

MOBILE PHONES AND DEVELOPMENT: AN ANALYSIS OF IDRC-SUPPORTED PROJECTS

Ahmed T. Rashid
Research Intern
PAN Asia Networking
IDRC

Laurent Elder
Programme Leader
PAN Asia Networking
IDRC

PO Box 8500
Ottawa, ON, Canada, K1G 3H9
arashid@idrc.ca

ABSTRACT

In the context of the rapid growth of mobile phone penetration in developing countries, mobile telephony is currently considered to be particularly important for development. Yet, until recently, very little systematic evidence was available that shed light on the developmental impacts of mobile telecommunication. The Information and Communication Technology for Development (ICT4D) program of the International Development Research Centre (IDRC), Canada, has played a critical role in filling some of the research gaps through its partnerships with several key actors in this area. The objective of this paper is to evaluate the case of mobile phones as a tool in solving development problems drawing from the evidence of IDRC supported projects. IDRC has supported around 20 projects that cut across several themes such as livelihoods, poverty reduction, health, education, the environment and disasters. The projects will be analyzed by theme in order to provide a thematic overview as well as a comparative analysis of the development role of mobile phones. In exploring the evidence from completed projects as well as the foci of new projects, the paper summarizes and critically assesses the key findings and suggests possible avenues for future research.

1. INTRODUCTION

In recent years, there has been a rapid growth of mobile phone networks in developing countries. Most of the countries in the developing world have skipped fixed-line infrastructure and leapfrogged directly into mobile technology. Currently mobile telephony is the predominant mode of communication in the developing world. At the beginning of the twenty-first century, the average number of mobile phones per 100 inhabitants in Asia, Africa and Latin America and the Caribbean (LAC) has risen by 100-400% in a span of just five years (Orbicom, 2007). In 1995, there were more phone lines in Manhattan than in all of Sub-Saharan Africa. Now almost one in five Africans owns a phone. More people in India and China own mobile phones than in North America and Europe combined. While developing countries are still lagging behind high-income countries in overall ICT usage and applications, the mobile phone has been regarded as a more accessible and less expensive means to close the digital divide (Wade 2004).

There are several reasons why mobile phones are considered as particularly important for development. First, beyond basic connectivity, mobile phones offer benefits such as mobility and security to owners (Donner, 2006). Second, due to their unique characteristics, the mobile phone is an especially good leapfrogger: it works using the radio spectrum, as such there is no need to rely on physical infrastructure such as roads and phone wires, and base-stations can be powered using their own generators in places where there is no electrical grid (Economist, 2008). Third, mobile phones only require basic literacy, and therefore are accessible to a large segment of the population. Fourth, mobiles enjoy some technical advantages that make them particularly attractive for development. In addition to voice communication, mobile phones allow for the transfer of data, which can be used in the context of applications for the purposes of health, education, commerce or governance.

Finally, due to factors like increased private sector competition and innovative payment methods (e.g. - pre-paid method), mobile phones are increasingly affordable to the lower strata of the population and thereby can be used as a mechanism to ensure greater participation of these groups in the development process¹.

As mobile penetration rates increase rapidly in developing countries, there has also been an increase in the extent of research on mobile phone usage². In general, studies have focused on different aspects of the adoption and use of mobile phones. However, there is still a lack of evidence of usage of mobile phones as a tool to solve development problems, due mainly to the difficulty in measuring their social and economic impacts. Moreover, there is an absence of a thematic approach to analyzing the impact of mobile phones on development. A thematic research approach, i.e. a focus on the different developmental domains, is particularly useful in terms of policy. For instance, such analysis can assist in determining the sectors or areas where mobile phones can have the highest developmental impacts and identifying the sectors where further research is needed.

The Information and Communication Technology for Development (ICT4D), is a program of the International Development Research Centre (IDRC), a crown corporation in Canada. ICT4D, through partnerships with key research partners in developing countries, has played a critical role in trying to fill the research gap as it relates to the developmental impacts of mobiles. The importance of mobile phones has been emphasized in policy documents of all three regional program initiatives regions of ICT4D³. The objective of this paper is to evaluate the case of mobile phones as a tool that help to solve development problems, drawing from the evidence of IDRC supported projects. IDRC has supported around 20 projects that have a mobile phone component, fully or in part. Although there is some overlap, the projects can be broadly categorized into five themes: mobile and the poor; rural livelihoods; health; distance education; and disasters. The projects will be analyzed by themes because a thematic approach is critical in our understanding of the suitability and feasibility of mobiles in solving different developmental problems. Some possible avenues for future research are also suggested.

2. MOBILE PHONES AND THE POOR

The introduction of pre-paid technology has significantly increased affordability of mobiles. Currently, mobile phones are used by a broader segment of the population than computers. Despite this trend, studies that explore mobile phone use of the economically constrained are few and far between. In fact, ICT4D program has been one of the main drivers of research that focuses on tele-use at the bottom of the pyramid through its regional research networks in Africa, Asia and Latin America. A summary of the projects is provided in Table 1.

