The importance of Information and Communication Technologies (ICT) in agriculture development in developing countries

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Abstract—In recent years, assistance from developed countries to developing countries has intensified. Information and Communication Technologies (ICTs) have also been widely deployed in developmental programmes, leading to the creation of a new field – ICT for development. This paper reviews a number of projects that introduce technically innovative ICTs that are intended for the development of marginalised rural areas.
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Introduction:

In the rural context, development involves use of physical, financial and human resources for economic growth and social development of the rural economies (Burkey, 2000). The term rural development also represents improvement in quality of life of rural people in villages. As per Chambers (1983) " Rural Development is a strategy to enable a specific group of people, poor rural women and men, to gain for themselves and their children more of what they want and need." Singh (1999) defines Rural Development as "A process leading to sustainable improvement in the quality of life of rural people, especially the poor". The fact of the matter is that three quarters of the world's poor, about 900 million people are in rural areas, and the Millennium poverty target set by Millenium Development Goals (MDG), cannot be met unless the world addresses rural poverty. "Sustainable Rural Development can make a powerful contribution to four critical goals of: Poverty Reduction, Wider shared growth, Household, national, and global food security and Sustainable natural resource management" (World Bank, 1997). Hence worldwide there is a growing emphasis on development of rural economy of the countries. Any improvement, in the social or economic status of rural areas would not just directly benefit rural poor but would also bring down the migration-pressures on cities and contribute by positive ripple effect in global stride towards development.

The process of development in a country is to be aided by its governance. The goal of governance "should be to develop capacities that are needed to realise development that gives priority to the poor, … and creates needed opportunities for employment and other livelihoods" (The World Bank, 1992, UNDP, 1994). Increased number of poor, hungry or marginalised people in a country represents decrease in its quality of governance. To promote development, various studies have proposed governance in the contextual realities of each country, including veritable participation of citizens in the governmental decision-making process (Grindle, 2004; Evans and David, 2006). Several institutions and experts accept Governance as a reflexive process, wherein policies, institutions, outcomes and analysis interact, to maximise the process of participatory development (UNDP, 1997; Ludden, 2005; Mehta, 2006).

There are two opposite perspectives on the role of ICT in society. One part of scholars views computers and the Internet as magic entities with the power to transform society. They consider the Internet as a new medium of communication, helping to cope with issues of social exclusion, social inequality. According to Manuel Castells (2002: xxxi), this is one of the reasons "why, after three decades of existence, it emerged from specialized communities in the world of researchers, techies, hackers, and countercultural communities, to catch fire in business and in society at large". But there are others who consider the new ICT as a tool to strengthen social inequality and widen the information gap, when one part of the population (haves of information) uses digital devices, while the

other part of the population (non-haves) is in a digital divide.

The last decade has seen a number of exciting changes in access to and use of information and communication technologies in rural areas. And not just in the comparatively wealthy countrysides of Western Europe or North America –even rural areas with some of the lowest levels of income in the World, from Kerala in India to Lindi in Tanzania, have seen an explosion in access to communications technologies, and these technologies are proving increasingly powerful as new applications spread. It is no exaggeration to say that this extended access has made a real difference to the quality of life of billions worldwide, including perhaps more than a billion people in rural areas.

It is no surprise that this 'ICT revolution' has proven a powerful source for creative vision by utopian thinkers the world over. Not least, Tom Friedman's best-selling works suggested that ICT has shrunk the world "from a size medium to a size small," offering new opportunities to poor people and regions to compete. He suggested that the Internet, along with globalization "are acting like nutcrackers to open societies," so that the Middle East is on the edge of a democratic revolution –and so on. Internet visionary George Gilder went as far as to suggest that the Internet presages "the overthrow of matter… that will make the new millennium a time of awakening to the oceanic grandeur and goodness of the universe" (see Kenny, 2006, for sources).

he Millennium Development Goals of the United Nations address a series of global social development issues, including halving extreme poverty by 2015 [1]. Since the publication of the millennium goals in 2000, much attention in the field of ICT has been focused on bringing ICT to poverty-stricken areas. Such projects have often not been evaluated scientifically, so there was until recently little evidence of the efficacy of ICT for development (ICT4D) in these environments [2]. However, most evidence supports deployment of ICTs in such areas and by some reports, ICTs can assist with several of the MDGs simultaneously [3]. Mostly off-the-shelf technologies have been used in innovative ways, but with the advent of funding by large international development organizations and also private companies, the field of ICT4D has increasingly become an area of technical innovation.

