invest, already users of research-generated technologies, and able to exercise monopoly power to reap the rewards of technological change (Kaimowitz). Furthermore, difficulty in coordinating and monitoring local organizations has contributed to central government reluctance to delegate authority for rural development activities to local groups.

An information technology being used participatively (and experimentally) is GIS. Research work at the University of Texas at Arlington, (Pinney 1991) has established a rationale for a community based approach to the use of SIS and GIS for land planning and natural resource management in Sub Saharan Africa. The research highlighted opportunities for facilitators trained in PRA techniques to work with communities --for example by using overlay mapping--. This enables researchers to document local environmental knowledge and traditional resource management systems. Illiterate communities understand overlay mapping and can contribute effectively to this research. This not only involves the community directly in land planning and natural resource management, but also establishes a dialogue between resource users and decision makers as they work together to develop solutions to jointly identified problems.

Opportunities from IT. IT can significantly alter this situation, forging better linkages between farmers, rural institutions, NGOs, agricultural research centers, marketing organizations, private firms, and government agencies. In doing so, IT can provide new opportunities for the rural poor to have input into decision-making. IT use by development agencies can facilitate information gathering from the rural population, and application of that

input into the design and implementation of project activities. In Nigeria, for example, the use of IT facilitated conduct of agricultural surveys, analysis of the data, and the use of those data for design of development projects.

In India video has been successfully used in advocacy by women vegetable vendors negotiating with municipal authorities, a move which led to the forming of Video SEWA (Self Employed Women's Association). Video SEWA is involved in training women in the use of video for different purposes and provides an example for women worldwide. (Stuart 1986)

Furthermore, much IT equipment has become so easy to use that non-professionals can quickly become proficient. This "deprofessionalizing" opens up valuable opportunities for those who are generally bypassed by development benefits. The ease of using IT can give disadvantaged groups greater access to information and communication technologies. The "glamour" of these technologies can invest greater power in, and draw more attention to, the messages of these groups than would otherwise be the case.

IT also provides new means for helping the rural poor (and their advocates) bypass obstructing agents and go directly to the source of the information they need. For example, in the Philippines, a group of subsistence farmers organized and raised their income by becoming pineapple specialists, using telex and fax to bypass government agencies and communicate directly with researchers of their choice and with market representatives.

In Mexico, campesino federations use microcomputers to monitor the performance of the national bank's rural credit program. Using that information, they have been able to strengthen their negotiation position to improve the fairness and effectiveness of the programs (Hanna, 1991).

IT also offers experts a means to test traditional wisdom. One project on water management in Indonesia, for example, used computers to simulate the traditional water rotation schedules controlled by local shaman. The simulation models using the traditional methods produced better results than the models using modern methods recommended by experts.

IT can provide the means for yet another type of participation -- on the part of the developing countries themselves. IT can give a larger role to borrowers in the Bank loan preparation process, and support greater collaboration between Bank staff and borrowers. With better communications, Bank staff can more easily involve borrowers in the resolution of new issues as they arise. With better access to information from the field, and the ability to analyze it, borrowers can add greater value to the loan preparation process.

IT can also enhance collaboration among developing countries themselves. Many Latin American countries are now using electronic networks to share information and experience

between countries, as well as to disseminate information to remote areas. By sharing information, developing countries can improve their understanding of the requirements for successful development efforts. They can also use IT to share information on global markets in order to strengthen their position in the world economy.

Agri-Informatics

The agricultural sector of Turkey still employs almost 50% of the civilian workforce. However, the information resources of the sector are extremely poor; and constrain the ability of farmers to make appropriate business decisions. Currently, the Ministry of Agriculture (MOA) is one of the least computerized segments of the Government - although agricultural information has a very high public good contact. There is no wide-area-network (WAN) that links Ankara with the field offices; and very little data (flowing in either direction). The MOA could be a showpiece for agency modernization through a systematic program to define information requirement, restructure work-patterns and create an enabling technological environment, based on field, office PCs, a WAN, and remote-sensing satellite data acquisition system.

Source: Turkey - Informatics and Economic Modernization

Improving governance

Current problems. Government decision-makers today operate under complex and uncertain conditions. Moreover, the role of government is shifting under their feet. As resources become increasingly constrained, and demands upon them grow, government can no longer "go it alone." They must be able to motivate and support other actors in designing and implementing development activities. Unfortunately, government offices generally lack the information required to effectively plan and manage rural development under these circumstances. Effective governance under these conditions demands a significant improvement in government's ability to obtain timely, accurate data, conduct reliable analysis, monitor government-supported activities, and communicate with a wide range of stakeholders.

Opportunities from IT. IT can support improved governance in a number of ways. The patterns of IT use in developing country government offices are very similar to those of organizations in industrialized countries. They generally begin by using IT to improve routine administrative processes and financial management. After some experience with IT, and usually relying on some technical support, they begin to utilize the technology to improve policy analysis, planning and decision-making, debt and adjustment management, and program implementation.

One such usage occurred in Kenya, where the Ministry of Agriculture used a microcomputer in budget allocation meetings to show decision-makers the consequences of adding or cutting particular projects as those decisions were being made. The result was far better allocation of resources and more timely decision-making (Brodman, 1985). Morocco presents another example, where one project aims to strengthen financial planning and control, improve

resource mobilization, and promote trade and indigenous industries. IT components constitute more than half the project costs. (Hanna, 1991)

IT's ability to improve communications between central authorities and the field also supports better decision-making, responsiveness, and monitoring. In Turkey, for example, 39 provincial agricultural extension and research offices have been linked together, and with the central office, enabling them to share information and provide one another with assistance. These improved communications not only strengthen government performance, they also support central authorities' willingness to decentralize control over resources by improving their ability to coordinate field organizations, motivate field managers, and monitor field activities. Indonesia's successful National Family Planning Agency, for example, combines strong central monitoring systems and regular reporting with decentralized day-to-day authority and rapid feedback from the field.

A systematic approach.

Needs assessment. *In order to support IT adoption that will contribute to rural development, it is essential to begin with the needs of the rural community. As a first step, a feasibility study is needed to:*

- *Identify the needs and priorities of rural communities for such areas as agriculture, natural resource management, and health.*

- *Determine the types of information needed to help meet those needs, including information gathered from the rural population and transmitted to policy-makers and project designers, and information shared among rural communities.*

- *Determine the gaps between the information currently available and what is needed.*

- *Determine how IT can help close these gaps and build valuable synergies by providing information across sectors.*

Systemization of "lessons learned". *There is considerable documentation on the factors contributing to success and failure of IT adoption. However, little of this material has been systematically organized and analyzed. Furthermore, it is often difficult to assess the impact of IT accurately because many of the benefits are difficult to measure. In order to learn from experience, it will be important to develop useful methodologies for more accurately evaluating the impact of IT, and to use those methodologies consistently to evaluate IT adoption efforts, identify the "critical success factors" and flag the common pitfalls.*

Simply gathering more information is not enough. It is essential to ensure that the information is of good quality, reliable, timely, and presented in a useful way. To do so, information system designers must clearly identify users' goals, the information that users need to achieve those goals, and the process by which that information will be gathered and entered into the system. This step must be taken *before* adopting any technology. It is this step that makes the adoption of IT "needs-driven" rather than "technology-driven".

This first step is important, as demonstrated in the private sector of industrialized countries. It is estimated that more than half of major system implementations fail. These failures are rarely due to technical aspects. Rather, they result from poor understanding of users' information needs. Not addressing the users' needs, while imposing changes that users do not assimilate are at the core of the failures. In many developing countries the same problems apply, but compounded by the rush to adopt hardware, before clarifying how the information system is to serve the users. To avoid these pitfalls, it is essential to begin with an information strategy, however simple.

Use of IT has been shown to stimulate government decision-makers' interest in ensuring data are accurate, as well as providing them with a means for assessing and controlling the quality of field data. During their attempts to use microcomputers to analyze field data, for example, a department in the Kenya Ministry of Agriculture realized that the field data they were using were highly flawed. Their rapid response to inadequate data motivated field personnel to improve data collection methods (Brodman, 1985).

The use of microcomputers can also encourage staff to improve their analytical skills and to apply those skills in decision-making. By making it easier to do statistical analysis and to apply techniques such as scenario-building, microcomputers often stimulate development and greater use of analytical skills. Furthermore, they provide the means for staff to explore these new alternatives.

Natural resource management.

Current problems. Despite widespread recognition of the importance of environmental protection and natural resource management, it continues to be rare for farmers and others in rural areas to have ready access to information on environmentally sound practices. It is also difficult for those responsible for natural resource development and management to analyze the complex relationships between natural resources and economic, environmental, and social factors that affect them.

Opportunities from IT. Industrialized countries have adopted IT in a number of ways to support environmental planning, monitoring, and natural resource management. Six major types of systems are used:

- Monitoring systems
- Large-scale storage systems, such as data banks
- Simulation and calculation models
- Decision-support systems, such as expert systems
- Training technologies
- Telecommunications technologies

These systems are not necessarily independent of one another. For example, an expert system may assist extension agents to use a large database.

Developing countries are increasingly turning to these technologies to help them in environmental management. For example, national environmental information systems are being established to support natural resource management in Burkina Faso, Guinea-Bissau, and Nigeria. Computerized pollution abatement technologies are used in Indian petrochemical plants to reduce pollution. Monitoring systems, particularly remote-sensing and geographic information systems (GIS), are increasingly used in developing countries to help monitor the physical environment, analyze spatial information in urban and rural planning, and determine the location and extent of environmental problems in order to strengthen natural resource management, agriculture, and water resource development projects.

Lessons from Africa

Moussa and Schware found five major constraints in IT application:

- Institutional: *insufficient planning, lack of management commitment, unclear objectives, impractical strategies, "quick fixes"*

- Human: *shortage of qualified staff, inadequate compensation, insufficient counterparts, high turn over of staff, lack of career prospects*

- Funding: *underestimated costs, lack of recurrent funds*

- Local environment: *lack of vendor representation, lack of after sales services and parts, imbalance of private/public sector wages*

- Technology: *limited availability of hard- and software, inappropriate software.*

As they note, these factors are not unique to Africa, nor to Information Technology. Hence the need to identify core constraints, agree on remedial action, and finally, to see where IT can help.

The visual power of GIS maps help users understand and gain a "feel for" their own area, and the environmental changes that are occurring over time. Those using GIS maps in the field have discovered that farmers and other rural groups find it easy to understand the maps, and the information they present.

Improve opportunities for women in development.

Current problems. In most developing countries, women continue to be excluded from most decision-making fora. They have limited input into designing programs that strongly affect them, little or no control over those programs, and little access to resources that would help raise their standards of living.

Opportunities from IT. IT can help open opportunities for women by improving their access to the various kinds of information they need, providing them channels for influencing programs that affect them, and offering means for them to share their experience and

mobilize their power. For example, IT can provide a communications network for women producers' that would offer information about input and market prices. By strengthening the ability of rural financial institutions to manage and monitor small loans, IT can enable those institutions to implement credit programs designed to assist rural women entrepreneurs. In some countries -- Pakistan, for example -- IT programs are important because they enable women to get access to information and training in the privacy of their own homes.

IT for environmental management.

In Chad, IT is being used to help develop a sustainable integration of crop-livestock activities that are technically and socially acceptable. IT will also be used to train local scientists to conduct related analyses.

A health planning project in China used a GIS to map and analyze housing density, health data, and water quality. The GIS analyses showed a strong link between housing density, health problems, water quality problems and sanitation problems. As a result, $6.5 million was shifted away from road construction to improve conditions in a slum area.

The World Bank is supporting an IT-intensive project in the Republic of Guinea, which will help manage vast tracts of forest, maintain land rights records, and improve offshore fishery planning and management.

IT can also be used to provide training to women in a wide variety of areas, from small business development to health care. Computer-based multimedia training programs can be used effectively by women with limited or no literacy or numeracy skills. Radio, and other distance learning programs, can offer training in a number of areas, as well as providing current information in areas such as marketing, input availability and prices, health care, family planning programs.

5. HOW CAN INFORMATION TECHNOLOGY BE USED FOR RURAL DEVELOPMENT?

The previous section suggested ways in which IT can support Bank priorities. In considering how IT can be used most effectively, a useful rule of thumb is to look for ways IT will permit people to do things **better, faster, cheaper** than before. By beginning with the needs and objectives of users, and considering ways IT can support attainment of those objectives, innovative applications of IT can be developed. Three major groups of users are considered below: rural people, public and private sector intermediaries, and Bank staff. For each group, access to IT has and can be used to serve rural development goals. The following examples are only indicative.

A missed opportunity.

Women farmers in the Central African Republic earn money by selling manioc that they have grated and washed, a back-breaking activity. However, washed manioc is perishable and many women loose money if the lorries that irregularly visit the villages do not appear and the manioc goes to waste. Farmers and truck owners agree that a small announcement on local radio about truck movements and previous day's prices would be of great value. Unfortunately, it has not happened, so far.

Rural people

- *Better*

  - Farmers' organizations can use fax and/or e-mail to obtain better information for their members and speak more effectively on behalf of their members, strengthening their advocacy role. (However, more research is required to find out what the role of IT has been in the promotion of smaller farmers, as opposed to the "high jacking" of resources by larger farmers.)

  - Rural groups can use video camcorders to present their needs and potential solutions more effectively to policy makers through the use of visual images.

  - Farmers and other rural groups can easily use powerful multimedia training programs with touch screens, even if they are not literate.

  - Vertical farmers' organizations can use telecommunications, radio, and/or packet radio to obtain and transmit price information in order to become integrated production and marketing chains, providing them with greater strength in negotiating with buyers.

The penalties of clinging to obsolete mass-production norms can be seen in the Pacific Northwest of the U.S. where wheat growers continue to produce only a few wheat varieties, all of which are cultivated by standardized methods. (Some 50 varieties of wheat could be grown in this region, and different cultivation methods could produce further differentiation.) Pomeranz, Rubenthaler and Sullivan (1987) point out that the mass-production wheat-growing strategy leaves export-oriented agriculture highly vulnerable: "We [farmers] have been saying for many years that we know what is best for our customers and we have one wheat that meets all their needs. This is tantamount to saying that if they do not like our wheat, they can get it elsewhere. This is what they have done."

In that article, the authors essentially argue for a production system that finds out what different customers want and then provides it to them. In meeting this challenge, telecommunications could play an instrumental role. One example is a farmer who established a computer connection with an overseas broker to find out about garbanzo bean yields in a country that completed its harvest in February. With this immediate knowledge, he could then decide whether or not to plant garbanzo beans on his own farm in early March. By utilizing containerized cargo shipping methods, he could then build a market identity for his particular crops. And by meeting consumers' demand, he would be in a good position to compete for future orders (Ochs, 1986). This same farmer learned via a computer bulletin board (accessed through his personal computer) that a Middle Eastern country was seeking to buy lentils. In collaboration with other farmers he was able to respond with a direct bid. In Alaska, once a satellite earth station was installed at a fish packing plant in the Aleutian Islands, the business was able to fill orders from its headquarters faster and to change the type of fish caught in response to fluctuations in New York prices. Trappers, once hostage to the village store, can now compare prices at city auction houses before selling their furs (Hudson, 1984).

Of course, instantaneous information is also available to buyers of farm produce. Iowa Beef Processors (IBP) uses a satellite network which allows their buyers in the field to keep in touch with the home office so that they can find out the price they should offer to cattle growers, the quantity they should buy, and the optimal delivery date. Besides trying to obtain the lowest possible price, IBP schedules cattle deliveries to keep its processing plants operating at near capacity (Stevenson, 1981). The growing information intensity of U.S. agriculture can be seen in the flourishing network of computer networks and databases, including, for example, AGRICOLA, AgriData and CMN.

Source: Rural America in the Information Age.

- *Faster*

  - Farmers can get information about daily market prices on the radio or through e-mail notices posted at a local center before taking produce to market.