¹ It has also been argued that increase in mobile phone penetration rates promotes economic growth and national development (Waverman et al., 2005).

² See Donner (2008) for a comprehensive literature review of research approaches to mobile phone use in the developing world.

³ The prospectus can be accessed from http://www.idrc.ca/en/ev-43441-201-1-DO_TOPIC.html.

Table 1: Summary of IDRC project on mobile phones and the poor

Project name	Organization	Duration	Region/countries	Methodology	Sample
Poverty and Mobile Telephony in Latin America and the Caribbean (LAC)	DIRSI	2006-	Jamaica, Brazil, Trinidad & Tobago, Peru, México, Colombia, Argentina	Survey	Low-income households; age 13-70; n=7,000
ICT Infrastructure in Emerging Asia	LIRNEasia	2006-2008	Sri-Lanka, India	Survey, face-to-face interviews	Financially constrained; Age >18; n=3,199
Towards an African E-Index: Household and Individual ICT Access and Usage	RIA	2004-2005	Botswana, Cameroon, Ethiopia, Ghana, Mozambique, Namibia, Rwanda, South Africa, Tanzania, Uganda, Zambia	Household and individual survey; focus groups	14,635 households; metropolitan, urban, rural areas

2.1 Key Findings and Analysis

The studies demonstrate the exponential growth of the mobile market in the developing world. Mobile telephony is compensating for the low fixed phone penetration in all the regions under investigation, although to various degrees. In LAC, with the exception of Mexico, the majority of respondents in the countries studied had used a mobile phone in the past three months regardless of whether or not they actually owned one. In sub-Saharan Africa, countries have much lower mobile penetration rates, with South Africa and Botswana at the higher end and Ethiopia, Tanzania and Uganda at the bottom. In many African countries, the distribution of mobile phones is concentrated in urban areas. For example, in Ghana, about 83% of the mobile subscribers surveyed were from major towns, 16% from other urban areas, and only 0.4% from rural areas. Affordability is a key barrier for adoption of basic mobile services by the rural poor. Approximately 80% of the respondents in the African survey believe that the major obstacle to increased mobile use is the cost of calls.

Although there are some country level differences, the extent of shared ownership is generally low in all three regions⁴. For instance, in South Africa, 50% of the respondents never allowed friends to use their mobiles while in India and Sri-Lanka only 7% of owners allowed non-household members to use their mobile phones. Not surprisingly, pre-paid service is preferred by the poor because of the cost as well as the ability to control spending behaviour. In sub-Saharan Africa, households with a pre-paid connection have an average income of US\$487 while the average income of households with contract mobiles is US\$ 1,911 (Gillwald, 2005, p.23).

It is also evident that the poor employ different strategies to reduce the cost of mobile usage. These strategies include making very few outgoing calls, miss-calling or “beeping”, etc.⁵ In most of the countries studied in LAC, over a third of the respondents had not made a single outgoing call in a week preceding the survey. In Rwanda, respondents with lower income are more likely to make missed calls compared with more affluent users. In contrast, the South Asian study revealed that the use of strategies is considerably lower, even among low-income users. One of the explanations forwarded in the study is that the lower-income groups may lack the opportunity to be strategic in their use of mobile phone. The use of SMS

⁴ The reasons for regional variation of shared use of mobiles are unclear. Some studies have indicated that lower levels of sharing can be explained by higher levels of mobile penetration (de Silva et al. 2008; James & Versrteeg, 2007; Samuel et al., 2005, p.45).

⁵ The strategic use of mobile phones by the poor has also been documented in other studies -- such as miscalling or “beeping” (Donner, 2007; Sey, 2007) and “call me” SMSs (Horst & Miller, 2005).

services, a cheaper alternative to phone calls, is mediated by other factors such as illiteracy and lack of knowledge (Galperin & Mariscal, 2007; Zainudeen, 2008).

Table 2: Percentage of monthly expenditure

Country	Spending on mobile phone as percentage of income
Brazil	3.2%
Argentina	6.3%
India and Sri Lanka	4-8%

Interestingly, while cost is an important consideration for the poor, they seem to spend a substantial amount of their income on mobile phones as well as monthly costs (see Table 2). In Brazil, respondents spent 3% of their monthly income on mobile phones while Argentine respondents spent twice as much (6%). In Peru and Argentina, respondents are willing to spend significant amounts on hand sets with averages

of US\$53 and US\$68 respectively. Monthly expenditure on mobile phones in India and Sri Lanka ranged from 4 -8%.

In each of the three regions, the main perceived benefit of mobile use among the poor is improved communication with family and friends. Relationship maintenance or social purpose is the most important use of mobile phones in the south Asian study (Zainudeen, 2008, p.50). The respondents also identified symbolic factors (fashion and improved social status) as key for using mobile phones. Similarly, Galperin & Mariscal (2007) in the LAC context showed that mobile telephony is highly valued by the poor as a tool for strengthening social ties and for increased personal security.