Information and communication technologies (ICT), including radio and television and the newer digital technologies like computers and the Internet as potentially are introduced powerful tools and activators of educational reform and changes.different ICT, when properly applied can be developed to help access to education and the relationship between training and workshops to strengthen the increasingly digital, the quality of education also helped to create teaching and learning in an active process connected to real life high take. However, the experience of being raised by ICT in the classroom and other educational sites around the world during the last few decades proves that is not automatic fully realize the potential benefits of ICT training.(Guptaand et al, 2004).

In the past few years, the power of Internet as a communication medium has captured the imagination of developmental organizations around the world. A number of projects have been undertaken in various parts of the world attempting to provide sustainable digital access to rural communities.

Wider Access of ICT:

The reach of information and communications technologies around the world has been expanding for decades. There is one television set for each four people on the planet (World Bank, 2005). In India, over 112 million households have a TV. As early as 1995, television exposure in China was estimated at one billion people (Jensen and Oster, 2006). The reach of radio is probably even greater. But the recent past has seen particularly rapid rollout of access to telephones and the Internet, as technology advance has driven down costs. Fixed phone connection and rental charges have more than halved worldwide over the past decade. Meanwhile, mobile handset costs have dropped to as low as $50 and companies in LDCs claim that they can profitably provide service at an average revenues per user of just $60 a year. As a result, the proportion of households worldwide that had a fixed telephone almost certainly surpassed 50 percent in 2003. And even more rapid growth in access has been driven by mobile telephony. The number of mobile subscribers worldwide increased from 11 million in 1990 to 1.7 billion in 2004.

This access has extended to people previously far from any phone. In Burkina Faso, for example, there were fewer than 7,000 telephones outside the capital city in 1990, serving a population of 8.3 million people spread across an area of over 100,000 square miles. There was no mobile phone service. In 2002, the mobile footprint (the area of the country where a mobile phone signal is available) covered 5.4 million people outside of the capital—far more than half of the population living outside of Ouagadougou. More widely, perhaps 83 percent of rural people in South Asia had access to a telephone in their village in 2002. In Africa, a 2001 survey of Ghana, Uganda and Botswana found that, even in rural areas, between 75 and 80 percent of respondents had made a phone call in the last three months. Across the globe, an estimated 86 percent of the World's

population, including a considerable majority of rural populations, were under the mobile footprint in 2004 –and it appears quite likely that total telecoms access rates are even higher than that (Keremane and Kenny, 2006).

While the recent spread of the Internet has been somewhat less dramatic than that of the telephone, its speed would be unprecedented for a communications technology were it not for mobiles. Both Internet and mobiles reached ten percent of the world's population within fifteen years of invention, and there are already far more Internet users in the developing world than in the developed. The number of users tripled over the 2001-2005 period in the developing world, reaching over 440 million (UNCTAD, 2006). Of course, rural areas in developing countries in particular do still see very low Internet usage. A few years ago, but ten percent of Thailand's Internet users were rural, despite the fact that rural people made up nearly 70 percent of the country's population (Kenny, 2006). Many rural areas of even comparatively rich developing countries still see Internet usage rates at below one percent of the population. Nonetheless, the opportunity to use the Internet has spread far and wide, even if usage itself has not.

More Uses of ICT:

Again, there is a long record of ICT use having an impact on development outcomes in rural areas. Over 700,000 secondary-school students in remote villages in Mexico watch the Telesecundaria program of televised classes. While students enter the program with lower mathematics and language test scores than the average, by graduation they have caught up in math and halved the language-score deficit (de Moura et al, 1999). Survey evidence from within developing countries has long suggested that rural areas with access to telephones see lower prices for inputs, higher prices for outputs, larger non-farm incomes, a greater number of small and medium enterprises and better delivery of public services (Forestier et al., 2002).

