

M4D Applications in Agriculture: Some Developments and Perspectives in India

Kasina V. Rao, Rajendra M. Sonar

Abstract:

In this paper we are looking at Indian projects, which are targeted specific to farmers through their applications and services delivery through mobile phones by customised innovative business processes. These are looking at the basic core needs and demands of the end-users as the adoptable mServices which are affordable and create confidence on them. Some of the initiatives crossed to commercial stage and other are at field testing phase after piloting well. The applications used in their services are of short message service (sms), multi-media service (mms) and voice stream options. These are customised based on subjectivity such as literacy, usage pattern, social acceptance, domain specific and life-style of rural farmers in various states. These practices are nothing but innovative business models, which are adopted based on their per capita. Most of the initiatives are push-based method providing opportunity to fill the knowledge transfer to end users' basic needs. The value added services concentrated on crop advisory issues, market intelligence, micro-finance for rural populations and finally local social networking at rural areas. But this paper look at, how effective are the projects which are specific to agriculture domain providing the information and knowledge services to enhance crop yields and improve productivity over a wide range of crops by taking effective decisions at right time by farmers under different agro climatic zones.

Keywords: Mobiles for development, Agricultural mobile services, Information and communication technology, Mobile applications and services

Introduction

The rural growth usually efficient than the urban growth as agriculture growth is more efficient than manufacturing growth in most cases. If we can see the pattern of effectiveness of poverty reduction impact (Danielson A, 2001) based on the corrective measures taken by governments, donor agencies, and the project implementing organisations (commercial and social). The indirect impacts generally create the long term effect on development mechanisms. With quality information at

rural people fingertips, rural people can make improved decisions, from what crop to plant, to whom to sell it for better profit, and benefiting from health and disease prevention advice. The technology (specially mobiles) is making it to happen since mobiles positioning themselves as a personal entity within each individual it occupy in their pockets along with money, keys etc (Rao and Sonar, 2009). The present mobile phone based projects are targeting the farmer specific applications since rural India depends on agriculture which is about 70 per cent population. This provides an opportunity to research community to study for socio-economic development of rural areas issues. The result oriented mobile based solutions based on farmers' needs and demands is a major challenge for research community (technical, social and field specific) with rural socio-economic constrains. By this study we are looking at how effective are these mobile phone induced projects in providing the user specific localised services to farmers in local language to enhance their crop yields and in turn improve their productivity over a wide range of crops under different agro climatic zones.

The main stakeholders in this process are governments (national and state), business enterprises including multi-nationals and entrepreneurs, NGOs and people's groups got a chance to make rural people's life easier. By analysing the pilots to know about the delivery of user needs as services at affordable cost in their local languages where ever they are. Analysis concentrated especially on the socio-economic aspects of the outcomes arising out of projects implementation rather than looking at immediate profits as returns. Keeping in mind the farmers' interest and benefits, the effectiveness of the outcomes are tried to measure in terms of development perspective. These projects fall under farm expert advice on crops, market intelligence on various produce, crop finance, weather and other information cum knowledge sharing areas. Most of the projects crossed the research and development and field testing stages at various small geographic zones of India. Now they started their commercial operations with other collaborating organisations to deliver the mServices to the rural end users. As high mobile penetration across the country providing an opportunity to provide mServices which are going to fulfill the basic needs and demands of rural populations. The adoption of mobile wireless telephone by people irrespective of cadre, created a huge market for the telecom operators on one end, a chance of opportunity raised to provide mServices to unreached consumers through contactless mode. The new telecom policy by

government of India created a new wave of mobile adoption rate of 10 million per month mainly through wireless telephony segment which contributed for overall diffusion rate.

Mobile ICT intervention for rural areas

Information Technology revolution is unfolding, and has very high visibility. However, its benefits have remained confined primarily to the urban areas. Rural communities have not been able to gain to the same extent from information communication technologies (ICTs). As a means of knowledge transfer to rural communities, Information Technology has had a limited impact. Even the vast potential of the broadcasting network has been tapped only minimally for the extension activities. The World Bank recognises that “making effective use of knowledge in any country requires developing appropriate policies and institutions to promote entrepreneurship and efficient use of knowledge”- (Michael G., 2005). Dahlman C. Utz recognizes that India has made tremendous strides in its economic and social development in the past two decades and is poised to realize even faster growth in the years to come. They note that the time is very opportune for India to make its transition to the knowledge economy.