Overall, the studies confirm that mobile phones are increasingly accessible to lower-income groups. The poor have very limited access to other modes of communication, making mobile phones the only option available. Nevertheless, the studies also underscore that the cost of a mobile phone is still an issue and income remains the major barrier for adoption. Mobile phones help to strengthen social ties among the poor and provide them an opportunity to communicate in the case of emergencies. This has considerable development imperatives on its own. However, the evidence regarding the role of mobile phones in contributing to greater income generation or employment opportunities remains inconclusive. The South Asian study found very little evidence to support the anecdotes of rural farmers using mobiles to check on the best prices for their products at the nearest markets or the use of mobile phone to receive remittances. Similarly, the LAC study suggested that mobile telephony is beginning to prove useful for enhancing business and employment opportunities (Galperin & Mariscal, 2007). The unexpected high use of mobile phones for social purposes may be explained by the blurry boundary between instrumental and social use.

One of the ways to overcome the overlaps between instrumental and social use is to explore each of the two dimensions more closely. This will require a better understanding of the nuances of mobile phone use, which is often missed if analysis is based simply on a dichotomy between social or instrumental use. For instance, research may assess to what extent mobile phones have contributed to higher incomes, through productivity gains or access to new economic opportunities? On the other hand, research can also focus on exploring the nature of social use of the mobile phone.

Another important area of research that could be given greater attention is the comparison of outcomes of mobile phone use by the poor and the non-poor. It is critical to assess the extent to which users at the bottom of the pyramid are benefited by mobile phones compared to more affluent users. Very little evidence exists related to this question. Among available studies, Bayes (2001) found higher returns of using mobile services for the poor compared to the non-poor. Analyzing the Village Phone service in Bangladesh, he shows that the consumer surplus of the poor users, measured by taking into account factors of time saved, transport cost, and opportunity costs, is 50% higher than that of the non-poor.

Furthermore, there needs to be a greater recognition that the poor is not a homogenous group. There are often significant differences in socioeconomic characteristics within the poor. Mobile phone adoption, use and any developmental implications are moderated by many intervening factors such as age, gender and education which need further in-depth exploration.

3. RURAL LIVELIHOODS

The livelihoods of millions in the developing world depend heavily on agriculture and small businesses. The recent increase in food prices, leading to riots in many developing countries, underscores the importance of this issue. One major problem in many rural regions is that farmers and small entrepreneurs generally have no way of knowing prices before they travel to the market due to poor communication facilities. They often have to rely on middlemen who take advantage of this ignorance. In particular, small-scale farmers have poor market infrastructure, inadequate marketing experience, and agricultural inputs (Munyua, 2007). Accurate and timely market information, particularly of perishable items, can significantly reduce transaction and travel costs. According to one estimate in Sri-Lanka, the “cost of information” constitutes 11% of the total cost of farmers from the time of deciding what to grow to the time of selling (de Silva, 2008).

There have been quite a few studies that explored how mobile phones impact livelihoods of farmers and fishermen. Jenson’s (2007) study on the fish prices in Kerala, India provides strong evidence of the micro-economic impact of mobile phones. He found that the arrival of mobiles brought significant and immediate reductions in the variability of price and the amount of waste in the fishing system. Direct impact are less obvious in most other studies which show greater use of mobile phone for social purposes and emergencies, rather than dedicated economic activity such as calling suppliers or customers (Souter et al., 2005; Donner, 2004). Against this backdrop, Donner (2008, p.146) argues, the broader story of the mobile phone’s impact on small enterprises, farmers, and the self-employed is not clear-cut. At the same time, most of the models of information provision are Internet-based. Yet, as one study shows mobile phones offer a more reliable and cost-effective tool for serving farmers’ need for information compared to the Internet (Campagne et al., 2006). Table 3 provides information about the ICT4D supported projects on rural livelihoods.

3.1 Key Findings and Analysis

As mentioned in the previous section, there is very little evidence to support the many anecdotes of rural farmers using their mobiles to check on the best prices for their products at the nearest market. The studies covered in this section, focusing exclusively on the impact of mobile phones on livelihoods of farmers, fisherman, and small entrepreneurs, show a somewhat mixed picture.

The most encouraging results emerge from a project in Senegal (BBC, 2002; Shore, 2005; Gamos, 2003). The project was implemented by an organization called Manobi, which independently collected prices and uploaded them to its central database using mobile phones that dial in to the server via WAP (wireless application protocol). Farmers in the field were able to check prices before they set off and find out the best offer of their produce. It was found that the farmers have secured, on average, about 15% higher profits for their farms after having paid net costs, including the price of Manobi’s service. In addition, the fishermen were able to reduce the amount of spoiled fish while in search for a market buyer. Moreover, an added benefit in reducing information asymmetry in the local context led to farmers realising that there were often higher returns in producing for the local markets compared to the export markets.