As technologies have spread, so have their impact. Robert Jensen and Emily Oster of the National Bureau of Economic Research study the rollout of cable television access in rural India and conclude that the introduction of cable in a village is associated with higher female school enrollment, declines in fertility and increased female autonomy (Jensen and Oster, 2007). The size of these effects is large: within two years of introduction, between 45 and 70 percent of the difference between urban and rural areas on these measures disappears, and the impact of cable TV on fertility decisions is as large as increasing the length of time girls stay in school by around five years.

Regarding the spread of mobile technologies, Grameen Phone has leased cell phones to poor rural women who set up local village pay phone shops. In a review of the early experience of the Grameen Phone project, this service was found to be of considerable benefit both to the provider and the users. Not least, the average operator was earning between 24 and 40 per cent of household income from providing phone services and the estimated consumer surplus from phone usage ranged as high as $2.70-$10 per call (Richardson et al. 2000).

This consumer surplus derives in part from the significant power of communications to improve market outcomes. In Kerala in India, mobile phone service was introduced over the period 1997-2001. One result was a dramatic improvement in the efficiency and profitability of the fishing industry. As mobile phone service spread, it allowed fishermen to land their catches where there were wholesalers ready to purchase them. This reduced waste from between 5-8 per cent of total catch to close to zero and increased average profitability by around 8 per cent. At the same time, consumer prices fell by 4 per cent (Jensen, 2007).

ICTs for development

The idea that the Internet and related technologies might have an important role in aiding developmental efforts has captured a central place in international policy debates. Over the course of the last few years, statements affirming the need to close the so-called 'digital divide' between social groups with and without access to the internet have been made through several UN agencies, and at meetings of developmental organizations around the world. The idea of digitally oriented development is as powerful and seductive as the technology upon which it is based. No single technological revolution has changed the lives of current generations in the way that the Internet has. For example, it took at least a century before the printing press touched 50 million individuals. It took 38 years for radio to reach the same number, and thirteen years for television. But the World Wide Web, in only four years, exceeded the 50,000,000 mark[13]. Never before has a communications revolution spread so rapidly.

The promise of digital development is that it might have the same reach as the original Internet boom of the mid 1990s – only this time the most disprivileged communities, those who had missed out on earlier waves of technology, might be able to 'leapfrog' over their more developed competitors. The greatest obstacles to rural development in developing economies – large distances and

inadequate infrastructure, might be obviated by instant access to virtual institutions that provide banking, education, health care, neonatal information, agricultural advice, and so forth.

At the same time, questions are being asked if ICTs are the way to go in developing countries, such as those in South Asia, where most rural populations lack running water and sanitation systems, electricity is still a scarce and intermittent resource, roads are poor and education a luxury. The value of IT for rural development is accompanied by this dilemma for decision makers and multilateral funding agencies: should the very limited resources for rural development be applied to developing IT capacities, or are they best used for other high priorities such as schools, hospitals, and dispensaries?

The concept of "Digital Divide":

One of the most hyped phrases in the context of ICTs for development is "Digital Divide". Kenneth Keniston[13] of MIT introduces the concept of, not one, but four digital divides. The first divide is that which exists within every nation, industrialized or developing, between those who are rich, educated, and powerful, and those who are not.

A second digital divide, less often noted, is linguistic and cultural. In many nations this divide separates those who speak English or another West European language from those who do not. This is quite notable in India, and is further compounded by linguistic issues. An estimated 60-80% of all Web sites in the world are in English while almost all the rest are in one of the major 'Northern' languages like Japanese, German, French, Spanish, Portuguese, and increasingly Chinese. But in India, like the rest of South Asia, only an estimated 2-10% of the population speaks fluent English while the rest (more than 900 million Indians and about 1.2 billion South Asians) speak other languages.

The third digital divide follows inevitably from the first two -- it is the growing digital gap between the rich and the poor nations. The fourth digital divide is the difference between the lifestyles of those who are in the IT or similar sunrise industries like Biotechnology and those who are in the other professions.