  - Rural people get information via radio about impending weather threats.

  - Rural midwives can get immediate information about particular health problems from a microcomputer at a local clinic.

- Small craftspeople in isolated villages can get information about transportation via radio.

- *Cheaper*

  - Rural advocacy groups can make video tapes cheaply with camcorders to describe their problems and suggested solutions through powerful visual and oral messages.

  - Community groups can develop their own radio programs, addressing local needs

  - Rural people can get high quality, consistent training at low cost via distance education or interactive training technologies

  - Advocacy groups in different parts of the country -- or the world -- can communicate with one another relatively inexpensively using e-mail or fax

Staff of public and private intermediaries

- *Better*

  - Training institutes can use multimedia to provide consistent, high quality training that is available whenever the learner requires it and that "tailors" the instruction to the learner.

  - Advocacy organizations can get and use information to support their case to decision-makers. For example, NGOs in Latin America use microcomputers to analyze the impact of public policies and programs on target groups, and use the information to improve accountability of public and private organizations to beneficiaries.

  - Extension workers can use expert systems for immediate access to expert advice and information, e.g., about dealing with a particular pest infestation under particular conditions.

  - Planning officials can use expert systems and geographic information systems (GIS) to improve their understanding of complex land requirements and conditions and to improve land use planning, including land titling and establishment of a land market.

- *Faster*

  - Extension offices can use satellite communications, e-mail, or fax to provide agents with up-to-date information on current conditions and the latest findings, for instance on probable pest outbreaks.

  - Health care workers in different regions, or countries, can use telecommunications or e-mail to communicate with one other regarding epidemics and other widespread health problems.

  - Meteorological stations can provide rapid information about changing weather conditions and make estimates of weather impact on sowing dates and harvest timing.

  - Irrigation engineers can use microcomputers to provide ongoing control of small irrigation systems.

- *Cheaper*

  - Advisory services can use desktop publishing to create effective publications at low cost.

  - Training institutes can use distance education to offer courses to workers in isolated areas, or to offer classes from a world-class institution in one country to students in other countries, at much lower costs than would be required to send the students to the classroom.

Interactive Video for Irrigation Training

The irrigation systems in India are essential for sufficient food production. To operate and maintain the system, Indian officials estimate that they need to train more than 100,000 irrigation engineers in the coming decade.

The Education Development Center (EDC) --under contract with USAID-- developed pilot interactive videodisc (IVD) to teach irrigation engineers. The project produced five IVD programs:

- *canal maintenance*
- *crop water requirements*
- *drainage problems and solutions*
- *working with water users' associations*
- *waterflow measurement*

The response has been enthusiastic, particularly because the project trained more engineers than hitherto possible and allowed for more flexible, on-the-job training. The Ministry of Water and the Central Water Commission decided to make the training programs more widely accessible, both by expanding the number of IVD systems, and by the development of other IVD programs.

The winner of the 1993 Intermedia Prize --John S. Andah, Counsellor at the Pan African Telecommunications Union, Zaire-- suggested several applications for mobile satellite communications in Africa, including:

- the transporting of terminals to villages on market days to provide voice, telex and fax communications for a fee;

- equipping long distance road and rail transporters with terminals to facilitate movement of goods and timely help in case of breakdowns;

- placing of terminals by request of rural organizations.

- A Ministry of Agriculture can get some kinds of information on remote and inaccessible areas more cheaply from a GIS than from sending out survey teams.

- A health clinic can get information via e-mail more cheaply than sending for a doctor from town.

Bank staff

An opportunity

The Bank --with help from the Bank-wide Learning Group on Participation-- is preparing a participatory handbook. The book aims to provide project managers with best practices and examples of participatory approaches to development. The handbook will follow a traditional Bank format: print.

Interactive video for instance would be much more effective learning tool. Project managers could pull up the handbook from their computer and actually see farmers and extension staff sit together, discuss and decide on action. The interactive aspect would allow the project manager to follow through different scenarios: "what if". The program could allow for farmers to give answers to questions from the project manager, but also provide on-screen information on Operational Directives or Evaluation findings, for instance.

- *Better*

  - Task managers can use telecommunications, e-mail, or fax to stay in closer and more effective contact with intended project beneficiaries and with borrowers.

  - Trainers can use interactive training technologies to provide consistent, high quality training to more staff.

  - Task managers can use microcomputers to access databases from institutions around the world.

  - Bank staff can use project management software to improve management of projects.

- *Faster*

  - Task managers can use telecommunications, fax, and e-mail from laptop computers to get and send information and messages quickly to and from the field.

  - Bank staff in different offices can use "groupware" -- software designed to support collaborative work -- to work with one another.

  - Bank staff can use e-mail to receive and transmit time-sensitive documents to those outside the Bank more quickly than by transporting documents via courier.

- Bank staff can refer to geographic information systems to get natural resource information about entire regions more quickly than to depend on land survey information.

- *Cheaper*

  - Bank staff can use e-mail to transmit documents to those outside the Bank more cheaply than using courier services

  - Trainers can train individuals in and outside Washington more cheaply using multimedia than bringing them to classrooms.

  - Task managers can hold "meetings" with people outside the Bank more cheaply using video conferencing than transporting them to Washington.

  - The Bank can use CD-ROM and other electronic storage media to cut costs by switching from paper storage of information to electronic storage.

6. WHAT IS REQUIRED TO GET THE BENEFITS OF INFORMATION TECHNOLOGY?

There are two types of benefits that can be drawn from IT. One type are incremental benefits, providing immediate improvement in a particular process or product. While incremental benefits can be of tremendous value, they are limited in their impact to a circumscribed process or situation within an institution. The second type of impact involves a comprehensive shift in the way things are done that significantly improves overall conditions and/or a range of processes throughout an institution, a set of institutions, or even an entire country.

Getting incremental benefits

IT is relatively inexpensive, divisible, and easy to use. Consequently, relatively small investments in IT can result in improvements in the way development projects are designed and implemented. The **requirements** to gain these incremental benefits of IT include:

Improved awareness and knowledge among Bank staff.

- Awareness of effective applications. It is necessary for Bank staff considering incorporation of IT components to know what is being done and can be done using IT in resource-poor and harsh environments. For example, to use IT in support of project lending that benefits the rural poor and intermediaries who serve them, it is important to understand how IT can contribute to such projects, and to discuss those uses with the borrower.

- Knowledge of where to get information on particular applications. An enormous number of IT applications are available that can support Bank work. Just as an example, there are thousands of public on-line databases. Given the number and variety of IT applications and resources, and the rapidity with which the technology changes, it is impossible for all Bank staff to become familiar with all IT applications. A more realistic alternative is to ensure that Bank staff know where to go for practical, detailed information about alternative technologies, their applications, and their potential to fill a particular information or training need. This paper and its recommendations (next chapter) aim to contribute to that understanding.

Greater understanding and capability on the part of the borrower.

- Recognized need by the borrower. In order for borrowers to use IT effectively, they must perceive the need for IT and the value it can deliver, *and* be willing to invest in IT for rural development. Obviously, it is hard to perceive if you do not have a background that can help you to conceptualize that need. The Bank can play an important role in raising awareness of appropriate and valuable uses of IT, and in

supporting a policy environment that encourages the use of IT where benefits are to be gained.

- Knowledge regarding where to get information on IT equipment and applications. Developing country government officers need better access to information about IT, how it has been used in other developing countries, and "best practices" in industrialized and developing countries. They also need assistance in choosing components that are most appropriate and cost-effective in the short and long term, and in integrating them. One way to meet these needs would be to establish a clearinghouse that provides information about IT, its applications, and sources of technical assistance, and also offers a channel through which developing countries can communicate with one another about IT issues.

- Training. Examination of Bank support for IT suggests that support for training has been insufficient. For example, a examination of Bank project allocations for IT components showed that approximately 24% of those IT costs were for training and technical support. By contrast, businesses generally allocate 50% or more of IT costs for training and information support. Thus, it is important for Task Managers to consider greater support for training in IT components.

  There are ten types of training that may be needed. In some cases only "a" and "i," below, will be required. In others, several of the following will be necessary.

  a. Users may need training in how to operate the equipment. Usually this requires very limited training - in some cases as little as ten minutes.

  b. Farmers and other rural groups need training in how to use IT to gain benefits. For example, farmers may need training in how to apply extension information they hear on the radio or from a mobile video cassette presentation. Members of a farmer organization may need training in how to send a query using a microcomputer e-mail system, and how to apply the information they get in response, or to send a follow-up query.

  c. Decision-makers may need training in how to utilize information effectively. This type of training often involves Bank staff or advisors working collaboratively with the decision-makers. While the need for this training may be highlighted by the presence of IT, it is often training that is required to improve decision-making in any case.

  d. Research and management staff may need training in data analysis and effective ways to present information to decision-makers. If researchers and managers are unaccustomed to conducting quantitative analysis, they are likely to need training to use IT for such analysis. The technology itself, however, can facilitate development of these skills, both by automating the calculations, and by providing computer-based training in these skills.

e. Management staff may need training in the use of microcomputers to support management tasks. Such training should include examination of the factors that have proven to be critical to successful use of microcomputers to improve management in industrialized countries

f. Clerks, accountants, and others may require training in utilizing spreadsheets, databases, or other packaged software. Generally, training in utilizing the software can be done quickly. In many cases, however, trainees will also need training in the logic of building a spreadsheet or creating a database.

g. Trainers and faculty may need training in effective ways to utilize training technologies and integrate them into ongoing training programs.

h. An ongoing training-of-trainers program is needed to ensure that trainers will adapt to and keep pace with technological advance.

i. Staff responsible for maintaining IT equipment need to be trained in equipment maintenance. Often, this training is limited, and can be completed in a day or less.

j. Staff responsible for repairing equipment may need training. Generally, IT equipment repair requires considerable technical skills, and the adopting organization should not attempt to build such an in-house capability. Rather, it is preferable to identify and rely on an outside vendor that specializes in IT repair. In most countries, there are numerous companies that specialize in computer repair and can handle most IT equipment. In unusual cases, it is worthwhile to train some staff of an external organization to repair specialized equipment.

k. Some organizations will have information systems professionals who can modify or develop software to meet specific organizational needs. In such cases, these staff may require training.

Explicit focus on rural development needs.

- Measures to ensure IT adoption is needs-driven. It is crucial that IT adoption respond to and be defined by development needs and objectives. IT that is adopted simply with the hope that somehow the technology will solve management, communications, or other problems is likely to prove disappointing. The best way to ensure that IT supports achievement of organizational goals (of a Ministry, the Bank, or others) is to conduct an IT strategy. Even a simple IT strategy exercise -- identifying the goals, the "critical information" needed to support realization of those goals, and the role IT can play in providing that information -- will help ensure that IT benefits the adopting organization and is cost effective.

- Investment for rural development. Although the cost of IT has dropped dramatically, technologies do require capital investment and coverage of recurrent costs. What is needed is clear, explicit support for programs and projects that use IT to support the needs of the rural population for training, information, and communications.

- Adequate physical infrastructure. Often, IT is considered to be inappropriate for rural areas because the physical environment is harsh and resource-poor. Yet, microcomputers are extremely sturdy, and experience in developing countries has shown that they can survive quite hostile physical conditions. While environmental problems (e.g., heat, dust, fluctuating electricity) do need to be addressed, they can usually be easily overcome at relatively low-cost. For example, voltage stabilizers can provide an inexpensive solution to fluctuations in electrical current. Dust covers can protect microcomputers in most situations. Although it is best to keep microcomputers in a relatively cool room, they have often been used without problems -- or air conditioning -- in climates where temperatures get quite high.

Getting the full benefits

Incremental benefits of using IT can be sizeable and of tremendous value. Exploiting the full potential of IT, however, will require far greater commitment, involving a comprehensive approach toward the role of information in rural development.

A radical change in perspective.

Today we approach rural development through different sectors: health, education, agriculture or private sector develop ent, for instance. This segmentation has been necessary to permit development of s ficient expertise, where even one sector is too large for one individual to understand in de h. Furthermore, even when there has been recognition of the advantages of a "hol stic" approach, the size and complexity of integrated rural development programs has made them difficult to implement successfully.

This sectoral approach is based on the reductionist tradition, which centers on the elements themselves, rather than on the interactions between them. It is based on precision of details, modifying one variable at a time, but with ill-defined goals. Therefore, the sectoral approach also has serious disadvantages. Many development goals cut across sectors -- goals such as reducing poverty, increasing participation, managing natural resources. A sectoral approach to these goals often results in unnecessarily high costs, due to redundant training, equipment investment, and personnel.

The Training and Visit approach of agricultural extension is strong on procedures: regular and controllable visits to farmers, monthly training sessions for staff, and periodic meetings

between research and extension, for instance. However, this focus has sometimes meant that staff would strictly follow farm visit schedules, but with little to tell the farmer.

Worse yet, solutions that would be successful under a cross-sectoral approach, are foregone because they are not cost-effective when considered on a sector-by-sector basis. For instance, the US Community Learning Information Network (CLIN) would not be supported by the users if they would have to pay for information on only one sector, like agriculture. As it turns out, they are happy to support their local network, because if gives them information and entertainment on all aspects they consider important.

Keywords in the systemic approach are: linkages, interaction, results, global view. It leads to multidisciplinarity and to objective-oriented action. The private sector is much more systemic in its approach than the public sector. Peters and Waterman for instance found a number of common factors among the best performing US businesses. These principles of excellence in management [1] are essentially systemic.

The need for a cross-sectoral approach is particularly apparent in considering investments in IT. IT that could train health professionals, farmers, engineers, teachers, and others is not adopted because no single group can afford the technology independently. Microcomputers that could assist local health clinics, schools, cooperatives, and small businesses are not adopted because no single organization can afford one.

The popular British radio show "the Archers" --a soap opera about rural life-- is essentially systemic. Facts and opinions about many aspects of rural life are interwoven in the story of a farming family. The show has successfully transferred information to and from rural and urban audiences. It could not have been successful for forty years if it had followed a narrow sectoral approach.

IT is unique, however, in that --to realize its full potential rather than incremental improvements-- it both **requires** a multidisciplinary, cross-sectoral approach *and* **provides** the means for creating the information management capability necessary to make such a cross-sectoral approach successful.

Experiences in rural areas of industrialized countries indicate a need for a more systemic, user-oriented approach. The EC funded Opportunities for Rural Areas (ORA) project for instance will focus on rural tourism (the second largest source of employment in rural areas), local and regional administration, small businesses and teleworking. If developing countries are to gain the full benefits of IT, this type of systemic, cross-sectoral, multidisciplinary approach will be needed. Such an approach implies a new role for

[1] These principles are: action-oriented; client-oriented; autonomy and quality of entrepreneur; people productivity; close contact with staff for shared values; specialization; simple structure with few bosses; balanced commitment and relaxation. From: T.S. Peters and R.H. Waterman; In search of excellence, Lessons from America's Best-Run Companies, Warner Books, Inc., New York, 1984.

The Nordic Telecottages

The first telecottage opened in 1985 in Sweden. It has been so successful that more than fifty were operational after five years. The aim of the telecottages is to provide isolated village communities with access to data-processing, telecommunication, and computer-assisted services. The purpose is to counteract geographical disadvantages. The following basic services are provided:

- information *services: access to regional, national and international databases;*
- data-processing *services: access to computers with a selection of programs;*
- IT consultancies*: the telecottage management is undertaken by an "IT caretaker", who also assists local businesses and organizations;*
- distance working: *providing workstations for distance working;*
- education: *open university type and online tutorials;*
- telecommunications*: fax, e-mail, etc.;*
- village hall facilities*: rooms and facilities for meetings, information.*

Almost all telecottages are organized as joint stock companies. In most telecottages the local municipality is the major share-holder, but in many there are also private share holders. Most have between two and five personal computers, one or two printers. modems and a fax. Normally there are two employees: director who acts as caretaker and local IT consultant and teacher, and a secretary who runs daily activities and provides word-processing and other services for local businesses. The necessary capital lies between $100,000 and $200,000 with much cheaper ones too, often based on public grants. As for operating cost, a few are publicly supported, while most start with public support, but are required to be self supporting within three to four years. *Source: Qvortrup 1989.*

government, for development experts, and for Bank staff. Instead of acting as authorities delivering a product or service to a passive rural population, they will need to foster local mobilization for action, support local participation, establish feedback loops from rural areas

to the center and create opportunities for interaction between themselves and rural people, for instance. For extension programs, the government role would shift from source of information to information broker, assisting farmers where to find relevant answers to their questions.

