A Review :

Mobile apps in agriculture and allied sector : An extended arm for farmers

Kalyan Mandi and Neela Madhav Patnaik

SUMMARY : ICTs are boon to the farmers and the introduction of Mobile apps in Agriculture and allied sector has accelerated the pace of technology transfer among the farmers at their fingertips. Information dissemination to the knowledge-intensive agriculture sector is upgraded by mobile-enabled information services and the rapid growth of mobile telephony. Today farmers are receiving diverse facts or information about farming like seeds, crop selection, crop cultivation, weather, fertilizer, pesticides etc. from various resources that are distributed in different locations according to its origin, its processors, producers or vendors using the app. However, due to the inefficacy of field level extension workers to provide information and service to a large segment of farmers in offline mode; the mobile app therein plays a vital role and offers a user-friendly solution to effective management and communication with the farmers.

BACKGROUND AND OBJECTIVES

Agriculture plays a vital role in the Indian economy with over 58 per cent of rural households depending on agriculture as their principal means of livelihood. Agriculture, along with fisheries and forestry alone contributes 17.32 per cent of the gross domestic product (GDP) in India. The challenging task for farmers is information management mainly in terms of the amount of data and the complexity of processes in precision farming. To meet these pressing challenges in this digital era, technology-driven smart mobile apps cater to the needs of the farmers.

The digital boom in the recent past has made India one of the largest users of the internet and mobile telephony on the global map. India is the 2nd largest user of the Internet next to China with 560 million internet subscribers in 2018 (IAMAI, 2019). Rural Internet penetration has increased from 9 per cent in 2015 to 25 per cent in 2018 with an estimated 251 million internet users. India being a young country with around 200 million rural youths *i.e.* 41 per cent of the total population in India, are motivated and attracted professionally to agriculture and allied fields. And therefore, there is a significant positive indication of digital transformation among the

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rural masses predominantly represented by rural youth. According to 'The rising connected consumer in rural India', a study by the Boston consulting group, upto 300 million Indian consumers are expected to be online by 2020. More than half of the new Internet users are expected to come from rural communities. Cheaper mobile handsets, spread of wireless data networks and evolving consumer preferences will all drive rural penetration and usage (BCG, 2016).

Information and communication technologies (ICT) plays a powerful role in the daily life of farmers. ICT in agriculture is an emerging field focusing on agricultural development and rural development in India. The introduction of ICT in Indian agriculture (Lantzos *et al.*, 2013) enables the dissemination of requisite information at the right time. ICT tools like Mobile apps serve as smart decision support tools (DST) and are designed to help users make more effective decisions by leading them through clear decision stages and presenting the likelihood of various outcomes resulting from different options (Dicks *et al.*, 2014 and Parker, 2004). The modern days' mobile apps are software programmes designed to run on smartphones, tablets and other devices (Serrano *et al.,* 2013). The application software on a mobile phone handset or tablet computer that enables a user to access specific information; make payments and other transactions; send messages; etc. The application (app) is downloaded (for free or for payment) from a wireless network from an online store and may require a live connection to function effectively.

The mobile software application provides a wide range of facilities like text message service, weather information, market pricing, agro-advisory services, online monitoring of crops, feedback mechanisms, helpline etc. It also provides updates on training programmes organized by different organizations to the agripreneurs and rural youths. The evidence from studies indicated that mobile services in farming led to higher productivity, enhanced income, improved efficiency in the supply chain and reduction of drudgery.

More specifically, mobile agricultural apps offer various kinds of services, such as weather forecasting for farmers (Romani *et al.*, 2015), agricultural business news, information for agricultural machinery and equipment, agricultural product market prices, management of agricultural product, dairy farming (Gichamba and Lukandu, 2012), management of irrigation systems, management of crop sensors (Lomotey and

Deters, 2014), yield forecasting and monitoring, registration of soil types and calculations.

The growth of mobile communication technology is creating several opportunities for social empowerment, and grassroots innovation in developing countries. One of the areas with potential impact is in the contribution of mobile applications to agricultural and rural development (ARD), by providing access to information, markets, and services to rural inhabitants (World Bank, 2012). In, India digital literacy initiated by digital India (2015) has given fillip and increased availability of bandwidth, cheap data plans and increased awareness driven by government programmes to rapidly bridge the digital gap between urban and rural India.