Table 3: Summary of IDRC projects on livelihood and mobile phones

Project name	Organization	Durati on	Region/ countries	Methodology	Sample
DrumNet: A Fair Deal For Kenyan Smallholder Farmers (Acacia II)	Pride Africa	2003-2006	Kirinyaga district, Kenya	Survey; Control group	750 Rural smallholder farmers
Using ICTs to Increase Incomes for Farmers and Fishermen in Senegal	Manobi	2001-2003	Senegal		150 farmers, importers, and fishermen
Using ICTs to create efficiencies in agricultural markets: Some Findings from Sri Lanka	LIRNEasia	2008	Sri-Lanka	Case study	314 small-holder farmers
Survey on the Use of Mobile Telephones for Micro and Small Business Development: The Case of Ghana	CSIR	2007-2008	Ghana (less urban and rural areas)	Survey (questionnaire and FGD)	600 micro and small business operators
Information and Communication Technologies and Small-scale Agriculture: Scoping Study	IDRC	2006-	Sub-Saharan Africa	Secondary analysis; interviews with key informants	N=66
ICTs and Urban Micro-enterprises: Identifying and Maximizing Opportunities for Economic Development	Indian Institute of Technology	2008-	Mumbai, India	Survey (qualitative and quantitative)	Cluster sampling (n=248)
Knowledge Networking for Rural Development in Asia/Pacific Region (ENRAP) - Phase III	IDRC	2008-	Asia Pacific	Pilot _ intervention evaluation (ex-post – case study)	TBD

DrumNet is a pilot project in Kenya that delivered a targeted set of services to rural smallholder farmers designed to increase their farm productivity, their access to markets, and the efficiency with which they conduct business. Analysis of the project reveals that even though there was an increase in the use of mobile phones for business proposes after the introduction of the project, the extent of use was generally low (Ashraf et al., 2005). Moreover, due to the study design it was difficult to precisely assess the impact of information services (Campaigne et al., 2006).

In Sri-Lanka, one pilot project initiated by an organization called Govi Gnana Seva in Dambulla (DDEC) provided independent price collection and dissemination service since 2003. The objective is to avoid costly information search by providing spot price information disseminated widely at DDEC. The role of the mobile phone however was minimal. While 77% of the farmers who used the services felt it helped get accurate price information, 75% had no direct access to a telephone.

One study in Ghana focused on micro entrepreneurs in semi-urban and rural areas (Frempong et al., 2007). A significant proportion of the surveyed entrepreneurs (around 78%) owned mobile phones. However, the intensity of usage of mobile phones for business activities was fairly low (54% made 1-4 calls while 48% received 1-4 calls daily). Nevertheless, the frequency of transactions made through was more encouraging. Categories with higher frequencies of transactions included checking prices (45% of the respondents), checking on customers for orders (52%) and ordering raw materials (47%). Mobile phones facilitated contact with existing suppliers and clients and to a lesser extent with potential customers. There was strong evidence of mobile phones reducing transportation costs. While

an assessment of mobile phone's contribution to the profit margin is difficult, it can be deduced from the above factors (e.g. reduction of travel costs, contact with suppliers and clients) that mobile phones do add to the profits of entrepreneurs.

The most important activity IDRC is supporting in Asia the livelihoods domain is the Knowledge Networking for Rural Development in Asia/Pacific Region project (ENRAP), a project jointly supported by the International Fund for Agricultural Development (IFAD). Currently, ENRAP is in its third phase. The aim of ENRAP III is to undertake systematic research to find ways to help rural communities and households to apply ICTs to improve their livelihoods. More specifically, the project focuses on the use of mobile phones to marketing and input supplies (market prices, input prices, transaction costs, warning and weather conditions, etc) as well as in micro-credit financing to improve rural livelihoods (ENRAP, 2008). It is expected that ENRAP will be able to lead to definitive findings on the role of mobiles in reducing agricultural transaction costs, making agricultural extension activities more effective, thus leading to more efficient markets that could benefit both producers and consumers.

Another project in India explores ICT use, including mobile phones, by urban micro-entrepreneurs as well as how mobile phones contribute to the stability and growth of urban micro-enterprises. This project is novel for two reasons; first, the project focuses on urban areas; and second, it focuses on enterprises that can be considered as growth enterprises that show a greater business focus which deliver broader longer term benefits of competitiveness, innovation and exports.

All the studies discussed above underscore the critical role mobile phones can play in greater efficiency for farmers/ fishermen and in business development of small entrepreneurs. For example, mobile phones can facilitate a greater export orientation in agricultural practices and marketing, potentially bringing higher incomes for farmers (de Silva 2008; Ashraf et al., 2005). Moreover, case studies from Senegal and Ghana indicate quite strong measurable evidence of economic return through mobile phone usage.