A more realistic model of technology transfer

The common perception of technology transfer is that research generates new technology, extension passes it on to the user. "From the knowledgeable to the grateful." (Prof. Bunting, private conversation) This model assumes the transfer to be linear, sequential and one-directional. Reality proves all three assumptions wrong.

Rural people are not simply depositories of technology that was developed somewhere else. Most are actively involved in the creation of new technology, simply by trying out new things, be it different ways of preparing food, planting seeds closer, or changing grazing patterns on a hill side. Because rural people have often been doing this for many years, or

TOWARD A RURAL INFORMATION UTILITY

Like water and electricity, information can be made readily available to rural communities. Although not every household will be connected, every community can be linked to a global information network.

What is an information utility? *An information utility is a network of interactive, digital information technologies, enabling users to communicate cheaply with one another and with many other information sources. It provides the users with tailor-made information from a variety of sources on many different topics. Because of its multisectoral approach, the information utility would be financially self-supporting. Just as we build one road to carry farmers, doctors, and teachers, the information utility serves information needs across the agricultural, health and education sectors, for instance.*

Is it possible? *The technology for an information utility already exists. What remains is to tailor software to different audiences, establish community "information centers," and build telecommunications systems in rural areas.*

Is it desirable? *There are many examples of "information hunger" being met with a willingness to pay, provided that the benefits are perceived to be bigger than the costs. This is more likely if the users' demand is taken as the point of departure, rather than the usual supply-driven agricultural extension advise, health promotion or adult education programs, for which few rural people are willing to pay.*

Is it sustainable? *Like other types of infrastructure, an information utility requires sizeable capital investment. Yet spread over all users, the per-person investment would not be prohibitive in many countries. Furthermore, many rural people will be willing and able to pay for service. Studies of telephone use indicate that rural people will pay premium rates to use a telephone, often covering the operations of the system very quickly. Furthermore, NGOs are often creative in keeping costs down, e.g., by using public domain information and buying second-hand hardware.*

Who will pay? *As with other utilities, different users pay different rates. Users' fees should cover operation and maintenance; NGOs and bilateral donors may be willing to pay capital costs.*

Has it been done before, in developing countries? *Yes. For instance in India, where the Ministry of Rural Development linked computers at village level to the national network to facilitate rural planning; or in Malaysia, where rural banks have initiated a "rural informatics program" (Woods, p 93); or in South Africa where planning has started for an information utility system for "social advancement".*

Where are the pitfalls? *Despite the drop in capital costs, and means for covering recurrent costs, an information utility represents a major investment. The investment is even greater where electricity and telecommunications systems would first have to be strengthened. Also, in the Indian case, for example, some of the government's motivation to invest was inspired by the desire to monitor and control. Furthermore, the skills and commitment for bringing about a change of this scale are in short supply, particularly in developing countries — with the limitations even greater in rural areas.*

even centuries, they are also important safekeepers of rural information. IT is being used to record some of the fast-disappearing local knowledge. (Jiggins, pers. comm.)

The government used to play a dominant role in Moroccan agriculture. To disengage the State, the Regional Irrigation Organizations no longer see themselves as the only information source. They are changing towards a brokerage role.

The information needs of farmers are identified through participatory diagnosis. Those needs are put on the vertical axis of a matrix. All sources of that information are put on the horizontal axis, including other public sector organizations, farmer organizations, NGOs and commercial organizations.

The public extension service invites those organizations to discuss the matrix, effectively matching demand for information with its supply. The result is an agreement as to "who will do what, next year".

Also, rural people are active transferrers of information. Many traditions in rural areas all over the world depend on rapid communication. IT is now building upon age-old traditions of puppets, drama, story telling and other communicative actions, for instance by the Tunisian chamber of agriculture, faxing for information with Italian consultants. Likewise, researchers are active transferrers and users of information, not just creators of new technology.

More realistic, cyclical and dynamic models of technology transfer, that recognize the mass of complex and multi-directional flows of information, are being developed. The application of those models and the application of IT in rural development strengthen each other. Farmers and researchers are already communicating directly with each other. Farmers and agro-business managers are increasingly communicating through IT-supported channels. Scientific language is "translated" into user-understandable language by using IT's capacity to visualize, making complex issues clear to illiterate people, particularly with the use of touch-screen and voice recognition.

This will mean a new role for public advisory services. They will be smaller and better. They will support an array of existing and developing advisory services and, on a residual basis, will they meet farmers' information needs directly, where they are not being met otherwise.

Support for empowerment of the poor

In Brazil's Amazon, pre-literate Indians learn to operate camcorders after 15 minutes of instruction. Literacy trainers in Ecuador produce audio tapes in about an hour. In Guatemala campesinos who do not know how to operate type writers, much less computers, fax human rights messages to journalists at the press of a few buttons. (Annis 1990)

Those in positions of power, who now control decision-making, will have to accept -- even support -- a participatory role for the rural poor and a change in the current bias toward urban development. This need for change exists among government officials, expert consultants and advisors, and Bank staff. The proper incentives and sanctions are critical in promoting participation. IT applications can make a modest contribution by better informing policy makers and public service managers through

providing a more powerful voice for the rural poor. IT applications have been demonstrated in increasing accountability through disclosure, attractive visualization and rapid dissemination of information.

Again, getting full advantage of IT not only requires these changes but also supports them. For example, IT can provide "models," in the form of television interviewers, of experts who seek out information rather than simply delivering conclusions. IT can offer the means for rural people to communicate input and for central decision-makers to be able to process that information.

Telecommunications as an Empowerment Tool

A key issue in the emerging role of telecommunications is how it alters - or reinforces - existing power relationships between buyers and sellers. Typically, major corporations use telecommunications to enhance their market advantages, often, if inadvertently, at the expense of rural America, whose use of telecommunications is usually a defensive attempt to stay competitive.

But can telecommunications be used to transform existing market relationships to favor rural America, or at least equalize bargaining power in the marketplace? Several participants expressed great interest in this potential. One reason this issue is important to rural economies, said Marty Stange, is because "rural economies are characterized by many sellers of undifferentiated products and few buyers - which is the exact opposite of urban markers. This has a special impact on the small commercial farmer, who remains the most omnipresent business activity in rural areas (even if the occupation does not employ the largest number of rural people)," said Strange.

The new trend in many livestock-raising areas is direct buying; the buyer visits larger farms (minimum, 1,000 head of cattle), quotes a price, and makes the buy on the spot. Smaller farmers still have to take their cattle to market, which puts them at a serious bargaining disadvantage. If they think the price quoted upon arrival at market is too low, they do not have any feasible alternatives; maintaining the cattle at market or returning home are both too costly. So they end up being forced to take whatever price is offered.

"What is the potential for telecommunications to remedy this situation so that small farmers can get a price on cattle before moving them to market?" Strange asked. "Packers have scuttled most experiments for telemarketing of cattle because they do not want a more competitive environment. They have monopsonistic power."

Heather Hudson told how one of the major cattle buyers set up a two-way telecommunications system a few years ago so that its buyers-in-the-field, with access to the latest market data, can optimize the price and day of delivery of cattle. The company calculated that if the system allowed them to bid one-half cent lower per pound of meat, the system would pay for itself within six months.

Source: Rural America in the Information Age

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7. NEXT STEPS

The power and promise of information technology makes it a crucial area of attention for the World Bank. As was noted in one Bank report, investment in IT for Bank projects is sizeable and growing. Furthermore, the Bank is well positioned to assist developing countries in using IT effectively to support achievement of development goals. As this report indicates, IT can be pivotal in supporting achievement of the Bank's priority goals in rural development.

To realize the potential of IT, concrete steps need to be taken in the short term. Some of these steps can be taken by individual Bank staff. Others will require an institutional commitment to using IT effectively. Given the large investment the Bank is already making in IT, such steps should have high priority.

Increase awareness and skills through information dissemination and training

- *Increase awareness among Bank staff, borrowers, and consultants about the potential of IT in agricultural extension.* One important step is to diffuse information on the opportunities IT offers in support of rural development. Most important is information about how IT is already being used effectively, and the kinds of applications that have been found to be relevant for rural development. Specific steps include:

  - Wide presentation of this report and its annexes, including annexes that are completed and those that will be developed in the future, in response to the needs of Bank staff and borrowers.

  - Workshops and demonstrations on information technologies that have and can be used effectively in developing countries.

  - Establishment of one or more Bank-based "IT Workshops for Rural Development," which would:

    -Build on existing initiatives within the Bank (e.g. Asia Technical on GIS).

    - Provide opportunities for Bank staff to gain hands-on experience, including simply "playing around" with different applications.

    -Facilitate information sharing among Task Managers form different sectors (agriculture, health, infrastructure) involved in rural development projects with IT components.

- *Train Bank staff in particular IT applications.* It will be important to build capacity within the Bank in core competencies for appraisal and supervision of IT components. Two applications that have already been identified by the Bank as key are computerized project management and geographic information systems. The Asia Information Technology Laboratory has taken the lead in promoting diffusion and competency in the use of project management computer programs.

  Recently, the Bank's Economic Development Institute entered into a unique commercial joint venture with Team Technologies, Inc. to create and field-test four software packages that can complement COSTAB and "close the loop" in automating the entire development project life cycle. Several modules or tools for project design and management have already been commercialized by the joint venture. One module, PC/LogFrame, is a computer-assisted project design tool, used at the very beginning of a project cycle, that provides a guide for the systematic analysis of interrelated project elements. One innovative application of this tool is to use it to enhance participation by stakeholders and beneficiaries in project preparation. (Hanna and Boyson 1993)

  It will be important to ensure that other critical types of application are identified, and that Bank staff build competency in using them effectively. Training can include both hands-on training in the use of the applications, and study tours to identify the "critical success factors" required to adopt and apply these applications with the greatest positive impact. Hence, it is suggested to prepare short (2-4 pages) best practice papers on successful applications of IT in rural development projects, both inside and outside the Bank. Also, the preparation of draft terms of reference for technical assistance and equipment would satisfy an existing demand.

- *Train rural poor as part of project components.* One important way to foster effective use of IT in support of Bank rural development priorities is for Bank staff to encourage appropriate training of rural poor in the use of IT as part of project components.

- *Train borrowers.* Borrowers also need to build capability in the use of IT applications. The Bank can support development of these skills with:

  -Technical training, particularly hands-on training programs.

  -Study tours to show the ways in which IT can be used effectively and efficiently.

  -Workshops on information technology strategy, to ensure that IT adoption supports organizational goals.

- *Focus the 1996 World Development Report on INFORMATION.* The World Development Report has tremendous influence among Bank staff, borrowers, other donor agencies, and development experts. It would be timely to focus the 1996 Report on the role of information in development, and, in particular, the role of IT for rural development.

- *Invest in "Information Technology Centers for Rural Development".* The Bank can spearhead establishment of centers, run as a private/public joint venture, throughout the world. These Centers would provide a range of services, that are crucial for the informatization of rural areas, but would not be developed without public investment. Their services would be on a subscription and/or fee basis, and include:

  - Dissemination of information on effective uses of IT for rural development, "lesson learned," and the factors that contribute to success, as drawn from experience in the developing world, the newly industrialized countries, and the industrialized world.

  - Technical assistance, including conducting needs assessments and helping developing country community organizations improve their access to and management of information. For example, assistance might involve building skills among advocacy groups in the conduct of opinion polls and analysis of results. It might strengthen NGO use of computers for service support, improved decision-making, and financial management.

  - Assistance in obtaining IT equipment at low cost. The Center can pool equipment demand in order to assist developing countries to procure equipment at lower costs than would otherwise be possible. NGOs have pooled, serviced and distributed used IT equipment successfully.

  - Provision of a wide range of training in IT technical areas, information management skills, information analysis, IT strategy development.

Invest in information technology for rural development

- *Put IT into investment lending.* Where appropriate, the Bank can lend for investments in IT in key areas:

  - Investment that supports communications between beneficiaries and researchers, central decision-makers, and others. For example, although agricultural extension must rely primarily on face-to-face communications, the Bank can support the use of IT in several ways to improve extension efficiency and effectiveness, e.g., use of mobile video units demonstrating new farm practices, use of radio for bulletins. Another example, would involve World Bank collaboration with the IFC to support networks that provide marketing extension.

  - Investment in human resource development. For example, the Bank can support investment in using IT to provide timely information to extension agents, in trial uses of expert systems for decision-support for extension agents, in multimedia programs to train extension agents. It can support university training for IT

application development specifically for agricultural planning, natural resources management, preventative and curative health services, and other rural development needs. It can support adult education in rural areas through distance learning where the Bank already invests, but where effectiveness and efficiency could be improved through the use of IT..

- Investment in the use of mass media, mobile radio, and other relevant IT to support rural development programs.

- *Put IT into adjustment lending.* The Bank can address issues of access and affordability of information for the rural poor. Also, the Bank can encourage development of an IT strategy that aims to reduce rural poverty.

- *Put IT into emergency lending.* Particularly during emergencies is it important to be informed. Rural people would benefit from advice on disease prevention and treatment, they would like to hear where inputs and food is available. Quick disbursements for rural radio, digital radio and mobile satellite stations would make a lot of sense, for instance.

- *Improve communications between the Bank, borrowers, rural intermediaries, private sector companies, and beneficiaries.* Discussions of the importance of increasing participation of beneficiaries in rural development projects will lack the ring of authenticity unless the Bank itself introduces methods soliciting such participation. Specific actions might include:

  - Support establishment of an electronic network that links the Bank, the borrower, beneficiaries, businesses, and rural intermediaries, such as provincial clinics, selected agriculture chambers, rural adult education centers, selected NGOs, etc.

  - Support establishment of an electronic network for extension that links key agents representing markets, credit, production, and inputs.

  - Use video to present Bank programs and explain Bank projects both to rural decision makers and to the majority of beneficiaries.