The rural society happens to be a tradition-bound community in which their traditions, cultures and religion play a strong role in influencing their behaviour. This shows on their adoption of technology, incremental change in work more clearly. The transfer of knowledge and information is the basic need to change traditional society to knowledge society. The need of ICT interventions are felt need of the hour in agriculture as rural areas mostly depend their socio-economic growth with agriculture. Rural India needs a very strong and innovative intervention to take a giant leap forward. “Connecting India”, with focus on rural connectivity is one such intervention, which can help, ignites the rural creativity to achieve its potential by integrating them in global market (Abdul Kalam, A.P.J., 2005). The idea of digitally oriented development is as powerful and seductive as the technology upon which it is based. No single technology revolution has changed the lives of current generations in the way that the Internet has and later mobiles. The greatest obstacles to rural development – large distances and inadequate infrastructure – made to obtain by instant access to virtual institutions that provide agricultural, market advice, banking, education, health care, neonatal information and so forth. Most of the

Indian rural villages lack connectivity or accessibility to people, this results the wastage of time and money chasing information and officials. This is effecting on their productivity of activities say on agriculture and related areas. Lack of market information (on commodity prices, various input supplies, etc) leads to loss of income and exploitation of rural entrepreneurs by middlemen. Such exploitation and losses further marginalize small and marginal farmers and village artisans (Misra Satyan, 2005).

Technical and research communities have come-up with new dedicated and customised applications to the specific segments especially rural communities. This created a huge emerging market at bottom of the pyramid (BOP) which created interest even for multi-nationals want to contribute their part in services going to be rendered. Bridging the development divide, mobile phone based projects is providing a platform to test the catalytic growth of rural India. These cabalistic activities are to be sustained with telecom intervention else unreached communities can't able get a chance to come up. The penetration percentages differ between urban and rural, where urban is placed at about 80 percent of subscribers' base as per TRAI annual report. The market trends shows communications will become a basic human right in modern civilization era. There will be a continued push on price and distribution to take costs out. The spread of communication based services to wider demographic area to get benefit more number of people specifically in rural areas. This was created an emerging market but the existing business models have to modify drastically to accommodate the characteristics of lower price based services, affordable handsets with localised content and local language options. India is one of the major emerging markets second after China, wants to push services to all its citizens as a policy. The role of private sector may be crucial because the country has not much achieved success in achieving state-coordinated economic growth. The scope, consumer usage skills and educated middle class are few advantages for the growth of mobile based services in India as shown in Figure-1.