Bridging the Digital Divide:

With the understanding of digital divide, several agencies are also talking about bridging the digital divide. Interestingly, ICTs have been touted as the solution to development. It has been suggested that digital access could well be linked to wealth accumulation. Victor, Philip et al[15] suggest a positive correlation between teledensity and GDP per capita for low and middle-income countries. As for Internet access, Thomas Schauer[18] feels that Internet has not existed for sufficiently long, and it is not possible to examine whether poor countries which have put a focus on overall development (wealth first!) subsequently have better opportunities to create an information society or whether the strategy should be to invest massively into the IT infrastructure in order to create subsequent wealth.

So then what is the promise of ICTs towards reducing the "digital divide" and the "income divide" associated with it? It would be interesting to look at the case of ITC initiated e-Choupal project in India. This is an excellent example of how Internet access has created wealth for farmers from about 6000 villages in MP in India[10]. The project initiated in September 2001 by ITC was intended to gain control over Soya procurement supply chain. ITC harnessed the power of information technology to fill institutional voids in the Soya procurement chain by avoiding middlemen and directly buying Soya from the farmers. According to ITC "The intermediary has information and, thus, extracts a greater margin. So we said to ourselves if you bring this information to the farmer and use go- betweens where they are adding value directly, you have a business model." To do that, ITC first leased three Soya processing and collection centers. These centers were created in the mid-90s and had, since then, gone under. Then it started scouting villages around these centers for lead farmers (sanchalaks) to head each choupal. The computer was placed at the sanchalak's house and he was trained to use it. Having put them in place, ITC started to pump information on daily mandi prices through the Internet into the sanchalak's homes. Farmers would gather as they did at choupals, check the prices and head out to the collection centers to sell their produce. The idea of heading out to the collection centers struck the right kind of chords among the farming community. Here, because systems were efficient, the transactions are completed in a few hours rather than days as they used to. So they came to the collection centers in droves. The sanchalaks, for their part in directing farmers to these collection centers, were paid a commission of 0.5% for each tonne of soyabean that originated from their choupal. On ITC's part, the procurement costs of Soya came down from Rs 700 per tonne to approx. Rs 300 per tonne. The math looked roughly like this. On an average, it cost Rs 40,000 to set up a basic Choupal. In places where connectivity was terribly

poor, and telephone lines to connect to the Internet still a pipe dream, ITC invested in V-SATs. These investments jacked up costs by as much as Rs 1 lakh. According to ITC, it has been able to recoup the investment in three sowing seasons (18 months). At the time of going to print (January 2003), MP had 1,045 e-choupals spread over 6,000 villages that covered six lakh farmers. ITC is now planning to apply the model to wheat procurement, which is a market, multiple times that of Soya market.

Rural Information Needs:

But what relevance do ICTs have to rural consumers? Can ICTs be the solution to poor infrastructure for health, telecom and education in rural India? What are the information needs of the rural consumer? Many of these questions are answered by an NIC, Government of India study[6]. Based upon a survey in a rural area in the state of Bihar, following information categories were arrived at:

1. **Health**
2. **Agriculture**
    - Rainfall (forecasting)
    - Cropping Pattern
    - Modern Techniques of Cultivation/Farming
    - Irrigation (Sources)
    - Information on Market and Market Prices
3. **Education**
    - Distance Education/Learning
    - Information on Schools & Virtual Schooling
4. **Government Information**
    - Information on Soft loans & Financial Institutions
    - Information on Government Go downs
5. **Land Records**

Conclusion:

A common strategy in higher education ministries in developing countries is public and private sector partnership in strategy or pursue rapid ICT projects is based. This partnership has different forms such as grant aid private sector interaction with public assistance, donated educational equipment and components by companies to public schools, providing technical assistance for planning, management and consolidation tools and human resources at the local level. But after financial aid, testing programs based on ICT is critical.

Many of the ICT training programs based on the charitable agencies aid have been unable to have high durability. Because the government has failed in its financial assistance in this situation none of the local communities to provide resources do not needed to continue these programs. Two strategies in here "to support government and local communities to move" are important. Since the 21st century, is century of education support about youth in Asia, to find sustainable ways to bridge the digital age in Asian countries is a real priority. And work through partnership that local leaders and guides are experts it can be lasting forever.

