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A REVIEW

Emerging ICTs and their potential in revitalizing small scale agriculture in India

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ABSTRACT

Agriculture plays a vital role in the social and economic development of India and is the main contributor to economic growth and stability. Small-scale agriculture and the harvesting of natural resources provide livelihoods for over 55% of the Indian population. However, most smallholders are resource-poor and face many challenges. Modern information and communication technologies (ICTs) have the potential to increase agricultural productivity through communicating knowledge and information to rural agricultural communities, providing capacity building, accessing markets and credit, restructuring of extension and scaling up inter-linkages of development interventions. This paper points out the potential of emerging ICTs in efforts aimed at dealing with some of the challenges small-scale farmers face. Findings suggest that the FM radio stations and the cellular phone have become important tools in improving small-scale agriculture in rural areas. The internet, web-sites and web-based applications are becoming increasingly important in sharing and disseminating agricultural information and knowledge and marketing of goods and services. Other emerging ICT applications for small-scale agriculture include radio frequency identification technology (RFID), market information systems (MIS), geographic information systems (GIS), precision agriculture and public access facilities. The study also established that low usage levels of these technologies is the result of low technical capacity and limited ICT infrastructure in the sector, especially in rural areas.

KEY WORDS : Small scale agriculture, Information and communication technologies, MIS, GIS

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The agricultural sector has been described as the engine for economic growth and improved livelihoods in India. The majority of the population in India lives in rural areas and depends directly or indirectly on agriculture. Agriculture contributes about 17 per cent to the Gross Domestic Product (GDP) of India.

India has made significant strides in agriculture and associated activities. The Green, Yellow, White and Blue revolutions are testimony to the progress made. Concurrently India has successfully embarked upon a "Cyber revolution". Despite the progress made in agriculture, information technology and the Cyber revolution integrating them to alleviate the above constraints is still incomplete. Without doubt agricultural information technology has the potential and will play a vital role in transforming India into a stable and prosperous democracy within this 21st century.

Small-scale agriculture and the harvesting of natural resources provide livelihoods for majority of the Indian population. Small-scale farmers have certain defining characteristics: they derive their livelihood from holdings of less than 2-5 hectares (usually less than 2 hectares), in normal circumstances they own between 10 to 20 heads of livestock, although often, they have less than 2 or none at all (Hirst *et al.*, 1988). Small-scale farmers also tend to practice a mix of commercial and subsistence production (in crops and / or

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livestock). The family provides the majority of labour, while the farm provides the principle source of income (Narayanan and Gulati, 2002).

To improve productivity, these small holders need access to improved technologies, best practices, and to appropriate, timely and comprehensive information and knowledge on production, value addition and markets. The FAO (2000) asserts that 'information and knowledge play a key role in ensuring food security and sustainable development'. Thus, ICTs are considered to be cross-cutting drivers of change for rural and agricultural development, by connecting rural and remote communities, and improving healthcare, education and agricultural productivity (Richardson, 1997). ICTs can, for example, speed up the extension of development services, can be instrumental in strengthening partnerships and in providing a framework for shared learning. A networked information economy helps to achieve competitiveness, and although it cannot in itself solve poverty, hunger and disease, it provides new avenues for cultural production, creates new economic opportunity, and facilitates the sharing and dissemination of scientific outputs and innovative linkages between farmers, scientists and other actors (Benkler, 2006). It is not surprising, therefore, that ICTs have led to increased use of a networked information environment and the development of platforms for better sharing and exchange of information and knowledge.

The system of modern farming system has recognized the importance of ICT initiatives in India, and noted that relatively little attention had been paid to the potential benefits in the broader use of ICTs to small-scale agriculture. In this paper aspects of the scoping study are presented, which focus on the challenges faced by small-scale farmers and the potential of emerging ICTs in revitalizing small scale agriculture in India.

The Indian agricultural scene is still in the process of rationalizing production and adopting itself to the graduation of the economy from a traditional farming society to an industrialized, market oriented economy. The process includes adopting modern practices, new crops and varieties of traditional staples, information utilization as a production factor and management tool, response to supply and demand on local and international markets and integration of agriculture into broader national environmental and other policies. ICT is now accepted as a dominant tool to achieve national and individual goals for agricultural production and sustained rural economic viability. In order to get a rough outline and information on ICT adoption and constraints in India, a study was undertaken to identify the information needs of farmers and bottlenecks in the use of ICT.