However, there are some critical issues that need further consideration. Not surprisingly, important similarities exist between the patterns of mobile phone use by the poor and the farmers and small entrepreneurs. First, mobile phone use by this group to access market information is very low (de Silva, 2008; Ashraf et al., 2005). While this is somewhat perplexing, the informal nature of the economic relations and the value attached to face-to-face interactions may partly explain this phenomenon⁶. The Sri-Lankan study illustrates this point- even though the cost of phone calls is only 0.21% of cost of information, farmers spent more in travelling to find information (de Silva, 2008).

The extent of SMS usage by farmers and small entrepreneurs is even lesser (Frempong et al., 2007; Ashraf et al., 2005). For instance, the Drum Net study revealed that only 9% of the respondents know how to send an SMS for business purposes while the corresponding figure in Ghana was 21%. In addition to the higher rate of illiteracy, other factors such as the stated complicated nature of SMS, very small displays and less functional user interfaces explain the lag in SMS adoption. This underscores the importance of finding out the optimal technical applications to be adopted by users.

The second issue, which is in part related to the first one, is that mobile phones are still relatively expensive for the poor farmers/entrepreneurs (Frempong et al., 2007). Ashraf et al. (2005) point out that in addition to the cost of the phone itself, maintenance factors (e.g.- cost of recharging the phone) are also important considerations in regions such as rural Kenya. While mobile calls are cheaper than the cost of travel, the extent to which these

⁶ See Molony (2006) for an analysis of the importance of traditional face-to-face interactions in the business culture in Tanzania. Similarly, in a survey in India, Tanzania and Mozambique, Souter et al. (2005) found that face-to-face communications is the principal means of acquiring information about business concerns.

savings offset the total costs of owning a mobile still remains to be determined. As Munyua (2007) points out in the African context, scattered and uncoordinated ICT initiatives cause several problems including the high cost of the technology, poor ICT connectivity and skills, lack of local content. At the same time, there is a lack of information sharing culture and low awareness of the role of ICT in development at all levels. These issues raise the question of finding out the appropriate ICT tool. While mobile phones may be suitable for certain aspects of improving livelihoods, other technologies such as radio or the Internet can play an equally important complementary role.

Another issue is that the projects on livelihoods generally tend to focus on information related to the selling stage of the value chain (for example, Manobi). There is a strong case for including the whole production cycle within the realm of IT – from decision-making on crop choice, key inputs like seeds and fertilizer, and marketing in the information services (de Silva, 2008). As an example, the DrumNet study led to a greater inclination for export-oriented crops in the area studied. There is also a case for providing farmers or small entrepreneurs with other key inputs (e.g. - credit) to fully utilize the benefits of mobile phones. The need for understanding the information flow through the value chain also emerged from the scoping study in Africa (Munyua, 2007). It is not inconceivable that mobile phones can play a significant role in transforming agriculture practices in the developing world.

Finally, several of the projects undertaken are pilots supported IDRC and other external organizations. Scaling up of successful pilot projects is challenging but essential. This aspect was considered in the DrumNet study. In the case of Manobi, the prices of getting the services are kept low as part of the deal between Manobi and the national telephone company, Sonatel, which points to the possible need for public-private partnerships in order to bring these initiatives to scale.

4. HEALTH

While early efforts in the use of ICT in healthcare showed mixed outcomes, currently there is considerable enthusiasm about the role ICT can play in this sector (Elder & Clarke, 2007). One of the main reasons for the enthusiasm is the rise in the penetration of mobile devices that can facilitate the delivery of important health services in developing countries. In fact, mobile phones or PDAs are seen as a more advantageous technology for e-health due to their pervasiveness and relative affordability. However, there is a dearth of research exploring mobile phone's role in health. Kaplan (2006) documents that there is almost no literature on using mobile telephones as a healthcare intervention for HIV, TB, malaria, and chronic conditions in developing countries. Some exceptions include Idowu et al. (2003) who describe how Nigerian doctors use mobiles to communicate with each other across different parts of a large hospital, and to respond to emergencies when offsite; and Lester et al. (2006) who assess the use of mobiles in facilitating information flows for HIV AIDS intervention programs.

4.1 Key Findings and Analysis

Two of the most notable IDRC projects on low-cost handheld computing devices and health are from Africa. Probably the most significant results emerged from the Uganda Health Information Network (UHIN) (Satellife, 2004; Satellife, 2005). In this project, health workers used timely two-way electronic information transmission to and from District offices in Mbale and Rakai, relying on mobile caching servers to transmit data over the cellular network. A cost-benefit analysis of the project showed that the network delivered 24% savings per unit of spending over the traditional manual data collection and transmission

approaches (Satellife, 2005). The potential impact could be even greater because the current estimate is based on only 2 of the 14 paper forms converted to the electronic format.

Moreover, close to 100% compliance rate was reported in two District Health Services with their weekly disease surveillance reporting, compared to the national average of 63%. Importantly, the local partner organization (Uganda Chartered HealthNet) not just acquired new technical and training capabilities, but also developed realistic strategic and business plans that forecast sustainability based on the organization's ability to deliver connectivity, training, and content on a fee-for-service basis to other NGOs, government agencies, and institutions. The second phase of UHIN entails expansion to all fifty-seven health centres in the two districts.