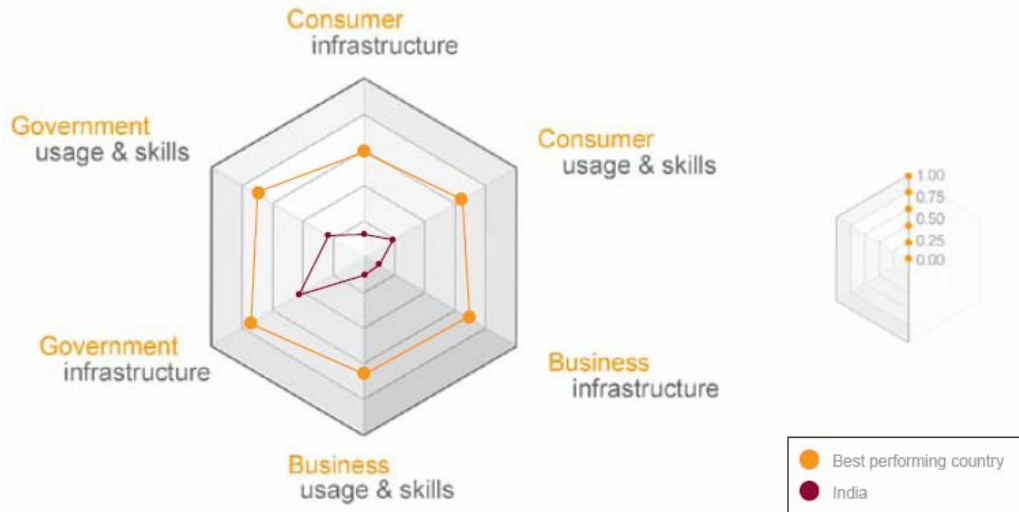


Figure 8: India's connectivity performance status (NSNRS, 2008)

Mobile diffusion in India

Indian telecommunication revolution that too wireless connectivity made it possible to reach to unreachable located consumers through mServices. During the present decade, India has seen an exponential growth in the telecom particularly in wireless. Rural teledensity has just reached the two digit level whereas the urban teledensity is moving towards the three digit level. Mobile- penetrations among the 700 million rural population are put at about 16-18 percent and growing rapidly (TRAI, 2009). The penetration is at least 10 million subscribers every month from September 2008 onwards. Even the masses have access to mobile connectivity, but the potential of the handsets are not yet tapped. This is largely because of the content delivered is often not directly related to their livelihood and environment. Since they need localised news and information directly delivered in their language to meet their daily needs. Only 29% of subscribers are from rural India, which constitutes about nearly 70% of the total population of the country (TRAI-1, 2008). Out of 593731 inhabited villages, the service providers had reported that 407112 villages have already been provided with mobile coverage (TRAI-1, 2008).

By March 2009 about 5.55 lack villages to be covered under public telephone (TRAI-4, 2009). By 2012, India is expected to have 200 million rural telecom connections (with trend shown in Table-1), and rural users will account for more than 60 percent of the total telecom subscriber base at a penetration rate 25 percent according to a report by the Confederation of Indian Industry and Ernst & Young.

Table 3: Telecom subscriber future growth

	2006	2007	2008	2009	2010	2011
Total population (in millions)	1152	1169	1186	1203	1220	1237
Mobile subscribers (in '000)	149,620	233,629	306,533	370,002	419,360	459,828
Mobile subscribers: % change y-o-y	97	56	31	21	13	10
Mobile penetration (in %)	13	20	26	31	34	37

Telecom sector has shown an exponential growth track after 1998 telecom policy introduction in India. Teledensity, which grew (TRAI, 2007) only 1.92% in 50 years (1948-98), increased by 35.06 per cent in just 11 years by March, 2009. Teledensity is interlinked with level of growth; the larger gap between urban and rural can't be sustained for long time. This is clearly seen in Table-2. From September 2008 till July, 2009 the teledensity raised by 10 percent stating the penetration or adoption of telecommunication services by people is very high. The monthly growth rate is high as seen in Figure-2.

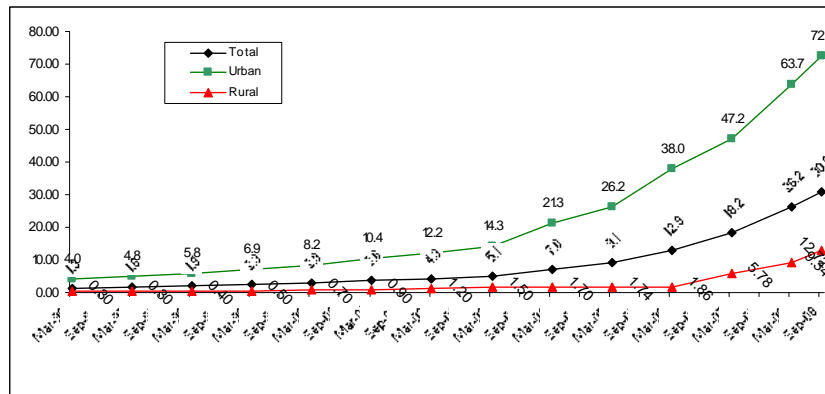


Figure 9: Telecom growth chart

As per AK Raman of Tata Strategic Management Group (TSMG), the fast-rising subscriber base, falling airtime rates, the rural thrust by various telecom players and the prevalence of information asymmetry among a large section of farmers make India an ideal place for the development of customer centric services. But these adoption rates depend on one major thing is, affordability (IKWarton, 2009).