ICT and Indian agriculture:

Indian agriculture contributes 17% of our GDP, and approximately 55% Indians derive their livelihood from the agricultural sector. Today's farmers want not only the two-time bread for their families from their hard sweat, but also surplus food production, which can be sold in the market to get sufficient money to fulfill their other daily needs. Also, private sector initiatives like contract farming have commercialized the Indian agricultural sector. It has also seen many new concepts and theories substituting the traditional methods. Introduction of Information and Communication Technology (ICT) is one of them, which enables the dissemination of requisite information at the right time. This revolution in information technology has made access to the information easy and cost-effective.

Need of ICT in Indian agriculture:

At present, the ratio of the farmers to the extension worker is 1000:1, which is really very less. Although the appointed Village Local Workers (VLWs) disseminate the information, they hardly accept any accountability. These two issues have created the urgency to help and guide the poor farmers properly. The cost factor in face-to-face information dissemination at the right time, and the difficulties in reaching the target audiences, has also created the urgency to introduce ICT. It is only by the introduction of ICT that information can also be upgraded at the least cost. There are several models of ICTs in Indian agriculture, which have made a significant difference in the delivery of services in Indian agriculture like, the establishments of Kisan Call Centers, Gyandoot project, Bhoomi project, Village Knowledge Centers, and AGMARKNET.

India's position in use of ICTs:

India is positioned as the highest English speaking population in Asia with the highest number of Information Kiosks implemented across rural sectors. 45 per cent of the worlds' ICT projects are implemented in India. India also has a proposal for Rural Info Kiosk project where in one Rural Info Kiosk in each of the 600,000 villages will be established.

Unique features of successful ICT projects in our country:

– The "Bhoomi" project (digitalized land records) in Karnataka today serves as an excellent example of governance in its ideal form, transparent and accountable.

– e-Shringula, a one-stop, Web-enabled portal for information and services relating to the government-citizen interface creating an "e-Shringula" ("electronic chain") of information and e-governance.

– 'Drishtee' besides providing technical expertise and management consultancy to build the IT infrastructure and the human capacity to link service providers (government department and private firms) with rural citizens.

– 'Info-Village' of Puducherry by MSSRF developed community ownership and collective action with a "pro-poor",

"pro-nature" and "pro-women" approach to development.

– In Gyan Ganga project, Gujarat all comprehensive education, support and services including agriculture and veterinary services were provided.

– 'e-Choupal' is a huge private sector investment by ICT, which revolutionized agricultural commodity marketing in India procuring soya, coffee and prawns at the doorsteps of the villagers and provides all real time data on crop prices, products and services and facilitate supply of high quality farm inputs in partnership mode.

– ICT devices into the management of operations of the National Dairy Development Board and their milk collection centres in Gujarat and the Swayam Krishi Sangram (SKS) smart cards project use of ICT to reduce transaction costs and reduce the cost of credit are other two successful examples of commercial ventures of ICT in India.

– Info knowledge Village at Puducherry, Warna Wired Village project in Maharashtra, Krishi Vigyan Kendras of ICAR at Ahmednagar and Baramati provided quality offline, static content including packages of practices, recommendations, locally relevant technologies, government schemes, FAQ etc. in local languages.

– Women empowerment through SEWA in Gujarat, mobile classrooms through IT buses in rural Pune, Project Shiksha – computer literacy, Action Aid at Bolangir, Orissa, Akshaya at Malappuram, Kerala, and EDUSAT address the issue of capacity building and empowerment of farmers, farm women, rural artisans and also large number of extension personnel and use of ICT for education and alleviation of poverty from rural sector.

– SATCOM, Madhya Pradesh, Teja TV in Andhra Pradesh and E-TV telecasted programmes on location specific agricultural technologies integrated and Interactive live question answer sessions in local languages resulting in high percentage of farmer-viewers.

Issues in ICT implementation in Indian agriculture:

There are various issues of importance which has to be considered for successful implementation of ICT in Indian agriculture. The most important ones are:

– *Regional priorities:* The remote regions of India, especially the North East is to be given priority for launching the S&T based Agricultural development programme using ICT in a significant way. The 'e-connectivity' programme implemented by Government of India in KVKs would have been more beneficial to the remote regions like NE region since other connectivity options are also limited or nil for KVKs here.

– Information, knowledge and skill empowerment of SHGs.

– *Every village knowledge centre:* ICT to all the 6, 00,000 villages by 2007.

– *Domestic software development and application:* Government projects mainly provide static information. Hence, dynamic information like wealth, markets, health, and other day to day information needs to be given priority.

– *Community radio:* For eg. Fishermen in Catamarans, Government of India should liberalise policies for the operation of community and farm radio thus reaching the unreached through the integrated ICT system.

– Technology upgradation in villages

– *Content creation:* Consortium of content providers will have to be developed for each agro-climatic zones.