Another project, 'Using Cell Phones to Improve Treatment of Cape Town Tuberculosis (TB) Patients', sends SMS to patients via mobile phones to remind them to take their TB medication at pre-determined times and provide an affordable solution to improve patient adherence to TB treatment and reduce cost (Bridges.org, 2005). Although the compliance service showed that rates for TB cure and completion similar to those of clinic-based therapy, the researchers intimated that poor project implementation was the main cause of the lack of benefit of the SMS system. However, there were some other critical obstacles. For instance, the study underscored the fact that healthcare workers cannot rely on technology alone to solve the problem of patient adherence. A significant number of patients interviewed were not using the service, despite expressing willingness to use mobile phones.

Much of the current IDRC work in Africa is focussing on the key issue of standards related to health data collection, with the goal of ensuring inter-operability between different devices and health information systems. The principal projects IDRC supports is developing "Open Architecture, Standards and Information Systems (OASIS) for Healthcare in Africa (OASIS)" and "OpenROSA", the latter being a consortium formed to create open source, standards-based tools for mobile data collection, aggregation, analysis, and reporting. By developing open source solutions and conforming to standards based on certain specifications, different projects can easily share code, data, ideas and infrastructure. Many of the consortium members are working on JavaROSA, an open source J2ME codebase that conforms to the OpenROSA standards. JavaROSA is being developed for a wide range of uses, including disease surveillance, household surveys, collection of longitudinal data for electronic medical records, guiding health workers through medical protocols at the point of care, and supporting community health workers.

In Asia, ICT4D is supporting an important research network on E-health in Asia called PANACeA (pan Asian collaborative evidence-based e-health adoption and applications), that will support research on e-health solutions in Asia. The research programme includes several studies related to mobiles including:

1. a pilot programme in Mongolia and the Philippines of remote consultation to improve health services for rural mothers;
2. online TB diagnostic committees for clinically suspect sputum negative patients in the TB-DOTS programme;
3. use of mobile phones for referral of pregnant women.

In addition, some small projects were undertaken in Asia that used mobile technologies for health (Dougherty, 2006). The projects focused on various aspects including: reporting child injuries through SMS in Philippines, developing a user-friendly graphic interface for a mobile phone tele-health information system over SMS in the Philippines, and developing a tele-medicine system in which people living in rural areas or far from hospitals can be given a routine check-up by using mobile phones in Indonesia. While an analysis of

the projects was not possible due to the lack of information on direct health outcomes, these projects showed some promise. The use of mobile phone in health is not surprising given the widespread penetration of mobile phones in the countries studied. However, challenges like the cost of SMS and integrating technology with the existing national and local health policies was also apparent.

Several projects are now being undertaken in LAC. One project titled 'Linkage for Education and Research in Nursing' assesses the role and impact of innovative ICT tools such as PDAs in enhancing information, resources access and evidence based practice in selected health care environments in the Caribbean. The next phase of the project will continue the introduction of the technology through a training the trainer mechanism to both build capacity and to enhance the investment in nurse participants in rural hospitals in the Caribbean. This project will focus specifically on three of the main health challenges: diabetes, hypertension, and HIV AIDS. Another project titled 'Plataforma para la e-Salud en Código Abierto (PESCA)' will implement a pilot for accessing essential health care information through the use of PDAs in two target populations in Argentina and Colombia.

On the basis of the research conducted by ICT4D, it is quite clear that mobile technology could be a very effective system for delivering health care services. Given the lack of other ICT infrastructure in poor countries, mobiles offer a great opportunity to provide information critical for health care provision. Mobiles could be invaluable in tackling serious diseases as one study shows in the context of HIV/AIDS response in Southern and Eastern Africa (AfriAfya, 2006).

Given the success of projects like UHIN, there is indeed a scope for cautious enthusiasm. However, it must be recognized that very few other projects were equally impressive. The efforts for integrating ICT in health have generally been sporadic. At the same time, most of the innovations in mobile technologies for health and medicine have yet to go beyond the pilot stage. This underscores the difficulties in e-health endeavours where successful implementation and scaling up depend on the interactions between technical aspects and the social-cultural and policy contexts. As a result, notwithstanding the regional and local variation in health sector needs and possible solutions, the optimal use and approach of mobiles in health are still being explored.

There are several issues that need to be addressed in order for mobile phones to play an effective role for health. Illiteracy and localization remain a critical challenge in developing countries (Elder & Clarke, 2007). In a scoping study in LAC, it was concluded that policy reforms related to funding, lack of research capacity, etc. remain significant obstacles in integrating mobile technology in the health systems particularly for disadvantaged populations in remote areas (OPS, 2008). The presence of multiple stakeholders involved in e-health projects illustrate the complexity- as the TB study in South Africa showed, patients' cooperation is essential for successful implementation (Bridges.org, 2005). Finally, the economic viability of mobile-based health services needs to be considered seriously. As Kaplan (2006) argues, convincing evidence regarding the overall cost-effectiveness of mobile phone "telemedicine" is still limited and good-quality studies are weak and rare. There is a need to support research that demonstrate benefits within a framework of a cost-benefit analysis in order to justify significant up-front costs associated with implementing comprehensive, system wide telemedicine solutions (Elder & Clarke, 2007).