Several recommendations that emerged from the discussions emphasized on the need to think of ICT in education beyond computer aided learning and investigate the potential other technologies like community radio and other medium. These mediums could not only be cost effective but also has a greater outreach potential. It was also pointed out that low cost software solutions for e-learning that have scopes for innovation, should be incorporated in large scale projects. With an indication to open source solutions, the sessions recommended that such solutions should become a part of the overall policy for implementating technology supported education interventions.

Sustainability and scalability of project are also issues that needed serious considerations. While moving beyond the pilot and experimental phase, projects especially those that needs a considerable financial contribution should have a viable sustainability model for up scaling. It was also recommended that implementers needs to be cautious when selecting areas for implementing ICT in education projects.

Projects should also not lose priority of the education objectives. In some cases ensuring school accountability system and teachers attendance may be more important that investing time and resources in ICT integration in schools. One fact that emerged in the sessions was that ICTs effectively computers, initiated in government department and schools were being used as decision support in education. Essentially, clear criteria, norms and standards needs to be developed for the information that was being used for decision-making.

This paper is a multidisciplinary study of ICT initiatives for rural development. It emphasizes adoption of a more systematic approach for

integrating Traditional Knowledge Systems (TKS) and ICT inputs to ensure sustainability of rural e-governance projects. The study of literature related to rural development and e-governance has indicated various issues impeding success of such initiatives. The main issues are lack of localization of content for rural communities and inadequate participation of rural communities in design of rural ICT initiatives. The study therefore suggests the use the systems-approach to integrate the relevant TKS along with ICT initiatives in the design of e-governance systems for rural development. This participatory approach can lead to creation of more acceptable and sustainable e-governance projects**.**

Regardless of the wide differences in ICT access between rich and poor countries and between different groups in the country, there are concerns that challenge the application of ICT in education with the existing differences among the lines of economic, social, cultural, geographic and gender will be broader. Everyone equal opportunities in terms of suitability for participation are necessary, but access to various factors, either as users or as producers through their sources is difficult and heavy. Therefore, the primary differences enhance and even grow. Consequently, programmers' international education is faced with a difficult challenge and how to help solve the problem and its development.

Promoting ICT in education, when done without careful study, can lead to the marginalization of those with more favorable conditions are unknown. For example, "women compared with men, because of illiteracy, lack of higher education, lack of time and mobility and poverty, controlling access to ICT and fewer opportunities for training are relevant. Also, more boys than girls' access to computers at home and school are not strange to say that if more boys than girls are willing to work with computers. The report of the University Association of American Women is that "Although some girls have an important gender gap have been limited, but today's technology, technology club, and boys in public schools while its own problems and programs are settled girls use computers for word processing the brand"**.** In an assessment in four African countries, the activities organized by World links remote international cooperation on projects between teachers and students in developing countries will promote, despite creating programs without regard to sex contacts, sexual inequalities remain Uganda and Ghana. In addition, while more girls than boys in relation to academic performance and advanced communication skills program will enjoy more than boys, but they were unable to perform their technological skills were. A set of economic factors, organizational and cultural differences involved in the social.

"The high ratio of students to computers and politics, whoever came first, the first is used in accordance with the girls wanted it." Girls travel restrictions in the early hours of daily work and home responsibilities are that this will limit their access. Also because local patriarchal beliefs dominate the boys are in the computer lab environment. Including proposed measures to address this discrimination, strategies to encourage schools to create "fair use" in the computer labs and the holding of meetings and sexual sensibilities conductivity decreased defense duties after school girls. ICT provides access to only a small part of the action is created equal. Equal attention should also be applied to ensure the technology really "is used by learners and ways of how well their needs will cure.

An educational program that reinforced this approach shows the overall program is bilingual. The program seeks to establish technology learning centers for bilingual teachers, students, teachers, parents and community members. Technical teams from each center three students, two teachers and the director of the Center with at least one female student and a teacher are female.

Another example of a general approach to the application of ICT in education, radio education project Gobi Women of Mongolia, which seeks to provide professional and educational structure of women's favorite courses around the nomads and their opportunities for income generation.

It contains topics such as livestock rearing, family support (family planning, health, nutrition and health) to create income in the application of local raw materials and basic skills for the job is a new market.

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