– Women and ICT

– *Participatory knowledge system:* E-governance is invariably a passive system of information empowerment. Hence, there is a need for promoting participatory methodologies of content creation and knowledge management. The present approach is of partnership and not patronage. Farmer Participatory Knowledge System (FPKS) could replace the existing beneficiary and patronage approach to knowledge dissemination.

– *Sustainability and replicability:* Should be the bottom line in the development of National Action Plan for the 'every village a knowledge centre'movement with involvement of Gram Sabha and Panchayat.

– Virtual academy for food security and rural prosperity.

– Political commitment.

METHODOLOGY

The study was carried out through secondary sources of information covering small scale agriculture and a wide range of ICT-related experiences and initiatives of government as well as private sector. The reports of the international organizations like FAO, UNDP also used for the documentations of the challenges faced by the small scale farmers.

ANALYSIS AND DISCUSSION

The findings of the present study as well as relevant discussion have been summarized under following heads:

Challenges faced by small-scale farmers:

Small-scale farmers in India face many problems that are often complex and multi-faceted. The most pronounced challenges facing small scale farmers included the farm sizes, which have been declining over time. Because of this factor, rural people have insufficient land to eke a living (Jayne, 2001). Some of the rural community members are landless or near landless, leading to major social and economic problems. The smallness of their lands leads to challenges of diseconomies of scale, and considering that most small-scale farmers are resource-poor, they find it difficult to access affordable credit

and inputs for their produce. Most of these farmers have little experience in produce marketing (Mukhwana *et al.,* 2005), and lack good and efficient markets (Mukhebi, 2007). Typical examples include the very high transport and transactional costs, small inefficient markets, low agricultural productivity, low levels of irrigation and erratic rainfall, vulnerability to high seasonal and inter-annual fluctuations, high rates of evapo-transpiration and very slow adoption of new technologies.

According to the FAO reports (2006), in India millions of peoples living in chronic hunger, smallholder farmers, consequently, they cannot re-invest and continue to face the demands of declining production and productivity. National policies have not adequately addressed the needs of small-scale farmers.

The (ECA, 2006) cites problems of weak backward and forward linkages between agriculture and other sectors. Further, small-scale farmers contend with inadequate subsidies and unfair trade (Karaan, 2006), limited access to animal and mechanical power, reduced availability of labour due to rural-urban migration, weak information systems, a poor regulatory framework that does not facilitate investment and specialization in new and high value products, inadequate market information and lack of agricultural information (Kidane *et al.,* 2006). There are also challenges of low uptake of research products, counter productive policies and insufficient investment in market infrastructure (Jones, 2006).

IA In addressing these issues, many emerging technologies are being examined for their potential in transforming agricultural development in India. As outlined below, the use and application of modern ICTs could occupy a pivotal position in this line of engagement, especially in the context of small scale agriculture.

So, we have to concentrate on high value agricultural (HVA) products, focus on improvement in productivity, considering the options for commercial agriculture, paying increased attention to new markets and marketing strategies and increasing agricultural production through biotechnology.

Some of the emerging ICTs that were identified include GIS and decision support systems, mobile mapping and hand held personal computers (personal digital assistants (PDAs)), precision agriculture and mobile (cellular) phone applications, community radio stations, radio frequency identification tags, World space satellite radio, and more generally, access to the internet and web-based applications.

GIS-based decision support systems:

A Geographical Information System (GIS) makes visual comparisons between different types of data possible. It helps to establish relationships between different data sets and is important in the production of maps, and charts and additional information associated with coordinates and time. It helps in the analysis of post harvest variation in crop yield measures, and provides a holistic view of the production system.

Mobile mapping is a component of GIS systems which provides the ability to collect field data, including unique geospatial time tags and attributes, for integrating into / updating a GIS.

Handheld personal computer (HPC) or personal digital assistants (PDAs):

HPCs are small, light and robust that have been used for providing access to information, mobile mapping and other data gathering activities (GIS Development 2007). This cuts down face-to-face contacts and reduces telecommunication and transport costs.

Mobile (cellular) phone applications:

The cellular phone has provided market links for farmers and entrepreneurs. This has reduced transaction costs, broadened trade networks and facilitated searches for employment.

The cellular phone applications such as the SMS to be one of the most important emerging ICT applications in India. This helps in dissemination of the market related services like the provision of market information and electronic trading platforms, where farmers and traders access information on commodities being sold, their prices and the identity of their buyers and extension messages.

Community radio stations:

Radio is an important mechanism for disseminating knowledge and information in different languages and formats (Bobbili *et al.,* 2006), especially to poor people. Radio is the most highly used media in accessing development and agricultural information. The convergence of ICTs, such as the internet with rural radio can provide powerful support to help harness and communicate knowledge for development.