  - Establish databases that support IT adoption, and are available on-line or through CD-ROM to borrowers. One example might be a database on advisors with expertise in IT and experience in developing countries

Overview of Information Technologies

Technologies	*Description*	*Representative Applications*	*Requirements*	*Advantages*	*Disadvantages*	*Comparative Costs*
Compact Disc - Read Only Memory (CD-ROM)	Microcomputer and CD-ROM drive	• Training: using pictures and sound as well as text. • Reference tool: Easy access to vast amount of material, e.g., slides, graphics, text, animation, small amount of video	• Microcomputer • CD-ROM drive • CD-ROM discs • Electricity source • Source for maintenance and repair.	• Holds and gives easy access to vast amount of materials: text, numbers, graphics, sound, slides, animation, small amount of video • Offers self-paced learning • Can substitute for trainer • Equipment and discs durable • Many existing programs	• Expensive equipment • Limited video • Standards not established	• Complete CD-ROM system = $1,300 - 8,300 - Microcomputer = $1,000-5,000 - CD-ROM drive = $250 - 1800 - Audio board = $50 - 1,500 • Optional video board = $400 - 1,500
Computer Networks	Computers at different locations, linked by modem to telecommunication system	• Link locations with typed messages, where voice communications poor, expensive • Link user to sources of data, worldwide, e.g., databases, experts, teleconferencing, computer bulletin boards	• Microcomputer • Modem • Communications software • Access to telecommunications system with link to networks • Source for maintenance and repair • Operator (trained non-professional)	• Cheaper and more convenient than fax and telex • Much cheaper than international phone call • Available in major cities of most countries	• Requires access to telecommunications system with network link • Usually requires registration fee, service fee, usage charges • Often available in only one or limited cities in a country	• Complete system = $1,200 and up - Microcomputer = $1,000 and up - Modem = $100 - 600 - Communications software = free - $400 • Registration, service charges and usage fees vary by network, country, phone company
Desktop Publishing (DTP)	• Microcomputer • High quality printer, e.g., laser	Produces high quality text and graphics for papers, brochures, newsletters, etc.	• Microcomputer • Software: desktop publishing, word-processing, & graphics • Printer: good quality, e.g., laser • Printing supplies • Reliable electricity • Operators with skills in using the software • Maintenance & repair services for micro-computer & printer	Produces high quality printed materials at low cost	Not good for producing large numbers of a document	Complete system (computer & software) = $1,500 - 10,000

Technologies	*Description*	*Representative Applications*	*Requirements*	*Advantages*	*Disadvantages*	*Comparative Costs*
Expert Systems (ES)	Microcomputer with expert system software	• Provides "expert" advice to less experienced user, e.g., extension agents, planners • Provides training, e.g., for researchers, extension agents, health workers, etc.	• Microcomputer (or more powerful computer) • Expert system software • Operator or trained user • Electricity source • Source for maintenance and repair	• Makes "expert" advice and information immediately available, even in remote areas • Training improves skills and decision making • Cheap software development "shells" make it easy for non-programmers to develop expert systems	• Use of ES requires skilled operators • Development of ES requires some software development skills and quality control of the "expert advice" included in the ES	• Complete microcomputer based systems = $2,000 - 10,000 and up • Software "shells" for developing expert systems on microcomputers = $100 - 5,000
Geographic Information Systems (GIS)	• Microcomputer with software • Printer, e.g., ink jet	• Organizes data on geographic areas to help analyze relationships between social, economic, and environmental conditions - Typical applications: land use planning, environmental impact assessment	• Microcomputer (or more powerful computer) • Printer that can plot maps, e.g., ink jet • GIS software • Digitizing tablet • Computer operator • Maps and/or data on the area to be analyzed • Electricity source	• Cost-effective way to analyze detailed land resource data • Helps understand and analyze relationships between different types of land use and socio-economic, environmental, and other factors	• Expensive equipment • Requires trained operator • Requires decision-makers able to apply GIS information • Software may need modification • Often requires specialist consultant to set up system	• Complete GIS system = $4,500 - 7,000 and up - Microcomputer = $2,800 and up - Digitizing tablet = $500 - Ink jet printer = $500 - Software = $700 and up

Technologies	*Description*	*Representative Applications*	*Requirements*	*Advantages*	*Disadvantages*	*Comparative Costs*
Interactive Videodisc (IVD)	Microcomputer with internal video board linked to videodisc player and speaker	• Training: Use where "hands on" training and/or visual images important • Reference tool: Give user easy access to vast amount of material, including video, slides, graphics, text, animation	For play: • IVD system: Microcomputer with video board; videodisc player; input device (e.g., mouse, touch screen); speaker • Videodiscs • Electricity source • Source for maintenance and repair For production: • Same IVD system as for play • Skilled designers, video production crew, software developers • Software packages	• Holds and gives easy access to vast amount of materials: text, numbers, graphics, sound, video, slides, animation • Studies show trainees learn faster, retain more than in classroom • Offers simulated "hands on" experience • Offers self-paced learning • Can substitute for trainer • Equipment and discs durable • If used by many users, cost-effective	• Expensive equipment • Requires electricity • IVD systems may not be compatible • Requires many users to be cost-effective • Video portions expensive to revise	Play: • Complete IVD system = $2,500 - 10,000 • Videodisc programs = $35 - 1,000 Production: • $35,000 - 2,000,000 per program, depending on such factors as complexity, amount of video and slides
Packet Radio	• Radio with modem & antenna • Microcomputer	Link groups in areas with poor communications to others	• For VHF, UHF: No physical obstruction, e.g., mountains • For HF: Access to satellite link • Radio operator (trained nonprofessional OK) • Trouble-shooting capability • License for transmission • Electricity source	• Quick transmission of text, numbers, spreadsheets, graphics • Cheap communications for small, rural groups • Error free messages • Can use solar cells or batteries	• Requires reliable electricity • Good signals have limited range (150 km)	• Packet radio station (w/o computer) = approx. $2,000-10,000. Variation due to quality of radio, antenna, electricity source

Technologies	*Description*	*Representative Applications*	*Requirements*	*Advantages*	*Disadvantages*	*Comparative Costs*
Radio and Interactive Radio	Radio	• Mass communications to announce bulletins, e.g., on weather, pest infestations • Adult training programs • Interactive radio (designed with pauses for listener response) for training, e.g., teachers, farmers, school children	• Radio • Radio broadcasting station • Script or other broadcast materials • Broadcast crew • Batteries or electricity for radio	• Easy to use • Reaches wide audience and remote areas at low cost • Easy to revise materials • Many existing programs exist • Interactive radio proven to raise learning at low cost • Can be used for training conducted by low skilled worker	• No visual material • Feedback of interactive radio is highly structured • Poor for "hands on" training or complex instruction • Too expensive for small audiences • Requires broadcasting station	Play: • Radios are cheap in most countries Production: • Interactive radio programs = $.40 - 3.00/trainee/course/year
Satellite Communications	• LEOs: satellite dish for low orbiting satellite • GEOs: satellite dish for geostationary orbiting satellite	• GEOs: real-time communications; TV broadcasts; distance education; remote sensing • LEOs: cheap communication between places with poor or no communications links, or willing to trade delay for low cost; remote sensing	• Access to satellite channel • User terminal • Reliable electricity	• GEOs: high quality, 24 hr communications; transmits video pictures, text, graphics, sound, "live" events; high quality images from remote sensing • LEOs: cheap communications for text, numbers, pictures, graphics	• GEOs: Expensive • LEOs: Delay in messages; no video; medium quality images from remote sensing	• GEOs: Dishes = $5,000 & up • LEOs: Terminals = $500 & up
Video Cassettes	• For production: video camera, e.g., camcorder • For play: video cassette recorder (VCR), television	Enable small groups with few funds to produce powerful visual material	• Production: - Video camera, e.g., camcorder - Video tape - Batteries (rechargeable) - Microphone - Editing equipment (preferable) - Source for equipment repair • Play: - VCR - Television - Electricity source (battery OK) - Source for equipment repair	• Production: - Cameras are easy to use, lightweight, durable - Consumables are inexpensive - Can use right after production - Easy to change sound/voice • Play: - VCRs are lightweight, durable - Cassettes are easy & cheap to duplicate, transport - Can be used even by illiterate audience - Many existing programs - Can substitute for trainer	• Production: - Cameras are expensive, need technical maintenance • Electricity needed to recharge batteries • Need to ensure format compatibility (e.g., PAL vs. NTSC) • Need for editing equipment raises cost	• Video camera = $1,000 and up • VCR = $250 - 1,000 • Video tape = $5 - 10 • Video cassettes = $5 - 15 • Camera batteries = $75

USING CD-ROM FOR RURAL DEVELOPMENT

Rural development depends on rural people having access to information they need and can use effectively. Yet poor communications systems make transmitting timely, accurate information to agricultural extension agents, health workers, and others, a difficult task. One approach to resolving this problem is to provide rural intermediaries with CD-ROM systems, holding vast amounts of information, graphical illustrations, oral discussion, and slides.

What is CD-ROM?

Compact Disc-Read Only Memory (CD-ROM) is a storage medium that, together with a microcomputer, offers rapid access to a very large volume of data, including:

- text;
- sound;
- computer graphics;
- animation;
- slides; and
- a limited amount of motion video.

Compact International Agricultural Research Library

The CGIAR Preservation and Dissemination Project has created one of the worlds largest integrated libraries on CD-ROM. The Compact International Agricultural Library is an entire working collection for agricultural researchers. All documents come complete on the diskette –not just the abstracts, but also including digitized graphs and color pictures, in addition to the integral text. This broad range of 2,000 publications selected by the CGIAR, include books, field guides, abstracts, annual reports, research highlights, technical reports, training manuals, symposia/workshop proceedings and, general and commodity news letters. The electronic library costs US$ 1,950.

Advantages of CD-ROM

1. ***Storage capacity***

Each disc can hold up to 660 megabytes of data, equivalent to 330,000 typewritten pages or 500,000 bibliographic references.

2. ***Durability and data safety***

CD-ROMs are resistant to dust, humidity, insects and fungi, power fluctuations or even spilt coffee. While computer floppy disks are written and read with magnetic media, which are sensitive to environmental conditions, CD-ROMs are stored and read with laser

media, giving them high durability. Data on CD-ROMs cannot be written over, or changed, even by accident.

3. *Transportability*

The low weight of each CD-ROM, about 20 grams, makes CD-ROMs a good medium for transporting huge amounts of data. They do not require any special handling or packaging.

4. *Low Cost*

CD-ROMs are relative low-cost, which has made them widely accessible as a storage medium, leading to a number of off-the-shelf CD-ROMs which can be purchased.

Electronic Compendium for Crop Protection

CAB International (CABI) is developing new methods of accessing information on crop protection through CD-ROM. It will soon be possible to say; view a summary of agricultural information about Vietnam with a map; compile a list of insect pests attacking rice stems in Vietnam; call up an illustrated interactive key to identify a particular species; check its appearance against full color illustrations; see it's global distribution on a world map or regional enlargements; read about it's biology and economic significance; list i's natural enemies, call up their data sheets and view illustrations; select control methods and pesticides; browse through relevant abstracts of the literature; digress to related pests mentioned; and on and on...

These features make CD-ROM a powerful technology where there is a need for ready access to large amounts of information, and CD-ROMs are used primarily to store resource materials. In addition, however, they are increasingly used for training, particularly for content that is well-defined and relatively concrete, and where training is enhanced by providing information and exercises using still visual images, graphics, animation, and sound. Another effective use of CD-ROM is to provide multiple layers of information in a "hypercard" format -- with this approach a user can choose to pursue deeper layers of information about particular terms or issues in which he/she is interested.

Application Examples

CD-ROM is used across all sectors, including agriculture, natural resource management, medicine and social sciences. Most applications involve storage of large amounts of material which can be easily retrieved. For example CD-ROMs can provide ready access to a vast amount of information on local pests and plant diseases (see Box 3), which can be used to support decision-making in crop management and integrated pest management, thereby increasing productivity and reducing the environmental impact of agriculture. With text, maps, illustrations, and other easy-to-understand material, the CD-ROM can deliver crop

protection information efficiently and effectively to extension agents and other intermediaries, as well as to farmers themselves. For other examples see Boxes.

Requirements

1. *Hardware Requirements*

A CD-ROM system consists of a microcomputer with a built-in or separate CD-ROM drive. Internal CD-ROM drives fit in an empty floppy bay drive inside the PC and do not require their own power. Separate CD-ROM drives have their own power supply, a cable connecting them to the microcomputer, and an adaptor board for the computer.

CD-ROM drives are either IBM-PC compatible or Apple Macintosh compatible. At this time, the two are not transferable from one to the other, although that limitation may well disappear in the coming year or two.

Hardware requirements for the IBM-PC are at least a 286, and preferably a 386 or 486 microcomputer with 640K RAM and a minimum of 512K free RAM. Hardware required for the Macintosh include 1Mb RAM.

CTA's CD-ROM Project

The Technical Center for Agricultural and Rural Development (CTA) selected agricultural information services in Cameroon, Kenya, Mali, Papua New Guinea, Trinidad and Tobago, Western Samoa, Zaire, Zambia and Zimbabwe to participate in a pilot project aimed at improving national self sufficiency in the dissemination of scientific agricultural information and to introduce computer technology in developing country information services in order to encourage the production of local databases.

Organizations which disseminate scientific agricultural information, such as ministerial libraries, universities and regional development centers, were provided with the necessary CD-ROM equipment and commercially available databases. Up to two weeks of on site training were given as well. Six to twelve months after installation, evaluation of the project found that the equipment had been used 50 percent of the time for CD-ROM applications and the remaining time was put toward word processing, local databases, inputing into international databases and online access to remote databases. On the basis of the success of the pilot project, CTA expanded the project to ten additional sites.

Both systems require:

- Standard keyboard or mouse;
- Monitor (preferably VGA);
- Audio and video boards if audio and video material are on the CD-ROM (the exception is Microsoft's Video for Windows, which can be used with a standard VGA 256 color system with no special video card);
- Printer (not essential, but preferable); and

- CD-ROM driver: software that enables the microcomputer to communicate with the CD-ROM. For both types of computers -- DOS and Macintosh -- the driver usually comes with the CD-ROM system.

The major technical concern in adopting CD-ROM is incompatibility among different CD-ROM formats. There are two major types of CD-ROMs, the Standard and an Extended Architecture format. It is important to establish the format that will be used in an organization and to adopt compatible drives and discs.

2. *Human Resource requirements*

CD-ROM systems are easy to operate, and, depending on the program, a non-professional can quickly learn to search the CD-ROM for material. To utilize a CD-ROM system, an organization needs:

- Training to ensure that users understand how to retrieve material and are comfortable with the system. Training can take as little as a few hours or as long as two weeks, depending on the existing skills of the user and the complexity of the CD-ROM program. It is generally recommended to train several people in the use of the CD-ROM. In some cases, certain staff positions may be established in which a CD-ROM operator conducts information searches for others.

- A CD-ROM system, like other microcomputer systems, requires a system administrator, i.e., someone to manage use of the CD-ROM system and resolve any problems that might arise. If the CD-ROM is used for training, it may be necessary to help instructors integrate the CD-ROM programs into the regular training program.

Evaluating CD-ROM for Extension Workers in US

In 1990 the National CD-ROM Sampler, a national extension reference library containing 14,500 documents, 1,900 graphics, 71 comprehensive collections, 65 individual computer programs and over 14 minutes of audio, was disseminated to field offices in 119 sites representing all 50 states, the District of Columbia, Puerto Ricco and US territories. The information spanned topics ranging from water quality to community preservation and provided solutions to the questions regularly posed to USDA extension professionals. Evaluation of this dissemination found that CD-ROM is an appropriate method of distributing extension information. Over 95 percent of the site managers and 94 percent of other users at the sites approved of CD-ROM to distribute extension material.

3. *Financial requirements*

Basic CD-ROM systems offer a means to provide graphics, text, sound, and slides at relatively low cost, particularly for organizations that already own a microcomputer. Recurrent costs are low, and generally involve routine maintenance of the microcomputer. The following costs are associated with a CD-ROM system.

Equipment costs. The basic equipment required for a CD-ROM system include:

- Microcomputer, including keyboard and/or mouse, at the cost of approximately $1,000 to $3,500;
- CD-ROM drive, at the cost of approximately $250 at the low end to $1,800 for very fast drives;
- Audio adaptor board, which can vary in price from about $50 to $1,500 depending on capability and quality; and
- Video board, which can vary in price from about $400 to $1,500.

CD-ROM program/disc costs. Individual CD-ROMs vary greatly, from as little as $50 to as much as $1,000. The price of database subscriptions vary greatly, and are complicated by frequent vendor discounts and complex options, based on the purchase of back-sets, and/or whether the customer already subscribes to print products. For example, FAO offers developing countries a 50% discount on the AGRIS database. In general, however, subscriptions are expensive, e.g., approximately $750 for an annual subscription to CAB Abstracts; $1,250 for Medicine from Compact Cambridge. The forgoing prices are for individual CD-ROMs to be used on a single microcomputer; if the CD-ROM is to run on a Local Area Network, prices are higher.