The Mobile Industry, which is one of the most dynamic and growing industry in the world, is no longer just about the delivery of voice over phones. The future of mobile telephony is expected to rely on mobile services (Carlsson et al, 2006) due to saturation in voice. The basic services evolved rapidly. This basic challenge is to understand how and why people adopt or do not adopt mobile services (Carlsson et al, 2006). Perceived ease of use and perceived usefulness predicts attitude toward use of a technology. It includes five concepts: ease of use, usefulness, attitudes towards use, intention to use and actual use (Davis, 1989).

Table 4: Telecom monthly growth rate

Wireless subscription (in million)	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09
Month	10.07	10.42	10.35	10.81	15.41	13.82	15.64	11.90	11.59	12.03	14.38
Total	315.31	325.73	336.08	346.89	362.30	376.12	391.76	403.66	415.25	427.28	441.66
Teledensity* (in per cent)	30.64	31.50	32.34	33.23	34.50	35.65	36.98	37.94	38.88	39.86	41.08

* Wireless and Wireline taken together; Wireless subscribers are 98 percent of the total.

Mobile based applications and services for rural India

With quality information at rural people fingertips, and appropriate mServices available in local languages, rural people can make improved decisions, in specific to each individual. Still expanding their vast reach and simplicity of use at affordable cost, mobile devices are now in a position to extend public services to rural people at corner of the country. As a result, there is a growing focus on m-based services implementation by public and private bodies ready to disseminate information as per the needs of the rural people.

The solution for reach, affordability, acceptability, personalised with privacy got ascertained. There are challenges – affordability is a key issue for many potential users. Not everyone can afford handsets; innovative business models adopted by the

firms and handsets at low price tag which work for voice and sms based services. Looking at flexible business model rather than complex and rigid one of the past is need of the day. The thing still missing is the confidence on the system, delivery mechanism through affordable mobile unit, localised content in local language, easy to understand (NSNRS, 2008). The customers of the future change and their demands will also change. It makes sense plan for the change in advance, based on their taste and expected demands. This provides a challenge to the firms providing mServices to fine tune accordingly with changing criteria of the customers. This made to provide a flexible rather than rigid business model to be built in for sustenance of the projects specific to rural segment (NSNRS, 2008).



Figure 10: Customer requirements (NSU Magazine-4)

The mobiles can play a role in the development of certain sectors say, agriculture, micro-commerce, banking, healthcare, education, infotainment, transport and other sectors. Most of the pilots till date supported well that mobiles can play a role to reach these sectors through mServices to rural populations. Tailor made mServices with rural specifics is not an easy task. But this derives better market spread to providers and good benefit to information hungry rural customers that too at affordable cost to them.

The challenge before business enterprises made to re-look into their business strategies to tailor their mServices for rural communities, since it is attributing for their promising future market. The mobile market is evolving into a mass market for rural consumers for their socio-economic development. The consumer reach and capacity for learning and development, which is providing confidence to make decisions on day to day basis. mServices are depending on end user demands and

how the provider able to deliver them is the key for success. Looking at key driver verses customer demands as presented in Table-1. In Indian market mostly the key drivers are: usage cost, consumer need based services, device independent services and finally services must be easy to find, subscribe and use.