Emerging challenges before farming community:

Even though India's mobile phone users and internet subscribers have outnumbered several developing nations in terms of its usage. Still, farmers in rural areas are yet to reap the benefit of the digital revolution and therefore, affordability, accessibility and availability still possess the determining factors for mobile app utility. Mobile applications indeed have widespread penetration worldwide in all sectors and to a lesser extent in the agricultural sector (Bhatnagar, 2008; Mittal *et al.*, 2010 and Manimekalai, 2013). And therefore, the development of mobile apps for agriculture compared with other business sectors is limited (Karetsos *et al.*, 2013). One of the major reasons why the farmers have faced challenges is because they rarely received adequate and timely information on various influencing factors such as weather, rainfall and soil conditions (Chambers and Ghildyal, 1985, Ratnam *et al.*, 2006; Cantor, 2009 and Goyal, 2010). Similarly, the majority of farmers do not have access to a communications platform that provides market trends and other current updates.

In this era of digital world information, farmers face challenges about information management of huge data and the complexity of processes in precision farming (Patel and Patel, 2016). Access to data from the mobile app having a different format and different specific contents can be heterogeneous in their structure and format (Steinberger *et al.,* 2009). Thus, creates difficulty for the laymen and farmers to easily access its service. The inventions in technology in the agriculture domain remain far from reach to the farmers; because either most of them are illiterates or due to unawareness of the location of information and service provides. Hence, most

of the farmers fail to meet the desired production rate (Prasad *et al.*, 2013) thus, affecting their rate of production/output.

However, research has shown that they have a keen interest in learning to operate and use technology which will enable them to take constructive and in time decisions about their farming (Aguero, 2009; Armstrong and Gandhi, 2012a and Armstrong *et al.*, 2012b). Mobile phones do have a multi-dimensional positive impact on sustainable poverty reduction and identify accessibility as the main challenge in harnessing the full potential (Bhavnani *et al.,* 2008). Hence, there is an immense opportunity to enhance the broadcasting of agricultural information that farmers receive through the use of ICTs.

Penetration of smartphones in India:

Among the technologies invented in the past few decades, smartphones have gained large market shares among various user sectors due to their usefulness, ease-of-use, and affordability. A smartphone is a device that is used to make telephone calls, having additional features and abilities like to send and receive e-mail, Wi-Fi and modem ability, internet access, Office documents, easy touch screen operation and most of all the capability to run custom software. The 'user interface' is one more important characteristic of the smartphone. The number of smartphone users in India is expected to double to 859 million by 2022 from 468 million users in 2017 growing at a compound annual growth rate (CAGR) of 12.9 per cent (ASSOCHAM-PwC). Mobile subscriptions are expected to reach 1.4 billion by 2021, according to the Ericsson Mobility Report of June 2016. (CNBC, 2016). For India, over the last decade, the markets in both developed and developing countries have been flooded by mobile phones, tablets and other pervasive devices (Cranston, 2009 and Cranston and Painting, 2010). Depending on the availability of network 2G and 3G, the applications have helped the farming community at large to be connected, updated, prepared and profitable, (Vodafone, 2010). These mobile-based smart applications potentially deliver timely information to different subscribers such as farmers, traders and producers. The information delivered includes weather, rainfall, crop information at large, while some applications also help update the market data of commodity prices and facilitate the local buying /selling via handheld devices (Woodill and Udell, 2012 and Shannon, 2013).

Farmers need timely information in response to their specific needs. There are mobile applications that provide the latest agricultural information about trends, equipment, technologies and methods being used, help identify pests and diseases, provide real-time data about weather, early warnings about storms, local markets offering best prices, seeds, fertilizers etc. Besides, farmers can also interact and get guidance from agriculture experts across the country via the apps. These apps help in providing market information, facilitating market links, providing access to extension services, farm-related information etc.

Keeping in view the changing scenario in the agriculture sector, the Government of India has launched several web and mobile-based applications for the dissemination of information on agriculture-related activities, free of cost, for the benefit of farmers and other stakeholders. These apps can be downloaded from the official website mkisan.gov.in or from the Google play store. There are apps also developed by agricultural institutions, private sectors, NGOs. These apps are disseminating information from agricultural research and extension to farmers and other stakeholders and facilitating the exchange of information among stakeholders.