Factors Critical for Successful CD-ROM Adoption

1. *Infrastructure*

Is there a good power source? Have electricity stabilizers been obtained? Is there acceptable mail service if CD-ROMs are to be sent to users?

2. *Training systems*

Is there local support for training, operations, and for system maintenance?

3. ***Recurrent costs***

Is there financial coverage for recurrent costs such as database subscriptions, document delivery, training, equipment maintenance? How will costs be covered -- by the institution or from user fees (from those requesting a search from a CD-ROM operator)?

4. ***Dissemination***

How widely will the CD-ROMs be disseminated, and what costs and logistics are required?

5. ***Compatibility***

Is the CD-ROM drive compatible with the microcomputer? Is the CD-ROM drive compatible with the CD-ROMs that will be used?

6. ***Evaluation***

How will the system be evaluated? Some factors to consider tracking include:

- Number and kind of searches;
- User satisfaction;
- Problems encountered and their solution; and
- Operating costs.

Sources of Information

Information and Documentation, Royal Tropical Institute, 63 Mauritskade, 1092 AD Amsterdam, Netherlands. Tel: 31 20 5688 298, Fax: 31 20 5688 444.

Head, AGRIS coordinating Center, Library and Documentation Systems Division, Department of General affairs and Information, FAO, Rome, Italy. Tel: 39 6 5797 4993, Fax: 39 6 5797 3152.

Directeur, CIDARC, Avenue du Val de Montferrand, 34032 Montpellier Cedex 1, France. Tel: 33 67 615 800, Fax: 33 67 615820.

CGIAR, 1818 H Street NW, Washington DC, 20433, USA. Tel: 202 473 8942, Fax: 202 477 8451/8164/6391.

CAB International, Head Office, Wallingford, Oxon Ox10 8 DE, UK. Tel: 44 491 32111, Fax: 44 491 33508.

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USING COMPUTER NETWORKS IN RURAL DEVELOPMENT

The increase in accessibility to computers worldwide and the new computer communication software packages makes it possible now to use the computer as a means for communication and information retrieval. For example, a computer user in India or S. Africa can now communicate to other users worldwide with the help of a reliable modem and a telephone line. Computer users with such connections can also dial up a large number of local, national or international computer networks which provide access to immense databases on a wide variety of subjects or to millions of other computer users having connections to these networks.

Universities, research institutions, governmental bodies, NGOs, private organisations etc are some among the numerous bodies which make use of computer communication these days. Computer communications are used for a variety of purposes, from personal messages to peer group communication, teleconferencing, access to electronic news bulletin boards and hotlines, electronic journals, subject databases, experts in different areas etc. With access to global networks, rural development agencies, research institutes, scientists and health workers can gain access to a vast array of information very quickly.

Advantages of Computer Communications

1. *Immediacy*

Computer communications can provide access to information at a very quick rate. Survey results, new papers, references all available at quicker rates.

2. *Sources*

Electronic databases abound on development, agriculture, health, communication and related fields. It is also growing at a rapid rate. With access to global networks, rural development agencies, research institutes, scientists, health workers etc could gain access to hordes of information very quickly.

3. ***Conferencing***

Discussions can be held with experts from different parts of the country and the world on these computer nets (eg. bulletin boards).

4. ***Ideas exchange***

Interactively by IRC or 'talk' commands or through mail messages.

5. ***Cheaper***

With some journals and articles being put on to databases it is becoming cheaper than subscribing to print alternatives. Also computer communications on many non commercial networks are substantially cheaper than ordinary post.

6. ***Faster***

Communication becomes faster between individuals and between organisations everywhere.

7. ***Error free***

Electronic communication over networks are free from the errors usually seen in teleprinter, wire etc, as error correction software takes care of it.

8. ***Coordination***

Co-ordination of work between widely scattered offices and individuals becomes quicker and easier when near instantaneous communication is possible cheaply over computer networks.

9. ***News***

Development of central databases can help participating institutes and centres to contribute and retrieve needed up-to-date information on various areas. News group and special interest group bulletin boards can be maintained at centres.

10. ***Networking***

Local, national, international networks possible helping in the formation of peer group networks at any level.

CONSTRAINTS

1. ***Infrastructural***

The availability of reliable telecommunication systems for access to the networks has to be considered. Packet radio technology might provide a way out where telecommunication lines are not available. Also to be considered is the lack of electricity in some areas, power cuts and drastic voltage fluctuations which can destroy computers. And the adaptability of PCs and computers to hot, dusty and humid tropical climates have also to be taken into consideration. Many institutes in India, for example, build expensive air conditioned environments for computer rooms. This could become an add on cost to the use of computers for communication.

2. ***Who gets access***

Access to computer networks could be confined to top officials. (In many Indian institutes, Email is offered only to the senior level staff and not for lower level staff or students - could be due to low number of PCs available. How do the vast majority of institute people get access then?

3. ***Affordability***

How many institutes can afford enough work stations ? How many individuals in developing countries can afford a PC let alone the rental and registration charges for network access. Will this mean that here is another technology which helps increase the 'knowledge gap' between the rich and the poor.

4. ***Training***

To be able to use the communication networks effectively, requires good experience in computer use. Without adequate regular access to a work station, people might get discouraged by problems encountered in networking during the early stages.

5. ***Imbalance***

Any problems in having information and technologies flowing in from North to South. Most databases are US based.

6. ***Linguistic***

With Internet and other major networks using English language, and with most computer program usage dependent on a level of English knowledge, this limit the number of users in non English speaking communities.

Computer Communications Applications

In this section, computer communications are explored using the African context.

Electronic Mailbox and Messaging

- Less expensive and more convenient than fax or telex wherever a computer and phone line are available.
- Use dependent on sort of communications infrastructure already in place like telephone links
- Appropriate electronic communication solution may vary from one location to the next in africa dependent on communication infrastructure available

1. **Packet Switching Services in Africa**

Many African countries are installing packet switched data line service also called IPSS (International Packet Switched Service), which uses the internationally standardized X.25 protocol

How it works: The PTT -national post office or telephone company - usually the operator of such services - installs connection points to IPSS in major cities. Computer users with modems in these cities can make a local phone call and connect online to any country with an electronic mail or database service which is connected to X.25 network.The user has to order a NUI(network user ID) from the local PTT before using such a service.
Efficiency of connections: Provided reliable local phone services are available, connection to the host computers can be achieved. Some IPSS providers install error correcting modems which overcome unreliable connections and if supporter by a user modem with MNP error correction protocol, all phone noises can be overcome

Costs: The service usually costs the user a registration fee, a monthly or quarterly rental and usage charges to connect to the remote host. Higher usage charge for connecting to host computers outside the country like telephone calls. Rental charges for a NUI can vary from $20 to $200 a quarter from country to country in africa. Charges are mostly based on the

amount of data transferred. Users are charged for both sending and receiving data (frequently making this service prohibitively expensive)

Availability: IPSS service exists in Ivory Coast, Kenya, Mozambique, Niger, Senegal, South Africa, Togo, and Zimbabwe.
IPSS service

Advantages over international direct dialling: Significantly cheaper option than making a direct dial international phone call to the electronic host and then connecting.

Constraints: The limited availability of IPSS services and the high costs charged for modem use and data transfer by local PTTs can make this less attractive.

2. Direct International Dialling

A second option is to resort to international direct dialling to the electronic host. With the help of new software, it is now possible to send messages and files even over poor quality telephone lines at minimal cost using automated computer control led connections with file compression and error checking. These programmes reduce the length of the long distance call by 80 - 95% compared to standard manually controlled interactive sessions with the host.

INTERNET

Internet is a loose amalgam of computer networks connecting thousands of sites and millions of users all over the world. It is not an individual organization or network but a collective term for the many backbone, regional and site data networks that it comprises - more than 5000 networks in 33 countries.

A connection to the Internet gives a user real-time access to online databases, library catalogues, software archives, full text reports and even graphic image files.

Tools to log on to other machines and search around for information include: Telnet a device(or protocol) which allows you to log into other computers on the internet; FTP, a File transfer protocol, which allows you to transfer files from a remote computer to your own; Email, Electronic mail for exchanging messages between individuals or groups; USENET, Discussion groups to cater for all interests from cultural news, to sport, science, sex etc., Gopher, a menu-based system for travelling around the Internet; ARCHIE, A system for locating files that are publicly available by FTP; WAIS (Wide Area Information Server), a free text method of searching the internet, and; WWW (World Wide Web), a hypertext system for subject searching.

Host computer services and global connections: Host computer services necessary to carry this traffic into the major networks are operational in London (Greennet), Stockholm (Nordnet) and Toronto (Web). These machines provide gateway connections to most other networks operating globally including Internet, bitnet, janet, Earn, usenet/uucp etc.

Software: A self installing configuration of software for IBM compatible to perform direct automated international dialling is now available.

Costs: Software is free or very cheap to use for non commercial purposes and a 2400 baud rate modem costs only about $100. A high speed modem costing $400 to $600 capable of 9600 bauds or higher is also available where several people can share one personal computer and transmit large amounts of data at a faster rate. It also does not involve paying for receiving messages. However, here too there will be a registration fee, quarterly rental and usage fees. Greennet with nodes in many parts of the world including Africa and Asia charge only a fraction of the going commercial price. The file transfer protocols used are also quite effective for large file transfers.

Local networks in Africa

The networks mentioned below are in different stages of realization.

ESANET (Uganda, Tanzania, Zambia, Zimbabwe, Kenya); RIO (Senegal, Mali, Niger, Burkina Faso, Togo, Cameroon, Congo); NGONET (Tunisia, Senegal, Kenya, Zimbabwe); WEDNET (Senegal, Burkina Faso, Ghana, Nigeria, Sudan, Kenya, Zambia, Zimbabwe); HEALTHNET-SATELIFE (Uganda, Kenya, Tanzania, Zambia, Zimbabwe); PADISNET (34 countries connected based at the UN Economic Commission for Africa); WORKNET (South Africa); MANGO (Zimbabwe, S. Africa); ARSONET (Ethiopia, Senegal, Kenya, Egypt).

All these nets could be interconnected at a later stage.

Basic skills and Training: A self installing software for IBM pcs which can perform direct international dialling can be ideally installed in half an hour by someone without any special skills other than basic familiarity with keyboard. For those with some familiarity with computer (eg word processing for) applications, a half-day, hands on training workshop is enough to gain familiarity to send and receive files and messages. However,to maintain a system supporting a group of users, several days of training might be necessary.

3. Local Network Applications

Local networks with a Fido bulletin board system help users to connect to the local node which acts as a gateway to international gateways like Greennet in London. This helps the user to share the costs of the international connection among other users of the local network, rather than compete for scarce and expensive international lines.

How it works: Nodes at different places on a network run Fido software on an IBM compatible At with 40MB hd, have a high speed modem and a dedicated phone line. Users connect to the nearest node providing them with a link to the global network for receiving

or sending private messages and public bulletins via an international gateway (like Greenet London)

Efficiency: Speeds of 220 characters per second(cps) are achieved even on poor phone lines using a 2400 baud modem. Automatic message and file compression ensures that it is possible to transmit 40,000 characters(about 6500 words) during a one minute call.

Constraints: cost of equipment; availability of skilled people to maintain the system; availability of spare parts and; cost and availability of technical support from vendors. Barriers to rapid implementation are the need to train system operators and high state tariffs on computer and communications equipment.

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USING DESKTOP PUBLISHING (DTP) FOR RURAL DEVELOPMENT

The design and production of teaching aids and learning materials is a difficult, expensive and time consuming task that requires skills, equipment and physical facilities usually unavailable in rural areas of developing countries. Desktop Publishing(DTP) offers many new opportunities. DTP combines typesetting, graphics production, in a low cost, user friendly package.

What is Desktop Publishing (DTP) ?

Desktop publishing (DTP) combines computing, graphics, and computer generated typography. It brings together the capabilities of typesetting, graphic and typographic design, and reproduction quality output in an integrated hardware and software configuration.

What Operations Can You Perform with a DTP System ?

- combining text and images (created on the DTP system or imported from outside);
- manipulating text and images e.g. select different typefaces and typesizes, change the size and shape of images, run text around images, etc.;
- Formatting text and images into a page layout using blocks and columns as you choose; and
- Printing out the formatted page ready for reproduction.

Word processing software on DTP systems removes the need for rekeying of authors text which has been produced on another computer.

What Material is a DTP System Suitable For ?

DTP is especially useful in situations where small numbers of good quality, relatively cheap, materials are called for. It can be used to produce anything from a single sheet newsletter to a book. The controlling factors being the particular software being used and the skill of the operator(s).

What are the Hard and Software Requirements ?

DTP software and hardware can be run on a Macintosh or IBM compatible PC. In addition to a good and reliable power supply, for either case basic hard and software requirements are the same. Basic hardware includes:

- a central processing unit (CPU);
- a monitor;
- a keyboard;
- a mouse;
- hard and floppy disks;
- a laser printer;
- a dot matrix printer for proofs; and
- a scanner.

Basic software includes:

- a word processing package;
- a DTP program; and
- a graphics program.

What is the Cost of a DTP System ?

There is a huge array of soft and hardware available, but it is possible to set up a single user system for between $2,000-6,500. Variations in price depend on:

- amount of memory;
- speed of processing; and
- resolution required on final output (resolution is the number of dots per inch printed on the page, the more dots the sharper the image).

Educational Materials Production System in Zimbabwe

The Training branch of the Zimbabwe Agricultural, Technical and Extension Services Department (AGRITEX) introduced a DTP system to develop printed educational materials to support extension staff and trainers, which was low cost, good quality and quick and easy to use. The hardware used was: 8 Macintosh SE computers, with 2Mb RAM, 40 Mb hardware and an internal floppy disk drive; 4 ImageWriter II dotmatrix printers; 2 Apple LaserWriter II NT laser printers; 1 SuperMac 19 inch display monitor; 1 Apple Scanner and; 10 Apple LocalTalk network systems. The Software used was Microsoft Word 4.0 and Aldus PageMaker 4.0, and Superpaint 2.0 for production of artwork.

150 hours of training for typist/wordprocessor operators and graphic artists were given as well as for computer wordprocessing and editing. This initial training was later supplemented by up to 250 to 300 hours of instruction on a daily basis which helped raise the skill level of trainees to an effective professional standard.

The most visible result was improvement in appearance of AGRITEX newsletters. DTP was also used for production of internal organizational charts, reports and proceedings of workshops and seminars, field support publications. There was also a significant saving in time devoted for production of printed documents.

What Skills are Needed to Use a DTP System ?

- typographic and graphic design skills;
- editing skills; and
- computing skills.

DTP systems **enable** you to carry out complex editing and design tasks, they **do not make the decisions** for you.

What Training is Needed to Use a DTP System ?

Training varies depending on the skills of those who are to be trained and the complexity of the system. However, there seems to be a general consensus that:

- initial skills need to be given on an intensive basis;
- 'handholding' training needs to go on for some time (up to 2 years in some cases) to enable trainees to grasp the complexities of the programmes; and
- training must cover skills other than those needed to operate the system (eg. general communication, editing and design principles).

DTP in Literacy and Environmental Protection

To produce a monthly newsletter for the EC funded Environmental Protection Program in N. Nigeria a DTP system was introduced. Hardware used was: 386 SX IBM compatible PC with 33 MHz processor speed; 8 Mb RAM; 210 Mb hard disk; SVGA Monitor; Mouse; Flatbed optical scanner and; Postscript laser printer. Software used was Wordperfect for Windows (word processing), Coreldraw (graphics program) and Ventura Gold (DTP program). Text from selected articles were keyboarded into the computer and run into page layouts. Photographs from color prints were scanned and scaled to the layouts. The finished page was then laser printed and sent for printing at local print-shops. Production of each four-page newsletter took 2 weeks from start to distribution.