Table 5: Five key driver category (NSNGIRS, 2007)

S.N o.	Key Driver	Customer demands
01.	Cost and billing <ul style="list-style-type: none"> • Total monthly cost • Device cost • Perceived value • Cost of same network calls • Tariff plans • Billing clarity and accuracy 	<ul style="list-style-type: none"> • I want value for money • I want pricing plans that are relevant, simple and transparent • I want online visibility on how much I have spent • Bills must be accurate and easy to understand
02.	Network performance and service quality <ul style="list-style-type: none"> • Coverage and service availability • Indoor coverage • Call drop rates • Failed events • Call quality 	<ul style="list-style-type: none"> • I want to access services wherever I am • The service must work well everywhere • I want the services I use to be secure • Applications must be easy to use
03.	Customer service <ul style="list-style-type: none"> • After-sales-service (easy to contact) • Quick-to-respond 	<ul style="list-style-type: none"> • I want proactive support • I want different service options matched to my needs • My problems must be solved first • As soon as I subscribe to a service, I want to be able
04.	Service and device portfolio <ul style="list-style-type: none"> • Services that are easy to find, buy and use • Services that match customer needs • Devices and customer premises equipments • Innovative services • Security 	<ul style="list-style-type: none"> • Services must be easy to find, easy to subscribe to and easy to use • I want services that match my needs and preferences • I want a particular device • Services must be cool and work well • I want to combine my own service packages

05.	Brand <ul style="list-style-type: none"> • Reputation for good service • Understanding of customer needs • Trustworthiness and loyalty schemes 	<ul style="list-style-type: none"> • I like respected brands • I want my loyalty to be valued and rewarded • I must be able to trust my CSP • The CSP must be reliable with a good reputation • My needs matter and the CSP must understand this
CSP – Communication Service Provider;		

What we observe now is not just the size of the network (governed by Metcalf's law) that determines its value but it's also the amount of participation of network stakeholders such as customers, employees, competitors and others. Once operators begin to provide profit that goes beyond basic connectivity there will be a cascading effect and a great rush will follow, because it will fundamentally change the business model of all service providers (Andrew Zolli, 2008). The high quality end-user satisfaction is achieved by providing new services faster and do not suffer confusing data. When it came to identify which ICT device can provide best method of delivering public services, mobiles are showing the best potential to stimulate the supply and demand of public services. Mobiles are becoming affordable and the connecting to more and more people is go on increasing and offering excellent interactivity than other ICT devices. This is providing a chance for all application providers to start customer specific services at affordable conditions.

Need of Mobile ICT intervention for Agriculture

Agriculture role in economic development is essential because the majority of the people in developing countries make their living from the land they cultivate. To improve the welfare of the majority of people is by helping to rise, (i) the farmer's productivity goes up by growing food and cash crops, (ii) the prices they receive for those crops produced. Although, it is a necessary condition, raising agricultural output is not by itself sufficient to achieve an increase in rural welfare (Perkins et al, 2007). The rural and often remote nature of the community makes it unbelievably difficult for farmers, in particular those with small holdings. The farmers consciously or unconsciously are adapting to modern living, their expectations being influenced by the urban dynamics, is an observed phenomena. Farmers inadequate information on current and local market prices or timely need-based information (advisory or time tested) which help them decide in harvesting the crops. Reduced crop yields, increased wastage (unwanted and ill-advised inputs), and slowed down market

efficiency, severely impacting farmer's earnings (Misra Satyan, 2005). The implications on the rural people are three-fold such as: loss of income, time and opportunity. Information is critical to the social and economic activities that comprise the development process. Telecommunications, as a means of sharing information, is not simply a connection between people, but a link in the chain of the development process itself (Hudson, 1995).

To bridge the information gap between the farmers and to build productive and competitive market, different ICT interventions providing to make rural and under-developed markets become efficient and productive. Agriculture extension and farmer-outreach programs are facing major challenges (Ramamritham, 2006) – cost-effective outreach, solutions tailored to needs of individual farmers and an image that is farmer-friendly. Mainly mobile technologies have created new channels to communicate with others in a well-located way. Farming is not so linear but requires constant inputs at every stage where new technological inputs provide better crop outputs. It means, crop production depends on weather, agricultural practices and management of pests and diseases at right time to save crops and gain better results. The final produce should provide better marketable price to farmers, where the market intelligence is the key, which was provided regularly for nearby markets in local language. The market dynamics are critical to take a decision by farmer where, when and at what price should the produce sell to gain better margin. The decision is in the hand of farmer only, but the actual market situation is known to him, by transfer of information about market dynamics. Due to the knowledge gain, farmer can able to deal with the middle men or the market forces well for better price for his produce. That means, knowing the market trends, both for inputs and outputs, farmer can make better decisions as he is the master in his own area. How effective are the mobile phone based projects which are specific to agriculture domain providing the information and knowledge services to enhance crop yields and improve productivity over a wide range of crops by taking effective decisions at right time by farmers under different agro climatic zones seen here.