Advantages of mobile applications:

The advantages of mobile apps include affordability, wide ownership, voice communication, and instant and convenient service delivery. Due to these, there is explosion across the world in the number of mobile apps, facilitated by the evolution of mobile networks and by the increasing functions and falling prices of mobile handsets (World Bank, 2012). All types of information on crop, soil, climate, rainfall, seeds and machinery at any point in time and any number of times is available on fingertips of farmers. For farmers and their advisers, software tools can facilitate effective farm management by recording data efficiently, analyzing it and generating a series of evidence-based recommendations (Rossi *et al.,* 2014). The available information is compiled and very well organized that farmer does not have to waste time while retrieving and referring (Kirk *et al.*, 2011). The market connectivity is also improved with the visibility and knowledge of the potential buyers and sellers in the locality with an opportunity to develop direct contacts. The commodity prices can be delivered in a real time mode (Shah *et al.*, 2014). Mobility can assist the farmers in better warehousing facility by updating their stock, track the dead stock, make note of the purchase

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Table 1: Android apps and its description

	Production technology and agro-advisory service based apps	
App name	Developed by	Description
Kisan Suvidha	Ministry of Agriculture and Farmers Welfare, Govt. of India	Kisan Suvidha is an omnibus mobile app developed to help farmers by providing relevant information. The app provides information to farmers on weather, market prices, dealers, plant protection, IPM practices, seeds, expert advisory, Soil Health Card, godowns and cold storage. The information is currently provided in English, Hindi, Tamil, Gujarati, Odia and Marathi
Pusa Krishi	Ministry of Agriculture and Farmers Welfare, Govt. of India	Provides information related to new varieties of crops developed by the Indian Council of Agricultural Research (ICAR), resource conserving cultivation practices, farm machinery and its implementation and production technologies, to the farmers. A feedback section enables farmers to have a real time conversation with the stakeholders
Soil Health Card (SHC) Mobile App	Ministry of Agriculture and Farmers Welfare, Govt. of India	A Soil Health Card App gives soil nutrient status to each farmer for his/her land holding and also gives advice on fertilizer dosage and soil amendments needed to maintain soil health in the long run. This will also help to take corrective measures on the soil nutrient deficiencies identified in soil health cards. This application also captures Latitude and Longitude automatically when "Location" is on. The farmer details, land details, crop details and fertilizer details can be entered using this mobile app
Crop Cutting Experiments-Agri Mobile App	Ministry of Agriculture and Farmers Welfare, Govt. of India	This app is for capturing crop cutting experiment data. The app works in both Online and Offline mode. Internet is required only to download this app and for registration. After that Crop Cutting Experiment (CCE) data can be entered using this app without internet connection. As and when internet connectivity is available, data can be pushed to the server
Bhuvan Hailstorm App	Ministry of Agriculture and Farmers Welfare, Govt. of India	This mobile app has been developed to capture crop loss, which has happened due to hailstorm, along with photographs and geographical locations. An Agriculture Officer would go to the field with a mobile or tablet loaded with this mobile app and collect field data for hailstorm damage assessment.
Crop Insurance	Ministry of Agriculture and Farmers Welfare, Govt. of India	Crop Insurance mobile app can be used to calculate the Insurance Premium for notified crops based on area, coverage amount and loan amount in case of loanee farmer. It can also be used to get details of the normal sum insured, extended sum insured, premium details and subsidy information of any notified crop in any notified area
Krishi Video Advice mobile app	MANAGE with NIC, Hyderabad	Krishi Video Advice project has been conceptualized by MANAGE to bridge the information gap between the farmer and the expert. The mobile app works on all smartphones or tabs having android operating system. Any farmer/extension officer can use the mobile app to capture three images of the crop live from the farmer's field itself and upload the same. The Kisan Call center (KCC) expert will provide advice based on the crop images
Plantix	PEAT, Germany	Plantix is a mobile app for plant disease diagnostics and monitoring. The App provides users worldwide with customized information concerning best practices, information on preventive measures and independent options for action. Plantix offers the possibility to send pictures of affected plants directly via smartphone and guides through an identification process to determine the plant disease in a very simple manner. All pictures sent via the Mobile App are tagged with coordinates, which enables real time monitoring of pests and diseases