The impact on the literacy program was found to be high. Instructors at adult literacy classes found the material to be of great use for reading practice and discussion. VIPs and administrators at Sokoto City were also impressed by the output, which in turn helped oil the wheels at important decision-making meetings.

Ideally a 486 with a faster processor, black and white prints for better scan output and increased laser printer RAM, would have improved delivery time and product.

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USING DECISION SUPPORT SOFTWARE IN RURAL DEVELOPMENT

Decision Support Software enhances the users capability of making timely and knowledgeable planning, management and analysis decisions. These applications can automate routine decision activities, or organize collected information in a more meaningful manner. Expert systems provide advice to field users or aid in organizing complex activities. The potential for using this software in the rural development context encompasses primary health care, crop protection, pollution control, extension, various agricultural applications etc. It's user-friendly nature permits use by all levels of management, field workers and farmers.

What is Decision Support Software ?

Decision Support Software, are computer programs that use knowledge, facts and reasoning techniques to solve problems and assist users in:

- planning;
- management;
- analysis activities; and
- problem solving.

Programs have been developed for:

- accounting;
- statistical analysis;
- inventory management;
- quality control; and
- range of agricultural applications.

How does it work ?

Decision Support Software that incorporates an expert system needs three components.

1. *Knowledge base*

The base consists of rules and facts which the system will use to guide the decision making process. These will be based on the knowledge of experts on the subject.

Types of Expert Systems

An Expert system is one in which the user asks the system a question and is given an answer with minimum dialogue between user and system

In the Colleague system the user consults the system and chooses whether or not to accept the expert's advice. If the advice were not acceptable, the user will provide additional information to the system for further processing.

The Advisor system is where a user consults the system for advice or confirmation of a decision. Typically the system would provide several alternatives to answers to a problem.

2. ***Inference mechanism***

This controls the selection of facts and rules. Rules are searched and deductions made as to which rules apply, and further information needs are identified before and answer is provided.

3. ***Interface***

This is the method by which the user and the system communicate. In most cases it will use a computer and a keyboard for interaction.

Advantages of Decision Support Software

Decision Support Software enhances the users capabilities to make timely and knowledgeable planning, management, and analysis decisions. These applications can automate routine decision activities, or organize collected information in a more meaningful manner. They can provide expert advice to field users, or aid in organizing complex activities. Some of the benefits of decision support software include:

- non programmers may develop expert systems using inexpensive software "shells";
- improved decision making and problem solving;
- automation of routine decision making;
- development of expertise in less experienced staff;
- improved staff productivity;
- improved user efficiency or effectiveness;
- wider distribution of scarce expertise;
- faster problem diagnosis;
- faster response time; and
- consistency in decisions over a period of time.

Using Decision Support Software in Agriculture Extension& Training

A range of functions can be accomplished in agriculture extension using this software. Activities can range from farm management expert systems to accounting or record keeping. These applications increase the information available to the user and assist in the decision making process. Programs can be used to solve statistical problems, to evaluate data, simulate activities, or track costs. Software has been developed for crop and livestock management. For example the calculation of nutritional intake of a cow based on the animal's weight, calculation of pregnancy probability based on weight at breeding, and forecasting calf weight. Programmers can determine how much fertilizer to use, how often and how much to irrigates crops, how much pesticides to use, the expected value of harvests and the best marketing or storage strategy for crops.

Requirements

1. *Hardware and Software*

Hardware requirements may vary from program to program. Basic requirements are:

- 640K or RAM (random access memory)
- computer
- monochrome or color monitor
- hard disk with at least 5 megabytes of space

Some Decision Support Software programs that are available include the following:

- Accounting: DACEasy (DAC), $100; and Quicken (Intuit), $70.
- Expert System Shell: Expert 4 (BioSoft), $299; VP Expert 2.2, $49; and MacroMind, $ 495.

2. *Skills*

A general knowledge of the subject area is required. Documentation is provided an provides adequate instruction.

An expert system can be created using an expert system shell. Most shells have built in inference mechanisms. However the programmer has to provide the rules and facts that the shell has to obey.

The "Synapse" Expert System

Canada's International Development Research Center (IDRC) supported by researchers at the National University of Singapore and Total Recovery Systems International have developed an Expert System shell that captures the expertise necessary in low technology industries that depend on experience. The shell, called "Synapse" can be learned in minutes, even by users unfamiliar with computers. Users "draw" the process that they are familiar with (expert on) on screen by selecting various shapes and symbols from an extensive menu of "icons". In this way hot air blowers, thermometers, valves, etc. are represented. Next, experience is transferred by users specifying which instruments require monitoring by the computer. In response to the system's prompts, the facts are inputed.

Currently Synapse is being tested in tea factories in Sri Lanka which have quality and consistency problems in the processing of green tea leaves. It is envisaged that the system can be used for soap makers, cheese producers and other industries where maintaining quality control is a must. It is suitable as well, for overseeing instruments used in fisheries, agriculture, environmental monitoring, research and health care.

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USING GEOGRAPHIC INFORMATION SYSTEM (GIS) IN RURAL DEVELOPMENT

GIS is a systematically designed, spatially indexed approach for organizing information about places or regions in order to facilitate analysis of relationships between different social, economic and environmental variables. It is rapidly becoming an affordable technology with substantial immediate as well as long term benefits for developing countries. The various applications of GIS have a role to play in rural development.

What is GIS ?

A GIS is a computer software which combines the capabilities of:

- computer mapping
- tabular database management
- statistical analysis
- spatial modelling

With a GIS you can carry out the following operations using different kinds of data (spatial and non-spatial) relating to one location:

- capture
- store
- manage
- manipulate
- analyze
- visualize

A GIS is not simply one piece of software, running on a computer, rather it is a combination of different kinds of hardware (computers and their peripherals) and software put together for particular application in different working environments centered around GIS software.

What are the applications of GIS ?

The main applications of GIS include:

- land use analysis
- thematic mapping (eg soil type)
- site selection
- socio-economic studies
- demographic analysis
- physical analysis
- environmental management

Specific sectoral applications and examples include:

- Agriculture: China, micro-watershed planning
- Education: Malaysia, poverty and transition rates
- Community planning: Japan, land use analysis
- Health: Vietnam, changes in fertility and infant mortality
- Environment: Mexico, analysis of biodiversity

What hardware and software makes up a GIS system ?

Until fairly recently most GIS systems were put together around powerful micro-computers or mainframes. Nowadays (1993) systems can be put together around a PC.

Hardware and software requirements for a GIS are impossible to state because it depends on what you want to do with it and where you want to use it. What is listed here is a general statement about the kind of products available.

Hardware products include:

- computers
- fileservers
- workstations
- digitizers for data capture
- plotters for graphic output
- terminals
- printers

Software products include:

- computer operating system
- the GIS program
- database management system
- special application packages (eg network analysis, digital terrain modelling)

Setting up and implementing

Setting up a GIS is a complicated process usually involving specialist consultants. The sequence of steps involved will vary from project to project, some steps will be carried out at the same time, some will happen in parallel and some in sequence. GIS software has been developed to supply the needs of the largest numbers of customers. This means that software may not fit exact requirements, and will need to be customized. Software tools which enable this have been developed and training is available in their use. Exactly how long a step takes and the amount of work involved will depend on the size of system to be installed, the numbers of people who will use it, the kind of applications it will be used for, etc.

What Training is Needed?

Given the range of hardware, software and applications for GIS that specifying details of training is difficult. Training is essential for everybody involved in using GIS and is a critical factor in the successful use of the

GIS in Watershed Management

IT Lab, Asia Technical Department of the World Bank tested the feasibility and utility of GIS techniques for supporting the development and evaluation of land use development plans in small watersheds in China. It evaluated the prospects for widespread adaptation of these techniques, especially the practical utility of Digital Elevation Modelling for evaluating landscape characteristics of small watersheds.

The technology used was ARC/INFO software running on a SUN workstation. Datasets were later downloaded to an IBM PC running PC ARC/INFO and were also converted to SPANS/GIS and Atlas-GIS (for comparative evaluation). Chinese agricultural engineers provided field data in the form of 1:10,000 maps. Maps and tabular input data were based on extensive field surveys and were considered to be of high quality.

GIS was shown to be a cost effective way of collating and analyzing detailed land resource data for small watersheds. Creation of digital databases was straightforward and could be completed within several days of receiving the maps. DEM provided a very effective visualization tool for three dimensional perspective views of the watershed, which were highly effective at communicating the development opportunities and constraints present at specific sites. Tabular and graphical outputs from DEM were used to identify potential development sites, superimposition techniques helped to show how land is currently being used and overlay techniques were used to compare proposed land use against its physical characteristics.

system. The organization employing a GIS must provide training for employees who will use the system.

- different levels of training required dependent on whether employee is a 'casual' user, fulltime user or a technical support staff
- GIS software vendors usually provides initial user training using its own training centers and manuals

Constraints

GIS, and related technologies such as satellite remote sensing have suffered from a credibility gap because development of GIS has been pushed from a suppliers perspective of what is technically possible rather than the user's perspective of what is needed or a clear articulation of the benefits expected from GIS use. In addition to satisfying the user's perspective on needs and benefits the following have been noted as constraints to successful implementation.

1. ***Baseline data availability***

   Successful use requires significant information infrastructure to support its widespread use. Data availability can be patchy in developing countries. Few countries have made adequate investments in field surveying and mapping to warrant GIS implementation.

GIS in Environmental Impact Assessment

The IT Lab, Asia Technical Department of the World Bank tested, in Nepal, the feasibility of developing a comprehensive, geographically referenced database consisting of a number of natural resource themes. The suitability of personal computer based GIS to carry out analytical tasks was evaluated and training was provided to Nepali technicians on the use of GIS technology for environmental impact assessments.

Land use and land capability maps derived from air photo interpretation, satellite image work were used. Technology was IBM PC running PC ARC/INFO (GIS) software (digitizer, small plotter etc.) The total cost of the GIS component of the impact study was about $20,000. The costs covered technician labour, GIS software, and hardware. In-service training was provided in ARC/INFO software use and database management to a technician who had a background in remote sensing and GIS. Awareness training through workshops and seminars was provided to subject matter specialists who needed to understand the strengths and limitations of GIS in order to formulate ideas for effective GIS use for different applications.
The contribution of GIS both as a planning and implementation monitoring tool was considered well worth the investment. GIS provided an excellent overview of a vast area and was immediately useful in visualizing and understanding the distribution of land use types, their characteristics and associated factors affecting each area. Query system provided with instant analytical maps of each assumption on land use. Success was mostly due to high level of commitment by staff, availability of high quality basemaps of known reliability, GIS software available on a personal computer environment (reduced user anxiety involved with larger workstations). Also low cost of PC hardware and software ensured the cost-effectiveness of the approach.

2. ***Lack of decision making context in which to use information***

In the developed world, the use of GIS is often driven by legislated reporting requirements which leave agencies with little choice but to adopt elaborate information systems for their documentation and reporting needs.

3. ***Lack of financial commitment***

Developing countries view intensive data gathering and analysis as a luxury relative to other pressing problems. There is also a lack of financial commitment to keep datasets current and up to date, which is costly and time consuming.

4. ***Technical manpower constraints***

Widespread use of GIS requires skills for both baseline data gathering and for GIS operations. Computer and data processing skills are poorly developed in general and few agencies can afford to have specialized GIS expertise. The problem of manpower constraints is not limited simply to technicians but applies to planners and decision makers who do fully appreciate the value of spatial based planning approaches.

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USING INTERACTIVE MULTI MEDIA IN RURAL DEVELOPMENT

The combination of computer and video has resulted in a remarkable new educational technology - Interactive Multimedia or Interactive Video. A major benefit of this technology is that it permits students to learn interactively using real situations, at a time, pace, and location suitable to them. Research on the effectiveness of IMM has found that it reduces learning time, increased learner retention, and reduced training costs.

What is Interactive Multimedia ?

Multimedia means many media - text, video, narrated sound, music, graphics, animations, special effects etc. which are controlled, coordinated and integrated by a computer. Special software enables users to interact with multimedia material using keyboard, mouse, touch screen etc. Hence the term interactive multimedia (or IMM). IMM permits the storage of massive amounts of data, graphics, text, still and moving images, and sound on a compact disc, which can be run on a PC. There are two aspects of IMM, the use and creation of IMM products.

At present the creation of IMM products for education and training is largely confined to industrialized or technologically advanced nations. The development of cheaper software may make it more accessible to developing countries, but the issue of human resources to create and produce multi-media products will still need to be addressed.

Future developments in IMM

McQuiller (1992) predicts that by the mid 1990's multi-media will be corporately networked and its influence will extend to "education and training, desktop video-conferencing, -network-wide conferencing, electronic mail, audio visual presentations, databases, groupware, desktop video production, electronic newsletters and information services.

The Use of IMM Products

IMM as a Training Tool

IMM multimedia training packages can complement educational drives where existing labour and technology cannot meet the education and training needs. It is especially useful in situations where:

- offering easy access to instruction is important;
- there are many people to be trained;
- learners vary in experience, knowledge or skill;
- 'hands-on' training is important, but difficult to arrange or dangerous;
- decision making and problem solving skills are vital;

- where access to a standard body of knowledge is important (see Cervical Cytology Training Program); and
- where learners have a wide range of learning strategies to be satisfied.

What Kinds of Training can IMM be Used for ?

Because this is such a new technology its full potential has yet to be explored. But the following examples give an idea of what can be done.

- The Open Learning Center at John Moores University, Liverpool, UK has produced a Cervical Cytology Training Course for technicians who have to read cervical smears. This course won the Gold for the Best Interactive Design at the 1993 European Multimedia Awards. The Center hopes the course will create a standard in an area of work where training is variable because people learn by apprenticeship in laboratories which may never receive a full set of abnormal and normal smears. The IMM will be used in laboratories to provide learners with a full range of experience.
- Aboriginal and Torres Strait Islanders (Australia) para professional teachers are being helped to upgrade their qualifications through a program created by RATEP (Remote Area Teacher Education Program). The RATEP team has carried out extensive research to ensure that culturally appropriate learning strategies can be accommodated by the training package.

IMM Training Program for Water Management Engineers in India

International Information Technology (IIT) was involved with the training of water management engineers in India, using five interactive video disc problem solving programmes on maintenance, crop water requirements, drainage, water users associations, and water flow measurement skills. The technology needed to run the program to run the program consisted of: 1. Microcomputer (hard disc); 2. User interface (monitor, mouse and keyboard); 3. Video overlay board, and; 4. Laser videodisc player.

Training time for the engineers was less than half an hour. They had to learn how to put the disc in the videodisc player, how to log on and how to handle the equipment. For technical staff in the multi-media room, a days training was needed. They had to learn how to make up a back-up of trainee files and how to trouble shoot minor problems with hardware and software. The interactive program allows the trainees to see different views of inspection sites and problem areas along the ditch. Almost real field experience is provided on screen using the program. By clicking on windows inset on the screen, trainees can get a menu of specific problems to be solved.

The overall cost of the IVD equipment for use with trainees was approximately $6000 per IVD system, plus another 10 per cent per year for servicing. The average cost of the IVD training program was $30 to $150 per trainee week.

- The National Library of Medicine, Bethesda, Maryland, has around 30 different workstations running hundreds of interactive multimedia medical programs. One interactive program, for example, puts the user in the Emergency Room when a patient is brought in. This gives the user an almost 'real life' experience of being an Emergency Room doctor in the same situation.
- International Information Technology Projects of the Education Development Center at MIT, USA, used multimedia technology to produce five interactive video disc problem-solving programs on maintenance, crop water requirements, drainage, water users associations, and water flow measurement skills, to help train water management engineers at Institutes in India.

What can IMM Training Packages be Used for?

IMM can be used for direct training or for training of trainers. Possible areas of use include:

- Irrigation management;
- Medical training;
- Industrial training;
- Equipment maintenance;
- Public health information;
- Hazardous materials handling; and
- Teacher training.