5. DISTANCE EDUCATION

The use of mobile telephony in education is a relatively new area, even for developed countries. Most of the research exploring the feasibility and potential benefits of using

mobiles for distance learning in this domain is still at a very early stage, (Stone et al., 2003; Traxler & Leach, 2006).

5.1 Key Findings and Analysis

ICT4D's activities on ICT and distance education revolve around a network of research based in Asia called PANDora (PANAsia Networking Initiative on Distance and Open Resource Access). As part of the network, several projects are being undertaken in different Asian countries that cover a wide range of topics such as mobile technologies, open-source software, learning object materials, and online assessment methods. From 2005- 2007, PANDora has undertaken nine sub-projects. With gradual decrease in prices and increased functionalities, mobile phones can play an important role in the educational systems (Ramos et al., 2006). In particular, there have been increased efforts to integrate SMS services into formal and informal education.

One of PANDora's projects, Viability of Mobile SMS Technologies (known as Project MIND), examines the socioeconomic and gender based factors that motivate or hinder cell-phone subscribers to use SMS for non-formal education. A component of the project included a baseline survey of 123 ALS students (out of school youth and adult learners) in Manila. It was found that 81% of the respondents allocate at least half their pre-paid cell-phone credits to SMS usage. The majority of the respondents are open to the idea of learning through SMS and are willing to set aside a portion of their load credits to learn through SMS. The scope of the content of learning was developed on the basis of the needs of the students. Preliminary findings of the project indicate that overall the participants expressed curiosity and excitement about the prospect of using new SMS methods to study (Baggaley & Belawati, 2007).

Another project called Technology-Supported Distance Education, explores the potential of ICTs and distance non-formal education to achieve the mandate of the Water, Sanitation, and Hygiene (WASH), Manila in an effective and sustainable manner. SMS technology, among other ICT tools, was used to enhance the delivery of WASH information through distance non-formal education strategies. The project resulted in a more engaged learning experience and contributed to improved lives of the targeted people in terms of empowerment of the community (Ramos, 2006). However, as the research did not disaggregate the findings on the basis on individual ICT tools, it was not possible to independently assess the role mobile phones had in this process.

While evidence is still emerging, the projects indicate that SMS could be a viable technology for delivering distance education courses. In particular, it appears that SMS technology will be easier to initiate and implement in countries where its usage is generally very high (e.g. - Philippines). It is therefore important to assess the feasibility of using SMS in other countries, given the fact that the extent of SMS usage is quite low overall, as discussed above in the previous sections.

The financial viability of the mobile phone based distance education technology needs to be considered carefully, particularly from the end-users' perspective. In the case of the MIND project, although the participants acknowledged the benefits of being able to learn from their homes or workplaces, the use of SMS actually cost most of them more than transportation. In addition, ensuring a user-friendly technology is essential as technical glitches, signal fluctuations, and system bottlenecks can cause delays in delivering the content thereby affecting the motivation of students or other beneficiaries to interact with the system (Ramos et al., 2006; Ramos, 2006).

6. DISASTER/ENVIRONMENT

Many developing countries are ravaged by natural disasters such as Tsunami, floods, particularly in Asia. Communication technologies can play a significant role in disaster intervention as they can save critical time. For instance, ICT tools can be used as a warning technology (LIRNEasia, 2008). In addition, communication is central in the ability of communities' strategy of coping and adapting with disasters (IDRC, 2007). Lack of adequate support during and after disaster events significantly affects survival as well as livelihoods in the longer terms. There are very few studies that explore the role mobiles in the context of disasters, exceptions include Agar (2003), who shows how mobiles can be useful in emergencies like the eruption of a volcano in Eastern Congo.

6.1 Key Findings and Analysis

Two projects -one completed and one ongoing – will be discussed in this theme. The objective of 'Evaluating Last-Mile Hazard Information Dissemination' project was to evaluate the suitability of five ICTs including mobile phones deployed in varied conditions for their suitability in the last mile of a national disaster warning system for Sri Lanka. Overall, it was found that there is a significant gap between the ICT reliability as stand alone ICTs and as warning technologies in last-mile communities.

The study further showed that mobile telephony did fairly well in terms of two critical dimensions of disaster warning: effectiveness and reliability. The effectiveness of mobile phones was attributed to their capability of displaying text messages in local languages as well as English. Although, as a stand alone technology, the mobile phone is a relatively less reliable terrestrial technology, when it is coupled with another one, such as Addressable Satellite Radios, the effectiveness and reliability levels were significantly increased (LIRNEasia, 2008, p.19-20).