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IFFCO Kisan Agriculture	IFFCO Kisan, a subsidiary of Indian Farmers' Fertilizer Cooperative Ltd.	This app enables access to various modules including agricultural advisory, weather, market prices, agriculture information library in the form of text, images, audio and videos in the selected language. The app also offers helpline numbers to get in touch with Kisan Call Centre Services. The app supports eleven languages across India including English
APEDA Farmer Connect	Agricultural and Processed Food Products Export Development Authority (APEDA)	This mobile app allows a farmer to apply online for farm registration and approval by state government and lab sampling by authorized laboratories. The farmer can track status of applications. An authorized State Government Officer, farmer or registered laboratory can login to access the information. This app has in-built GPS capabilities to identify the farm location
Marketing apps		
e-NAM Mobile App	Small Farmers' Agribusiness Consortium (SFAC), Ministry of Agriculture & Farmers Welfare, Govt. of India	National Agriculture Market (NAM) is a pan-India electronic trading portal promoted by the Government of India which networks the existing mandis to create a unified national market for agricultural commodities. The purpose of the Mobile App is to facilitate remote bidding by traders and access to arrivals and price related information to farmers and other stakeholders on their smartphones
AgriMarket	Ministry of Agriculture and Farmers Welfare, Govt. of India	The app has been developed with an aim to keep farmers abreast of crop prices. This app automatically captures the location of the person using mobile GPS and fetches the market price of crops in those markets which fall within the range of 50 km
Digital Mandi India	Appkiddo	This App helps in checking the latest Mandi prices of agricultural commodities reported from different states and districts/mandis in India One can get commodity wise categorization or state wise categorization
Crop specific apps		
riceXpert	ICAR-National Rice Research Institute (NRRI), Cuttack	It is a bilingual (English and Odia) Android platform with a view to reach the latest rice technologies to the rice farmers in real time basis. It provides real time diagnosis of insect pests, diseases, nematodes, weeds, nutrient deficiencies and toxicities to farmers. It has other features like rice varieties, agricultural implements, news, expert consultation through e-advisory services module, weather information
Mana Verusanaga App	Regional Agricultural Research Station, Tirupati, Acharya N.G.Ranga Agricultural University, Andhra Pradesh, India	Provides detailed information to the farmers and extension personnel on all aspects of groundnut cultivation. The content includes varieties, seeds, nutrient management, pest and diseases, farm mechanization, value addition and contact details with photographs
Mobile App on Castor	ICAR - Indian Institute of Oilseeds Research (IIOR), Hyderabad	This mobile app provides information on castor production technologies, recommended hybrid varieties, intercropping, major insects, pests and diseases and its remedies to castor farmers.
Solapur Anar	ICAR - National Research Centre on Pomegranate (NRCP), Solapur	This app aims to educate pomegranate growers about scientific pomegranate production practices
Cane Adviser	ICAR-Sugarcane Breeding Institute, Coimbatore, Tamil Nadu	Cane Adviser is a mobile app for cane growers and millers. It gives details from planting to harvest with text and graphics for tropical and sub-tropical India. The features of the app include static as well as dynamic platforms
Allied sector apps		
Pashu Poshan	National Dairy Development Board (NDDB)	With the help of this app, balanced ration can be formulated while optimizing the cost considering animal profile, *i.e.* cattle or buffalo, age, milk production, milk fat, and feeding regime etc. and milk producers are advised to adjust the quantity of locally available feed ingredients offered to their animals along with mineral mixture
Cattle Expert System	TNAU, Coimbatore and C-DAC, Hyderabad	Cattle expert system is a mobile app that covers feeding management for cattle and buffalo, breeding management, disease and control management, production technology, calf management, general care and management, practices etc. for cattle and buffalo

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	Tata Consultancy Services (TCS)	The app provides vulnerable fishermen access to knowledge and information
m-Krishi Fisheries App	Innovation Lab – Mumbai, in collaboration with ICAR- Central Marine Fisheries Research Institute and Indian National Centre for Ocean Information Services (INCOIS) Hyderabad	services on weather, potential fishing zones, ocean state forecasts, disaster alerts and market related information
eOther apps providing agro-advisory		
RML Farmer	RML AgTech	Farmer can access information related to weather forecast, market price, crop advisory, farm related news as per their location in their preferred language. The app gives personalized recommendations, keeps track of pest and disease attack
My Agri Guru	Mahindra Agri Solutions, Mahindra and Mahindra	MyAgriGuru connects farmers and agri-experts across the country. The farmer agri-expert interactions cover over 90 diverse crops – ranging from Cotton, Wheat, Tomato to non-traditional crops like Tulsi, Aloevera, Flowers etc
Rythu Nestham	Rythu Nestham Foundation	Rythunestham is a mobile app which helps farmers in organic farming. The mobile app is available in both English and Telugu
Kultivate	Gowthaman Ramasamy	Kultivate is a software platform aiming to fill the gap in traditional agricultural extension to make "Smart Agriculture Extension Easy for Everyone

Source: Extension digest, Dec.-2017

requirements and thereby honoring the delivery commitments promptly and getting the stock to reach the end consumer and at the same time ensuring quality (Kuek *et al.,* 2011). Cell phones have a greater impact on price dispersion for participants who are further away from their markets, and for those with worse roads (Aker, 2008). In addition to it, the farmers can be well updated about their investments, track orders made on purchases, view bank statements, be well informed of insurance details and deadlines and thereby plan the production effectively (Baumuller, 2012).