Advantages of IMM

- Shifts from passive to active learning
- Empowerment of learners who can learn at their own pace

Proposed IMM environment program

The Environment and Multi-media Consortium, is planning to produce an interactive multi-media education package on a series of critical environment and development issues. The package will be used to train students and aid decision makers in the government of developing countries. The consortium includes the World Bank, World Resources Institute, Danish International Development Agency, Worldwide Fund for Nature, Television Trust for the Environment, and UN bodies.

Using intellectual and audiovisual material related to environment and development issues available from members of the Consortium, the project proposes to design 12 interactive multimedia discs as part of the package. The user of the package will be able to package explore and research the information it contains and also adopt various roles as farmer, government official, investor etc. to see how different input decisions will affect the end result. Users will have access to an extensive range of primary resource materials including video clips and photographs of project sites, interviews with experts, project documents and maps. Models will be provided to explore 'What if' situations and GIS (Geographic Information System) tools will enable them to investigate spatial aspects of problems.

Projected costs for production of an interactive multi-media package of two CD ROM on 'Water and Irrigation', is estimated from $1.37 million to $1.70 million depending on the level of sophistication of the final product.

- Provides "real world" applications
- Maintains quality control
- Raises retention by 40%
- Reduces learning time by 50%
- Skills improvement by 15%

Costs

The cost of producing training programmes varies according to levels of complexity. The amount of video and stills, the complexity of the animation and graphics, complexity of the program, sophistication of the design, the number of languages in which the program is presented. A video disc training program can be produced for as little as $35,000 or for as much as $3,000,000 depending on the above arameters.

Sources of Information

Multimedia & Videodisc Monitor, P. O. Box 26, Falls Church VA 22040 (T: 703 341 1799).

Education Development Center, Inc. 55 Chapel Street, Newton, MA 02160 (T: 617 969 7100, Fax: 617 332 6405).

Society for Applied Learning Technology, 50 Culpeper St. Warrington, VA 22186 (T: 703 347 0055).

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Interactive multimedia for culturally appropriate learning

Educational institutions involved with the Queensland Remote Area Teacher Education Program (RATEP) in Australia, are assisting Aboriginal and Torres Strait Islander paraprofessional teachers to upgrade their qualifications and career aspirations by providing them with culturally appropriate Interactive Multimedia learning methods. Creation of an IMM product which could empower, extend and enrich the student's culturally specific knowledge and ways of thinking and achieve a nexus between these and the demands of the required academic culture. Interactive multimedia courseware being developed had to recognize and incorporate current-traditional ways of learning of Torres Strait Islanders, accommodate the specific requirements of an academic culture (ie. course work, written and oral work specific to university culture and, incorporate design features that provided students with the means to control the matching of their academic learning tasks with their cultural and individual ways of learning. The cyclic model proved extremely acceptable to the students, who liked being able to work at their own pace. IMM courseware was found to be entirely appropriate for visual-oral learners. The use of Authorware Professional generated text, graphics, stills and diagrams with sound to illustrate or emphasize concepts or processes and simple animations such as moving arrows to link causal relationships provided a holistic multi-sensory learning environment, which reflected current-traditional informal learning far more than any static display of text and graphics.

USING PACKET RADIO IN RURAL DEVELOPMENT

Packet Radio, which combines radio and computer technology, has the potential to provide the "missing link" of reliable and inexpensive communications between isolated regions[2].

What is Packet Radio ?

Packet radio combines radio and computing technologies in a system that lets personal computers (PC's) communicate with each other using radio frequencies at low cost.

The Technology Required

Each packet radio station needs:

- a reliable power supply; and
- permission to use the radio frequencies.

Each packet radio station consists of:

- a PC;
- a radio transceiver;
- a terminal code controller (TNC) (this is also called a radio modem);
- a printer; and
- an antenna.

The Future of Packet Radio

A niche exists for the use of digital communications. In spite of the number of installations, the use of packet radio, particularly when linked to LEO satellites (see annex 9), is in it's infancy. Full scale implementation has yet to be evaluated and questions on the life expectancy of equipment, provision of spare parts, maintenance etc. remain to answered. On the positive side, frequencies have recently been assigned for LEO satellite use and LEO programs are going ahead. Therefore the future for packet radio linked by satellite looks bright.

How Does Packet Radio Work ?

- messages are entered into the PC;
- the sending TNC (modem) breaks the messages into small packets and codes them for transmission;

[2] VITA (Volunteers in Technical Assistance) is a major private voluntary organization pursuing this technology.

- the radio transmits these packets to the receiving radio;
- the receiving TNC (modem) decodes the packets; and
- the decoded packets appear as messages on the PC. They can be stored or printed out as needed.

What Kind of Material Can Be Sent Over Packet Radio ?

All kinds of computer files can be transmitted over a packet radio network, including text, spreadsheets, database result sets and graphics.

What is the Range of Communication?

The distance between computers is governed by the radio frequencies used. The clarity of the link is dependent on whether voice radio signals on the same frequency are good or not. The optimal radio frequencies are VHF (very high frequency) and UHF (ultra high frequency). These restrict the distance between computers to a range of 100-150 kilometres. Less ideal frequencies are HF (high frequencies). Using HF, the distance between computers can be extended to a range of between 1000-3000 kilometres provided there is little interference.

Can the Range be Extended ?

Ground based packet radio stations can be linked by satellite where great distances need to be covered (either within a country or for international links). Low-earth orbiting satellite systems (LEO's) are used for this purpose. LEO satellites circle the earth at 800 kilometres.

Packet Radio Network Installations

Ground based or terrestrial networks

Sudan (1989): 6 station solar powered packet radio network for UNDP in Sudan, linked field projects to headquarters in Khartoum for administrative use (VITAPAC)

Sudan (1990): 6 station network for CARE and for Relief and Rehabilitation Commission of Sudan - Disaster relief (VITAPAC)

Jamaica (1988): Packet radio network for Office of Disaster Preparedness, Jamaica - disaster relief (VITAPAC)

Philippines (1988/89): Network of packet stations between Department of Health regional and central offices - Health information (VITAPAC)

Somalia: VITASAT ground station in N. Somalia where no other international communication facilities available. Operated by Christian Aid to coordinate relief activities - disaster relief.

Ethiopia: Packet radio network for Ethiopian Government Relief and Rehabilitation Commission to coordinate relief operations. (Installed as part of CARE's Commodity Monitoring Project) - Disaster relief (VITAPAC)

Madagascar: Packet radio network between Grants Management Unit of the Sustainable Approaches to Viable Environmental Management Program HQs and project offices - Environment (VITAPAC).

They have a 5,000 kilometres 'footprint' that passes every spot on earth at least 4 times daily. When the satellite is in range it signals the ground station and will receive or send messages even if the station is unattended. Where there is a telecommunications infrastructure packet radio stations can also be linked into existing worldwide networks such as the Internet, Fidonet and BITNET.

What Kind of Costs are Involved ?

According to Garriott (1993) the costs of installing and operating a packet radio system can only be determined by studying the specific environmental variables of each location. However, as far as the installation itself is concerned he estimates the cost of the basic station (excluding the computer) to be between $2000-$10,000. The variation in cost is dependent on:

- the quality of the radio required;
- the quality of the antenna system; and
- the source of stable electricity (whether from mains, generators, or solar panel/battery combinations)

Satellite linked packet radio stations

Pakistan: VITASAT ground stations in Peshawar for UN High Commissioner for Refugees - to facilitate administrative communications between Peshawar and Geneva offices.

Indonesia: VITASAT ground stations for monitoring energy applications - Energy monitoring.

Tanzania: VITASAT ground stations for communication between Kibidula Farm Institute's ground station near Iringa and its offices in the US and for technology exchange with VITA on agriculture.

Sierra Leone: VITASAT ground station for PLAN International to communicate with its HQ in Rhode Island.

Advantages of Packet Radio

The advantages of **ground** based or terrestrial packet radio are:

- Quick access to information;
- Links for small enterprises with market, credit sources, suppliers, local and regional centres, etc.;
- Permits transmission of messages, letters, spreadsheets, reports and images;
- Error free messages;
- No manual transcription needed;
- No decoding of messages needed;
- Computers can be used for other purposes when not receiving or sending transfer of text and binary files;
- Power source can be solar cells or lead acid batteries or direct power; and
- System permits channel sharing - several stations can hold digital conversations at the same time.

The advantages of linking packet radio and satellites are:

- Satellite use ensures packet radio exchange of information from anywhere in the world within 24 hours; and
- Portable stations the size of suitcases means there is no need to be near urban centres for information retrieval and transfer.

What Kind of Training is Needed ?

Training needs to be carefully considered. There are two levels of training required:

1. *Operator*

   For this level trainees need to have basic computing skills such as familiarity with DOS commands and the ability to use a word-processing program A well motivated person can be trained in a day if one-to-one training is provided.

2. *System training*

   For this level trainees need to be familiar with radios and computers or have a background in radio installation and system trouble-shooting. On-the-job training of several weeks is needed to grasp basic system trouble-shooting techniques.

In Country Ground Based Packet Radio Network: Agriculture Work in Sudan

The UNDP uses VITAPAC packet radio consisting of PC, TNC, Radio transceiver antenna and printer to transmit field data, reports, administrative communication, technical and agricultural information between UNDP HQs in Khartoum and five field offices in rural Sudan. Messages which used to be hand carried, or sent by telex or radio where such connections existed, can now be sent over the packet radio network quickly and without error.

On site training for local staff folowed by a two day training session for each packet site team, involving hands on instruction in the more advanced features of the packet system, from VITA volunteers was provided towards the end of the project. Operators received more than 20 hours of training in addition to the hours they spend experimenting on their own.

Experimental Packet Radio: Health Work in the Philippines

The Dept. of Health, Philippines, is testing packet use as a communication tool between the DOH, Manila and regional offices. Connection was made and information transfer was made in both directions. No hardware or software failures occurred at any point during the training or demonstration sessions.

Factors in Planning for Success

Experience with, and evaluation of, the installation and use of packet radio is still limited. However, some factors are emerging which need to be addressed if implementation is to be successful. They are:

- *Need.* Analysis to establish need is essential, for example, what will the system be used for, who will use it, how often, and how much 'traffic' will there be;
- *Technical feasibility.* A study is needed to ascertain: the quality of the radio communication link there is likely to be between one station and another; the source and stability of the power supply;
- *Licensing/regulatory issues.* In most countries this is a very political subject and there is no one system in place, sufficient to say that the licensing/regulatory system needs to be known about and complied with; and
- *Staffing.* It is important to check out that people with the necessary levels of computing/radio skills which can be built on are available. Training from scratch is a lengthy process and leaves organisations and communities vulnerable if the only trained people should leave.

Satellite Linked Packet Radio: CANADA -INDONESIA

Gadjah Mada University Indonesia and McMaster University, Canada use Packet Radio technology comprising a PC with 40Mb Hd, a transmitter, a receiver, antenna and a modem which converts computer characteristics to sound and vice versa, to form a electronic health data communication network between different health center offices in Central Java. The system has proved very useful for communication to distant offices that do not have automatic telephones. Also the health information electronic network is seen as a reasonably reliable network for health information.

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USING RADIO IN RURAL DEVELOPMENT

Radio's wide reach and low cost provide effective and efficient communication in rural areas. While television remains only in the hands of a small percentage of the population in developing countries, low-cost transistor radios run on batteries are now affordable even for the poorer sections of the population. Unlike newspapers and magazines, radio does not require literacy. The increasing shift to local radio program production and broadcasting is also removing barriers of language and dialect. As a result, radio has become a valuable channel for dissemination of information, for training and education, for broad segments of rural communities in developing countries.

Radio for Sustainable Development

Sustainable development depends in part on ensuring that people in rural areas have access to information they need. To adopt new, sustainable practices, farmers need information they can understand and apply in a timely fashion. They need information about market and input prices. They need information about emergency situations, e.g., related to weather or pest infestations. Face-to-face communications between extension agents and farmers, while crucial, cannot fill all of these needs. Extension agents are too few and, particularly in emergencies, time is too short. Similar information needs apply to other rural groups. As a result, radio has been recognized as a highly cost-effective technology to convey information, training, and education.

Ecuador: Grassroots Participation in Radio Programming.

Radio Latacunga, which serves Cotopaxi (76 percent rural, of which 50 percent of the population is indigenous from the Quechua nation) in the highlands of Ecuador, is breaking the traditional top down communication model of radio by ensuring participation of the locals in radio programming to make sure that the community's real history and real situation are known. Seven recording studios have been set up in peasant and indigenous organizations in the area. Peasants and indigenous people of the area produce educational and news programs in Quechua and Spanish as part of the station's rural programming. People are encouraged to transmit their problems, needs, or messages for their organizations and families by writing in or phoning in. Modern mobile studios are used for moving into any part of the province so that live programs involving the participation of the population can be transmitted.

Uses of Radio in Rural Areas

- Regular broadcast of information
- Broadcast of emergency bulletins

- Broadcast of "social marketing" messages, often in the form of stories or dramas Broadcast of education or training instruction
- Interactive radio instruction (IRI), which incorporates instruction, active participation, and reinforcement of correct answers (interactive radio programs are designed with pauses for student responses. After the pause, there is feedback that corrects an incorrect response or reinforces a correct one).

In-school interactive radio

Interactive radio programs have been developed for a wide variety of subjects, including mathematics, languages, arts, science education, health, and environmental education. Most studies of interactive radio instruction (IRI) examine classroom use, and conclude that IRI can significantly improve student achievement. For example: The Thailand Radio Mathematics Experiment (grades 1-3) raised student math achievement significantly, and reduced disparities between rural and urban students; The Kenya Radio Language Arts Program showed that the interactive radio program was significantly more effective in raising achievement than were textbooks ; In a Honduras study, IRI learning was much higher than textbook classes and then conventional classes, and; A Guatemalan education radio project substantially reduced dropout rates among the Shuar.

Some of the advantages of IRI are: Primary students usually learn more by IRI than by conventional teaching; Often they learn more at lower costs; IRI improves teaching quality and consistency; Even untrained "teachers" use IRI effectively; Recurrent costs per student per year are low; Few supplementary materials are needed, and; IRI reaches under-served populations: girls, the rural-remote, the poor, minorities, and the disabled.

Requirements

1. ***Design requirements***

The effectiveness of radio training programs depends on the design and quality of the content. The goals of the program need to be clear, appropriate for the audience, and relevant to learners' experience and culture. The program must be engaging and delivered in a language listeners understand.

2. ***Financial requirements***

Although radio is cost-effective, it does require investment in a number of elements. First, a large number of radios are required. In most developing countries, there is already a substantial installed base of radios, purchased by individuals. Second, courseware must be

developed. In many cases, this cost can be reduced by using radio programs that already exist and adapting them to particular contexts. Third, if supplementary material is needed, it must be produced and distributed. Fourth, the cost of transmission must be covered. Finally, there must be sufficient resources to plan, implement, and institutionalize the radio program. Even considering all of these costs, radio has been shown to be highly cost effective for education. Operating costs of IRI have been calculated to be $.40 - $3.00 per student/course/year, which is very close to the cost of text books

3. ***Human resource requirements***

Some instructional radio programs require supplementary instruction or explanation. If face-to-face instruction is needed, e.g., from an extension agent, a teacher, or a facilitator, those providing the instruction or assistance to follow up on the program, may require training.

Management skills are also extremely important. Programs must be designed and produced, often involving an array of individuals, from content experts to script writers and actors. In some cases, print materials must be designed and be delivered. If trainers, extension agents, or teachers need to be trained, training-of-trainer activities must be conducted. Individuals running the radio programs must be able to work effectively with local, national, and international organizations. For long-term success, radio education/training programs require careful integration into existing education, training, and extension programs. Given these demanding management tasks, those managing radio education/training programs may need training in management skills.