Evidence of the role of mobile phones in disaster situations is still emerging. From the existing studies, it is apparent that there is scope of further research in this area. For instance, it needs to be determined what model of roll out is best suited to other developing countries if mobile phones are used as an alerting system. Aspects that need particular considerations include whether the service should be provided through public or private mechanisms and the kind of standards that should be used. Moreover, the suitability of mobile alerting needs to be examined according to different types of emergencies. More cases studies of mobile phone use in disaster situations are necessary in order to draw conclusions on the effectiveness of mobile phones in disasters.

7. CONCLUSION

The paper set out to evaluate how mobile phones can contribute to solving development problems by assessing IDRC supported mobile phone projects in five different development domains. Amongst the most important conclusions the paper raises is actually the dearth of reliable evidence related to the impact mobiles are having within the different development areas. Much of this is due to the fact that the adoption and use of mobiles in developing countries is still a relatively new phenomenon. Moreover, although there is quite a lot of excitement for the potential of mobiles to have a positive effect on the lives of the poor, there are still only few public interventions that would help to shed light on how exactly that can take place.

One of the key findings this paper is that mobile phones are increasingly accessible to lower-income groups in developing countries. The proliferation of mobile phones experienced in most developing countries needs to be understood in the context of the continued absence of other ICT infrastructure, most notably fixed phones. Mobiles simply offer the poor with a relatively affordable and accessible option, compared to other ICTs. As

seen in several of the studies discussed above, the cost of a mobile phone is still very high for many and income remains the major barrier for adoption. The studies further showed that mobile phones help to strengthen social ties among the poor and provide them an opportunity to communicate in the case of emergencies.

By and large, the studies confirm the potential of mobile phones as a tool for economic empowerment. Mobile phones contribute to greater efficiencies for farmers/fishermen and in business development of small entrepreneurs. For example, case studies from Senegal and Ghana show quite strong measurable evidence of economic return through mobile phone usage. However, for now, these are isolated cases. Many other studies indicate that while using mobile phones can significantly reduce transaction costs, face to face interactions are still preferred in many contexts -- despite the higher costs often associated with the latter. Understanding the role of trust in these economic relationships will be the key to better understanding which mobile applications could be successful.

Among the different developmental domains of mobiles supported by IDRC, education had the least amount of activity in terms of intervention. Yet, mobiles have great potential in this sector, particularly in the delivery of courses. A few IDRC supported studies have suggested that SMS could be a viable technology for delivering distance education courses. In contrast to education, attempts to use mobiles for improving health outcomes and health systems abound. Projects in Uganda and South Africa have demonstrated the important role hand-held devices can play in facilitating demographic surveillance or treatment compliance. However, the potential for wide scale improvement of the health sector is enormous and more activities are needed to ensure that pilot activities are scaled.

The role of mobiles in disaster relief and prevention is often overlooked, and yet most of the poor surveyed in Asia cite the mobile's role in an emergency as its most useful instrumental function. The project in Sri Lanka has further corroborated this by demonstrating that mobiles, complemented by satellite radio, were the most reliable means of warning people of an impending disaster.

In terms of the broad range of developmental effects of the mobile phone, the themes covered in this paper are far from exhaustive. Indeed, there are some other critical areas that can be explored by IDRC. One of these areas is governance related projects, where not much findings are available as yet. Another area where further research could be particularly useful is m-commerce. M-commerce, particularly m-banking, has great potential for those engaged in rural livelihoods such as small-scale agriculture and fisheries. This activity might be particularly challenging as it may require significant private sector involvement, private-public partnerships, etc. IDRC will therefore pay particular attention to ensuring there is a greater body of knowledge related to the role of mobile in these areas, which are essential for sustainable development.

One of the principal weaknesses of the conclusions that we bring forth within the context of this paper is that they only represent findings from IDRC supported projects, and hence do not necessarily represent findings from the broader area of mobiles and their impact on development. Although the authors have attempted to bring in perspectives from the existing literature, a systematic review was not undertaken and it is assumed that a vast treasure of important findings still reside in grey literature, particularly stemming from international development actors. More work is needed to examine to what extent IDRC conclusions coincide with other experiences regarding mobile telephony. However, both authors are reasonably familiar with the literature in this area and find that it is probably close to being an accurate representation of the overall state of knowledge.

The findings of this paper are simply a glimpse into the potential role mobiles could play in improving public services in health, education and governance; increasing participation in democratic processes; predicting and preventing diseases; making markets

more efficient and generally spurring creativity. It is hoped that the current effort will contribute to the formulation of future policy directions on the basis of available evidence. In sum, there is a definite scope for enthusiasm for mobile phones potential for development. Although one doesn't want to sound like an advertisement for a mobile manufacturer, it does seem like the possibilities are endless. However, a clearer understanding is needed of what environment, skills and applications are needed to ensure these benefits accrue. Failure to do it in a systematic and rigorous manner, with clear evidence informing policy and practice, may lead to an M4D "white elephant", like so many other technological applications before it.

8. REFERENCES

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