Disadvantages of mobile applications:

Due to less relative advantage, compatibility, trialability, observability and more complexity of the mobile apps creates difficulty and disadvantageous for its user to easily access the applications. With the diversity in languages, even if the best of the applications do not support regional languages then the translation will be required at all stages which will increase the dependency and in turn reduce acceptability and popularity (Cantor, 2009). At times, due to network issues, speed of the data delivery, legal restrictions, it might prevent the farmers by getting the updated and complete information (Kirk *et al.*, 2011). There may be a requirement of a skilled person to understand and translate the various complex functions to be performed on farm, ambiguous information and videos in other languages (Baumuller,

2012). The farmers in the developing nations may not be adequately equipped to afford and use the applications which may be chargeable and also require huge data usage thereby levying the network charges on the burdened shoulders of the farmer (World Bank, 2012).
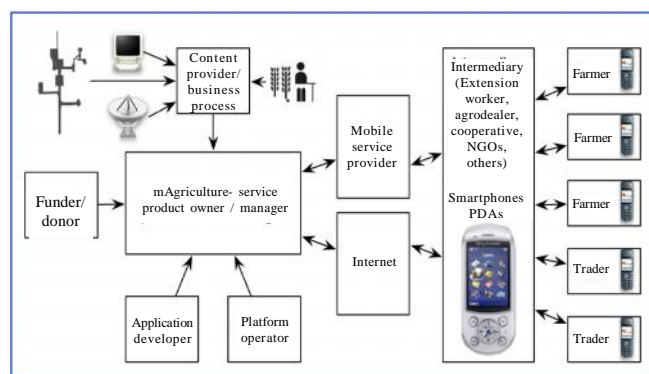

Fig. 1: Basic mobile service app structure

According to the World Bank (2012) the benefits of these apps in the development of the agricultural sector could be achieved through the following ways:

Provision of better access to information:

By providing to producers immediate access to market information, higher product prices and increased demand are achieved. Also, by accessing accurate information regarding weather and pest and diseases, better risk management is achieved.
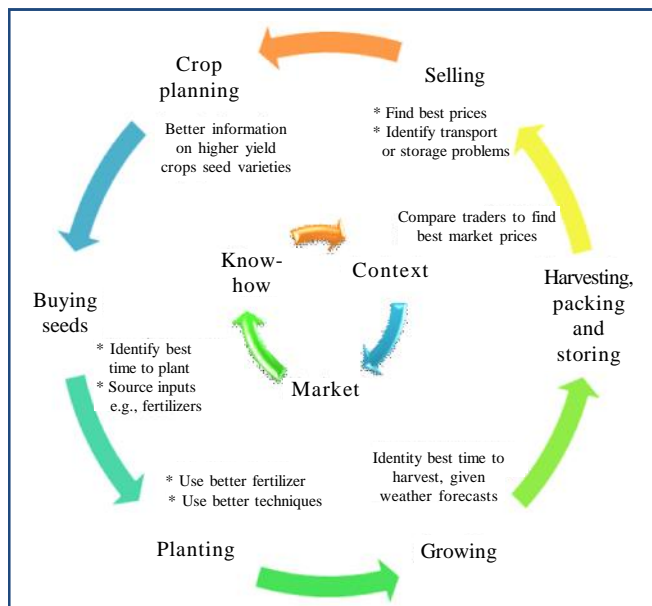
Fig. 2: Information needs of farmers (Mittal *et al.*, 2010)

Provision of better access to agricultural extension services:

Accurate advice for good farming practices and support can be given. This could result in crop yield improvements and more accurate assessments for the condition of pastures.

Provision of better connections with the market and distribution networks:

With the improvement of links among producers, suppliers and buyers value chains become more transparent and efficient, less manipulated by intermediaries. Also, better accounting and traceability helps to increase efficiency and forecasting and reduce administrative burden and fraud.

Provision of better access to funding opportunities:

With access to funding and insurance opportunities and alternative payment methods, farmers can achieve an increase in crop yields production diversification and reduction of economic loss.

Conclusion:

Mobile technology is transforming access to information among farming masses. The emergence of the digital revolution and internet penetration in rural areas has enthralled farmers to access new apps that would keep pace with modern technology. Several new apps are emerging in response to new requirements and challenges in agriculture and allied sector. As the number of apps continues to increase it is important to be selective in choosing the app, review and ensure that the App provides credible and current information and meets requirements. Since agricultural work is context-based, which is primarily distinguishable by different geographical locations, smartphone applications already available in one scope of context can be developed to fit other crops or countries or regions. Hence, the mobile app should aim at holistic rural development and forge closer links between farmers and consumers through gender-sensitive technology, training and capacity building of the farmers through technology-driven platforms for income generation activities.

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