Thailand: Hill Tribe Education

Since radio was widespread among tribes people, with large numbers carrying transistor radios with them on their daily chores, a radio-oriented non-formal adult education program for the hill tribes of Chiang Mai was developed and broadcast on the Chiang Mai Radio Station.

Seven extension agents working in the area and nine broadcasters from the Chiang Mai station were trained at a Non-formal Educational Broadcasting workshop conducted in Chiang Mai in July 1980. Participants were introduced to the scope of non-formal education and methods of developing curricula for its successful implementation. They were also made aware of the importance of grassroots participation and the need for helping rural people to identify their most pressing problems and to actively work towards resolving them. Participants were then trained on producing radio programs recorded on cassette. In two weeks, participants were able to produce three local language radio programs, which were then played back in the villages. After playback, listeners comments were recorded on the reverse of the cassettes, providing for a start of radio broadcast on nonformal education.close to the cost of textbooks. Although this estimate excludes the capital cost of instructional development, calculations of textbook costs generally exclude those expenses as well. Adapting existing radio programs that have already proven effective can also reduce costs.

4. ***Supplementary materials***

Radio programs delivering vocational or technical training appear to be most effective if they utilize supplemental material, e.g., work sheets or other printed materials. Such material needs to be short, so that learners will use them.

5. ***Hardware***

Radio programs require radios for the audience and radio stations within transmission range. In all developing countries, radios are widely available and relatively inexpensive.

6. ***Technical requirements***

Radio programs depend on the availability of a radio transmission station that can transmit a clear signal and is willing to do so at a reasonable cost. In some instances, education radio has its own independent facilities. In others, the stations are owned by the government. In many developing countries, however, the education/training/information radio programs must rent commercial stations, and scheduling can be difficult.

Radio for training

Radio has been used successfully for adult education and training, particularly for areas or groups that are bypassed by other training programs. Radio training programs include vocational skills development, agricultural extension, health programs, and family planning. In Nepal, for example, the Radio Education Teacher Training project has used IRI for more than 15 years to train primary school teachers who have not passed their school-leaving certificate examination. Of approximately 5,600 teachers enrolled in a 10-month course, nearly 3,000 have successfully passed the exam and are recognized as trained teachers. The participants in the Radio Education Teacher Training Project scored 25% to 50% higher than those attending regular classes.

Agricultural training programs delivered over the radio have also proven highly successful. In Malawi, for example, one project evaluation found that radio trained farmers in new agricultural techniques at costs 3,000 times less per hour than face-to-face extension services.

Future Opportunities

Despite the proven success of radio for informing, educating or training large numbers of people, these programs have not been fully utilized on a national scale in most developing countries. The reasons are unclear. There may be technical problems with weak radio signals, financial problems with recurrent costs, or political problems with resistance from teachers, extension agents, or others. In order to take advantage of this powerful, cost-effective tool for rural development, however, the source of problems needs to be identified and resolved.

Why Scriptwriters Love Radio Drama

Radio drama is often called "theater of the imagination". The absence of fixed images on radio allows each listener to create their own individual pictures of action. Skilled scriptwriters see this as an asset, not a liability. Whether intend to do so or not, all stories influence us through the same process of audience identification with leading characters and their winning ways. There are at least five different dramatic styles (Drama, melodrama, Comedy, Allegory, and Fantasy) that can be adapted to at least six different radio formats (Spots, Vignettes, Plays, Novellas, Soap Operas and Situation Series) in whatever combination will best link the story content with the audience.

Every story has five basic elements (Characters, Conflict, Plot, Climax and Setting) which are described. But how is the story found in the first place (Audience Research, Brainstorming, Field Observations and Audience Drama Workshops) ? Most radio scriptwriters develop the resulting story ideas in three preliminary stages (Plot Summary, Plot Sketch and script Outline).
Every Radio drama is created by integrating four categories of sound (Narration, Dialogue, sound Effects and Music). A radio script is only a blueprint for studio production. Finding talented actors and musicians, rehearsing and recording a drama, and preproduction planning actually brings to life the script in the studio.

Source: Pamela Brook

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USAID, Washington, D.C 20523 (T: 703 875 4490, Fax: 703 875 5490), Contact: Mr. James Hoxeng.

Radio Learning Project, Educational Development Center, 55 Chapel Street, Newton, MA 02160 (T: 617 969 7100, Fax 617 332 6405). Contact: Dr. Thomas Tilson.

Radio and Development, Radio Nederland Training Center, Witte Kruislaan 55, P.O.Box 222, 1200 JG Hilversum, The Netherlands (Fax: 035 724532). Contact: Mr. Joop Swart.

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USING SATELLITE COMMUNICATION IN RURAL DEVELOPMENT

Satellite technology has truly made the world a "global village". Communication satellites have made possible the world wide transmission of telephone and telex, radio, and television broadcasting, business information, and the delivery of education and health services to rural areas.

What is satellite communication?

There are two major types of satellite communication systems.

- those in geostationary orbit (GEO's)
- those in low-earth-orbit (LEO's)

Of the two, LEOs have the greater potential for use in developing countries.

Characteristics of a GEO

- GEO's are in high orbit from the earth
- they go round the earth at the same speed as the earth turns so are always in the same position in relation to the earth
- they orbit in the equatorial plane so do not cover the polar latitudes
- 3 of them are needed to cover the earth's surface
- GEO's are used as repeaters for voice and data signals
- they are linked to terrestrial infrastructures which are owned and operated by international communications companies

The future

There are, clearly, wide applications for store-and-forward communications, particularly in remote areas and plans to launch more satellites for different applications are already in hand. Experiments show that low cost environmental monitoring from LEO's also appears to be feasible, provided it has only limited requirements (eg. medium resolution) and this is an area where further developments can be expected. At the present time it is unlikely that moving images (TV and video) will be able to be transmitted by LEO's.

ELECTRONIC DISTANCE EDUCATION SYSTEMS
Using GEOs

GLOSAS/USA (Global Systems Analysis and Simulation Association) is a publicly supported, non-profit educational service organization based in New York which aims to improve the quality and availability of international educational exchange through the use of telecommunication and information technologies. Some of the projects by GLOSAS/USA follow.

The Global Lecture Hall (GLH): Using interactive video technology for video conferencing, global lecture halls have been demonstrated by connecting multi-country sites together by GLOSAS/USA. Live 'events' have been presented in an interactive setting to wide area audiences.However, at present due to cost and technical considerations, the interactive element relies on audio, fax and electronic mail for live feedback.

Video as an interactive agent: The GLOSAS Project. The Global Systems Analysis and Simulation (GLOSAS) project on energy, resources and environment (ERE) system for peace gaming is a project to make video a multi-user interactive educational agent.
The aim of the project is to use gaming simulations, with the help of computer based networking and multimedia technologies, as a useful tool for understanding global problems and global policy among globally diverse users.

Global (Electronic) University (GU): The GU aims to take advantage of multimedia technologies and computer networking to serve as a global education agent. It hopes to provide institutions, learners and researchers currently limited to resources on one site, access on a global scale to educational, cultural, information, knowledge, vocational and community activities, in a networked environment.

Russian Electronic University: A US-Russian Electronic Distance Education System (EDES) is currently being established jointly by GU/USA (a division of GLOSA/USA) and the Association of International Education (AIE) of Russia on the basis of a request from the Ministry of Science, Higher Education and Technology Policy of the Russian Federation. The EDES is to become the 'Russian Electronic University' once it is completed. Russian students will be able to use the EDES to access courses offered by member schools of GU/USA without coming to the US or having American instructors travelling to Russia. The system will allow Russian students to converse with American instructors and classmates at a distance using audio, voice mail, electronic mail, fax and slow-scan TV through a free of charge narrow band channel of INTELSAT's Project ACCESS. It also proposed to later allow American students and those from other nations to receive courses from universities and academicians in Russia.

END

What are GEOs used for ?

- real-time, 24 hour communication
- TV broadcasting

Characteristics of a LEO

- LEO's are in low-earth orbit
- they take typically 100 minutes to orbit the earth
- during a single 24 hour period they will complete 13+ orbits
- the number of orbits combined with the earth's rotation means they are within range at any point on the earth's surface several times a day
- depending on the location points communication time will vary from minutes to 10-12 hours.

What can LEO's be used for ?

- store-and-forward communications
- earth resources observation and monitoring
- navigation
- space science
- microgravity
- education

What are LEO's designed to do ?

LEO's are a newer concept in satellite communication designed to meet the needs of those whom GEO's do not serve including:

- users in remote regions, developing countries, earthquake disaster zones;
- users at high latitudes where GEO coverage is poor or non-existent;
- users who do not need instantaneous communications and are prepared to trade-off delay in message delivery for a lower cost; and
- educationalists in space engineering and technology.

What are the costs of a LEO ?

LEO's are amazingly low-cost when compared with GEO's. As with most technologies absolute costs relate to what you want the satellite to do. The more you want it to perform for you the more equipment it will need to carry and consequently the higher the cost. A low-cost small (50kg) satellite can be put into orbit for between £1-3 million depending on the exact payloads, specifications and who are the manufacturers. User terminals could cost as little as £300.

Factors to be Taken Into Account when Considering the Potential for LEO Programmes

- the available, or likely budget
- the launcher to be used
- the objectives
- frequencies available to service the mission

Source of Information for LEOs

Volunteers in Technical Assistance (VTA), 1600 Wilson Blvd., Suite 200, Arlington, VA 22209 (T: 703 276 1800, Fax: 703 243 1865).

USING VIDEO FOR RURAL DEVELOPMENT

Video is a powerful means of communication and cultural dissemination, and an alternative to official networks. Rural community groups are using video as an educational tool and, where problems of illiteracy exist, as a means of communication.

Advantages of Video

Video technology offers a communication tool which has advantages over many other media. Some of these advantages follow.

- Ease of operation: Only a few weeks is necessary for anyone to learn to manipulate video editing equipment and just a few hours, to use a video camera. The medium can be put right in the hands Zof the communicator, who can be a farmer, rural housewife or a teacher.
- VCRs help overcome the barrier of illiteracy as it relies on the spoken word and visuals.
- Minimal running costs once initial equipment investment has been made with recyclable tapes and freedom from processing expenses and outside processing facilities.
- Immediacy: In production work, the pictures and sound recorded can be played back and studied during or immediately after recording. It provides for instant feedback.
- Flexibility: Recordings can be upgraded, updated and adapted to local requirements and languages etc. with minimal problems.
- Transportability: With development of video technology towards more lighter, more robust equipment, transportability of a VCR unit has become quite easy.

Video in Health and Sanitation

The Village Video Network in Mali used portable video equipment to promote an educational program on health and sanitation for village women. Women learnt quickly and produced a highly successful videotape on prevention and treatment of diarrhoea. The video captured the context in which diarrhoea occurs; the village water source, the pond where people wash their dirty clothes, and unwashed kitchen utensils. It provided a clear understanding of factors contributing to infant diarrhoea.

The tape was available not only for the village in concern, but also to other villages in Mali and, through the Village Video Network, to villages and communities world wide. This provided for horizontal communication of the subject and steps taken to tackle the problem to other communities experiencing similar problems.

VIDEO IN BOTTOM UP COMMUNICATION

The Worldview International Foundation (WIF) used video camera and playback facilities to: strengthen communication between the local government offices and the village of Ramghat in Nepal; strengthen communication between Ramghat and Kathmandu, the capital city and; develop educational materials for village use. Twelve women from Ramghat initially participated in the training session. The women learnt how to assemble two camcorders, perform simple maintenance and conduct interviews. They also learnt how to list and prioritize their needs, draw up practical solutions and discuss how best to use video to convey the message.

In the first video the group produced, the participants spoke directly to the camera about their concerns regarding a government scheme on income generation. As the women were illiterate, the video was shot without a formal script. However the objective of the video was first discussed before shooting. The narration and editing was done in Kathmandu. This taped videoletter was then sent to the project sponsors, which had an immediate result.

In the second video, the women recorded a series of interviews with women who had been mistreated by their husbands or wanted to get divorced and needed legal advice. The video was then sent to the Women's Legal Services Project in Kathmandu. They returned taped solutions.

The video letters were also shown to the larger community during Saturday night movie screenings. The women later produced videoletters on deforestation, health, irrigation and also a series of short films on educational topics such as fertilizing methods and livestock feeding. These letters and films were screened on Saturday night and also at smaller screenings organized by the women at the various wards within the village.

The project's initial aim was met. Two-way communication had been established between villages and the central government and between villages and the local government. The women also developed confidence in themselves after their video letters began getting the required responses. Eight months after the project was initiated, the women went to Kathmandu to discuss directly with the officials concerned their issues of concern.

Moreover video cassette tapes can be sent over mail and played back in other parts of the region or the country.

- Duplication: Video cassette tapes are easy and comparatively inexpensive to duplicate and hence provide for wide dissemination of tapes from a single recording.

Disadvantages of Video

- Relatively high initial expense and the need for technical maintenance.
- Fragility: though today's equipment is robust and portable, bumpy roads and rough or inexperienced handling can cause breakdowns.

- Maintenance and repair facilities are not always easily accessible in developing countries, especially in remote areas.
- Power supply can be a problem, as batteries have to be kept constantly charged and sources of power are not dependable. Running the video cassette playback on batteries can be a severe drain of power. Use of generators, while helpful, could increase the cost of operation and operation becomes more complicated.
- Editing: there is a tendency to shoot too much material which, if editing facilities are not available, can produce boring and tedious viewing for audiences.
- Compatibility problems between connectors, cassette formats, video standards and broadcasting norms have also to be taken into consideration.

Equipment & Costs

1. *Production*

   - video camera, e.g., camcorder: $1000 and up
   - video tape: $5 - 10
   - rechargeable batteries: $75
   - microphone (if not included in the camera)
   - editing equipment (preferable)

2. *Play*

   - VCR: $250 - 1,000
   - television
   - electricity source of battery

Bringing Video Within Everyone's Reach

Video Tiers-Monde, a Montreal based NGO, has developed a training kit designed for people in developing countries who want to familiarize themselves with video or perfect their technique. Entitled "Portable Video Production", the kit consists of three volumes and a video cassette with a running time of about 45 minutes and is available in French, English, Spanish and Italian.

The video document is clear, simple and accessible. It takes the viewer point by point through the basic rules of producing an effective documentary. 600 copies of the kit are in circulation in several countries in Africa, Latin America and Europe and North America. The kit sells for about $250 in developed countries and $75 for orders from developing countries.

Putting Video to Use

Video has been used for different purposes by groups, communities and individuals to enhance communication flow. Where centralized media fail to help, video has offered the potential for horizontal communication and bottom-up communication. Video is also used as a tool for training and for publicity.

- *Tanzania* Interviews with Tanzanian farmers were recorded on videotape and played back for government officials to reduce the communication gap between the two groups.

- *Ghana* Video was used to help train managers in rural areas. The tapes helped spark interest and participation, enhanced discussions and inspired managers to take action after seeing the success of their peers on video in other areas.
- *India* Rickshaw drivers in an Indian village were taped explaining why they felt that they met a bank's loan criteria and should be allocated loans. The tape was shown to bank managers and their responses were further recorded on tape and shown to the villagers. End result was the rickshaw drivers got the loans which they eventually paid back.
- *Philippines* A community facing trouble getting the government to re-channel a river which flooded once a year, used video to tape their efforts in building a rock dyke over eight weekends. The tape shown to the government officials resulted in the government contributing heavy equipment to finish the project. This tape was further used to show other communities what organized communities can do on their own.
- *Zimbabwe* Video was used to record people on a public speaking course before and after the course. By playing back the initial tape, trainees were able to identify by themselves or with help from the trainer any faults in presentation. This helped to take corrective steps. The final tape which was produced at the end of the course also provided an objective assessment of the improvements made during the course through a comparison of the before and after tapes.

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