Agro-information services through Mobiles

The internet and mobile networks have the potential to provide agro-information services that are (i) affordable, (ii) relevant (timely and customized), (iii) searchable and (iv) up-to-date (Ramamritham et al, 2004). The mobile phone technology

provides electronic capabilities (battery, processing power, memory) (Helen Nierinck, 2008), reach to customer, privacy, and anytime/anywhere, physical contact-less services (Helen Nierinck, 2008). Keeping these factors and needs of Indian farmers in mind, various applications and services provided by mProjects for dissemination of agricultural information. Operators are developing consumer friendly value added applications which can be accessed by just two-three key strokes. Complicated applications will be discouraged by rural communities. Hence, operators are selling handsets with pre-embedded value added services (VAS) content in the mobile devices. These measures are driving customized applications and services in India. The projects are being taken up at locations which are more favourable to test and implement the technology, applications and services (Rao and Sonar, 2008). The VAS concentrated on crop advisory, market intelligence, micro-finance and finally local social networking at rural areas.

Mobile based projects' overview for rural India

The mobile phone technology provides the electronic capabilities (battery, processing power, memory) (Helen Nierinck, 2008), reach to customer, provides privacy, anytime and anywhere, contact-less services and most preferred user carry personal item (Helen Nierinck, 2008). Keeping these factors and the needs of Indian farmers in mind, various applications and services have been deployed by different projects. The projects considered are providing farmer needs' based mServices through their technological innovative applications combined with creative business plans – aAqua mini (Bahuman and Kirthi, 2007), Fisher Friend (Thomas, 2007), mKrishi (Robert Horvath, 2008), Reuters Market Light (RML) (Amit Mehra, 2007), IFFCO Kisan Sanchar (Awasthi, 2008), Life Tools (NSNRS, 2008) and CERES (Anurag et al, 2008). Development occurs when people are increasingly able to take control of their lives - means the decision power for the development challenged citizens had a chance to come out of bottom of the pyramid (Danielson A, 2001). The mobile based projects for farmers had objectives which benefit farmers and based on development agenda. These objectives suits for markets (input, output) prices, availability status, agricultural extension, social connectivity and finally financial support systems. Here we are looking specific agriculture domain specific projects as listed in Table-4 and their usefulness to farmers in specific but rural development in general.

The company background provide indirectly that elimination of donor agency need, long term project execution, scale up issues and sustainability of projects are well attained. The projects sustain based on their objectives and usefulness for all stakeholders. The basic core needs and demands of the end-users as the adoptable mServices at affordable cost creating confidence on users. The applications used in their services are of short message service (sms), multi-media service (mms) and voice stream options. These are customised based on subjectivity such as literacy, usage pattern, social acceptance, domain specific and life-style of rural farmers in various states. These practices are nothing but innovative business models, which are adopted based on user per capita. Most of the initiatives are push-based method providing opportunity to fill the knowledge transfer to end users' basic needs.

Table 6: Indian pilot projects in Agriculture domain

S. No.	Project Name	Partners (with service option)	Project Stage
1.	aAqua Mini	Agrocom (on GSM,CDMA)	Commercial trails
2.	mKrishi	TCS-Qualcomm (on GSM)	Commercial trails
3.	Fisher Friend	TATA Tele-Qualcomm-MS Swaminathan Foundation+ Astute Systems Technologies (CDMA)	Commercial trails
4.	Reuters Market Light (RML)	Reuter-MSAMB-India Post (on GSM, CDMA)	Commercial trails
5.	IFFCO Kisan Sanchar (IKSL)	IFFCO-Airtel (on GSM)	Commercial trails
6.	Life Tools	Nokia+ Idea+ RML (on GSM)	Commercial trails
7.	CERES	CERES+ Reliance (on CDMA)	Commercial trails