Radio frequency identification (RFID):

RFID can be used to capture data on individual livestock that is then transmitted to a central database as part of a repository of information for livestock farmers, state veterinary services and health authorities.

Internet and web-based applications:

The internet, e-mail, web sites and web-based applications are becoming increasingly important in sharing and in disseminating agricultural information and there are many ongoing web-based application initiatives in India. The FAO and partners are implementing *e- Agriculture* – aimed at the intersection of agricultural informatics, agricultural development and entrepreneurship, focusing on agricultural services, technology dissemination and information delivered through the internet. *e-Agriculture* is intended to promote

the integration of agricultural stakeholders and technology with multimedia, knowledge and culture, and aims to improve communication and learning processes (FAO, 2006).

In India, Agmarknet, Kissan Call Centres etc. use a web portal to provide market information services and a question and answer service to small scale farmers. Internet cafes, telecentres, information kiosks, market information centres have attracted the attention of rural information brokers who disseminate agricultural information on the web.

Precision agriculture (PA):

PA has been described as the 'next great revolution in agriculture'. PA is also known as 'precision farming, information-intensive agriculture, prescription farming, target farming' (Srinivasan, 2006)' Taylor and Whelan define PA as 'an integrated information and production-based farming system that is designed to increase long-term, site-specific and whole farm production efficiency, productivity and profitability, while minimizing unintended impacts on wildlife and the environment'. PA has 'the ability to manage land by the square meter instead of the square mile'. It adapts to variability: spatial – changes across farm, temporal – season to season and predictive – difference between predicted and actual results (Wikipedia, 2006). Through PA, local situations of disease or lodging can be assessed to enable a farmer to optimize use and vary the rate of inputs, such as fertilizer, across a field based on the need identified by GPS guided grid sampling. Satellite positioning and navigation have played a catalytic role in the evolution of PA. The technology encompasses four key information technologies, namely location determination (via GPS), GIS, computer-guided controllers for variable rate application (VRA) of crop inputs, and sensing technologies for automated data collection and mapping. Among the four, GPS and GIS have been more widely established and used (Swinton and Lowenberg-Deboer, 2001). PA has been used to increase yields for row crops, hay production, pasture management, animal grazing and other agricultural activities (GIS Development, 2006). PA also has the inherent capacity to provide an effective forum for disseminating research and experience and for assessing natural resources variability such as soil and landscape variability, weather forecasting and remote sensing.

ITConclusion:

India is a country with over 1 billion population and 5 million computers. 80% of the 5 million computers used in offices and hardly, 20 per cent are available for use in development work. Despite all the barriers, the Indian agriculture is bound to adopt and implement ICT to double the agricultural production. This aim can be achieved only when there is proper utilization of ICT and more investment in it.

ICTs has grown steadily in India but weak ICT policies and poor implementation capacity are among the biggest obstacles to wider use. One of the key factors affecting the use of ICTs in agriculture is inappropriate ICT policies, especially those that address rural communities and rural development. Sustainability is another key requirement for the use of ICTs, yet most ICT initiatives were project-based, and were disjointed and uncoordinated. The use of ICTs further calls for good ICT infrastructure, adequate ICT skills, good and affordable connectivity, and appropriate ICT policies

In addition, there is a need for high bandwidth despite these problems; there has been massive rollout of basic information communication infrastructure in India, partly spurred by the introduction of cellular technology that has reduced subscriber costs. Indian government has also continued to support ICT initiatives in under-served areas by offering incentives to the lowest competitive bidders for infrastructure provision.

Findings of the present study have shown that radio stations and the cellular phone have become important tools in improving small-scale agriculture in rural areas. The internet and web-based applications are becoming increasingly important in the sharing and disseminating agricultural information and knowledge and marketing of goods and services. The livelihoods of farmers could be enhanced through adoption of modern technologies such as PA, online markets and the application of appropriate ICTs in information and knowledge dissemination. The creation of 'one-stop centres' for training and for linking farmers to markets and restructured extension services that target farmer groups to improve agricultural production and assist in the exchange of knowledge and information. However, the study established that there is low capacity and usage of ICTs and the ICT infrastructure in rural areas, which is a major problem. These challenges and their causes need to be addressed if ICTs are to benefit the small-scale farmers in India.

There is a great scope to implement ICT in order to communicate and integrate the complete agri-food supply chain, as the e-choupals are doing in Madhya Pradesh to procure soybean. The other beneficiaries of ICT can be food-processing companies, and suppliers within the agri-food sector. On the other hand, the need to market the agricultural produce at reasonable prices will also change the farmers' attitude, and they will be more dependent on ICT. ICTs will, thus, definitely help in fortifying small scale agriculture in India.

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