The projects become a source of knowledge and information transfer for farmers from agriculture scientists/extension functionaries and markets through mobiles. The critical thing here is the understanding of requisite content or knowledge for farmers' needs. Providing local content in local language through text mode, the literacy challenged farmer is facing the real hurdle to utilise the opportunity for his/her benefit. Understanding the nature of agriculture is fundamental to understanding development is the key.

i. **aAqua Mini** - offers real-time decision-support tools (aAQUA) to progressive farmers and organizations supporting progressive farming (Bahuman and Kirthi, 2007). The project is working on revenue generating business model. The services provided are broadly to farmers include, localised – remote crop diagnostic solution; audio prompted guide application (in English/Marathi/Hindi); remote crop & land properties based disease diagnostics; micro-weather info (temp, cloud cover, precipitation); SMS enabled register & query mechanism; online poll for registered users; spam, search, rank features; and service is available on GSM and CDMA networks.

Table 7: Projects' company profile

Project Name	Company Name	Location	Type of Company				Sector Type				
			Multinational Corporation	Large national Company	Local SME or National	Non-profit Organisation	Agriculture and/or Food	Research & Development	Mobile Communication	Hardware Manufacturer	Media & Content
aAqua Mini	Agrocom	Indian			x		x	x			
mKrishi	TCS	Indian	x					x			
	Qualcomm	UK	x					x	x		
Fisher Friend	Astute Sys	Indian			x			x			
	TATA Tele	Indian		x					x		
	Qualcomm	UK	x					x	x		
	SF	Indian				x	x				
Reuters Market Light (RML)	Reuters	UK	x								x
	MSAMB	Indian			x		x				
	India Post	Indian			x						x
IFFCO Kisan Sanchar (IKSL)	IFFCO	Indian			x		x				
	Airtel	Indian		x					x		
Life Tools	Nokia	Finland	x						x	x	
	Idea cellular	Indian		x					x		
CERES	CERES	Indian			x			x			
	Reliance Infocom	Indian		x					x		

SME – Small and Medium Enterprise;

SF – Swaminathan Foundation;

ii. Fisher friend – The project is working on private NGO partnership based revenue generating business model in Tamilnadu state at present (Thomas, 2007). It is to test its sustainability with Indian fishing communities. The services provided are broadly to fishing farmers include, weather forecasting; market price; sea wave heights information; fish shoals location information (via satellite scan data); and service is available on CDMA (pre configured handset) networks only, but not on GSM networks.

iii. mKrishi – allows the farmer to make a query in a local language from a mobile phone and receive personalised advice or relevant information on the same in local language (Robert Horvath, 2008). This is the project working on private partnership based revenue generating business model in Maharashtra and Uttar Pradesh states at present. It is testing to test its sustainability with Indian farmers' needs. The services provided are broadly to farmers include, crop disease diagnosis; sensors based remote land & crop property recording (grape, cotton, soybean and potato); micro-weather Information (temp, cloud cover, precipitation) and service is available on CDMA networks only, but not on GSM networks.

iv. Reuters Market Light (RML) - offers Indian farmers up-to-date, local and customised commodity pricing information, news and weather updates (Amit Mehra, 2007). The project is working on public private partnership (PPP) revenue generating business model in Maharashtra and Punjab states. The broad services provided to farmers include, localised - commodity pricing (Onion, Cotton, Soybean, Pulses, Pomegranate et al); weather updates; news (agriculture & general) and service is available on GSM networks only, but not on CDMA networks.

v. IFFCO Kisan Sanchar (IKSL) - would be focusing on communication requirement of rural India through mobile operator Airtel, besides providing agriculture related information to enable villagers take right farming decisions (Awasthi, 2008). The project is working on public-private-NGO partnership based revenue generating business model across major states covering in two stages. The services are broadly to farmers include, telecom products and services of Airtel; free daily voice updates on VAS platform (mandi prices, farming techniques, weather forecasts and fertilizer availability) and dedicated helpline for farmers to answer their queries

vi. Life Tools – having a range of agriculture, education and entertainment services designed especially for the consumers in small towns and rural areas of the emerging markets (Nokia report: 2008). This is the project going to work on private partnership (PP) based revenue generating business model in India. The services provided specific to farmers include, information on seeds, fertilizers, pesticides, weather (temperature, rainfall, wind conditions) and prices in English, Marathi and Hindi language option and prevailing market prices, education service in dual language display option.

vii. CERES - aims to assist farmers by providing exhaustive information covering all areas in timely and customized manner to meet specific local needs to increase the overall productivity of agricultural practices (Anurag et al, 2008). This is the project working on private partnership based revenue generating business model in Gujarat state covering 78 villages in Vadodara district. The services provided specific to farmers include, information on seeds, fertilizers, pesticides, disease and farming input; market prices and weather (micro-climatic, rain/storms, temperature, humidity, precipitation, wind speed) on weekly and monthly basis.

Results and discussion

The projects have similar objectives but their business models are different based on subjective planning and implementation. There are challenges – affordability is the one important for many potential users. The missing issues are the confidence on the system, delivery mechanism through affordable mobile device, localised content in local language and easy to adopt. The major observation is that the project's capabilities to serve the farmers needs, but not through in any single project till date. The combined outcomes are arrived through SW analysis on mKrishi, RML, aAqua mini and eSagu to see how effective these pilots as per farmers needs are.

- The objective of all of the pilots is to provide latest information about crop practices, input and output market information to farmers to gain good price for their produce.
- The strength in providing better back-end crop information system management including crop yields per farmer handled by agri-experts to provide advice.
- The back-end information management supported by automated data collection of weather, crop information, soil analysis details through remote sensory system.

- Expert (Agriculture/Extension official) can contact farmer on his mobile handset at any time to get further crop details as per expected needs.
- Remote operation capability at front-end and automated multi-media based back-end information management system provides farmers better crop management guidance from experts.
- The tools and features providing to expert(s) to study state of the crop are quite advanced and guide farmer(s) critically at needy time on demand at any time.
- EMI with differed payment based (proposed) business model suits best to Indian farmer conditions and situations of rural India.
- Providing market (input and output) information (price and stock) through SMS to farmers timely in local language daily.

The observed features of the projects looked collectively the networked ones can provide an excellent services and applications to farmers at affordable cost. By looking at the above issues, it is inferred that:

- The projects initiators are multinational or major communication companies of India provide stable business with extended reach and penetration across the country.
- Transparency and feedback system mechanisms are to be adopted into the system to enhance pilot's sustainability.
- Add on feature of expert interaction through mobile with back-end information management system can provide any-time any-where service mechanism.
- Network independent operations can give users better service confidence else some parts of the market segments get negative feedback which leads to negative growth.
- By providing consolidated weekly market price trends reports (by email, snail mail or on their mobiles itself) on crops, provide farmers a chance to plan better.
- The growth can expect with signal spread across villages with affordable price tags.
- Network independent hybrid model is the best bet for any project want to deliver the services to rural consumers.

One of the stepping stones to achieve the goals is utilising technology to make services reach the unreached in development process.

Conclusion

The information is a key ingredient for sustainable human development – hence, for further human development access to it is a prerequisite for the needy communities. Once these projects are time tested with common objectives, then they become hope for developing countries. The process has just started but the impact has to be seen. It is looked upon outcomes with farmers' needs perspective rather than in economic sustainability angle. The mobile based projects are offering a method for bridging the gaps between development professionals and rural communities by initiating interaction among them a dialogue, new alliance, inter-personal networks, and cross-sectoral links between organisations and communities. It can articulate bottom up mechanism, sharing domain specific and localised knowledge in local language. The benefits observed through pilot projects include increased efficiency in the use of development resources, less duplication activates, reduced communication costs. More in-depth study of mobile based services can provide better understanding of how effectively and efficiently mobiles can act as a tool for development to solve farmer's needs. These initiatives provide a new hope for rural masses in their socio-economic development, only time will tell.

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