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CURRENT TRENDS OF MOBILE APPLICATIONS IN FARMING FOR RURAL DEVELOPMENT

[1]Dr.K.Lokeswari, [2]S.R.Ravikumar
[1]Assistant Professor, [2]Research Scholar
[1]Department of Communication
[1]PSG College of Arts & Science, Coimbatore, Tamilnadu, India.

Abstract: Farming plays a significant role in rural development. The significant contribution of farming to rural development are advocating employment, allied businesses, environmental services, and supporting the economic and social infrastructure. Mobile communication technology is creating opportunities for social and economic empowerment in developing countries, especially in farming. Smartphones are actively adopted by farmers in developing countries and this gives space for mobile applications that can meet their requirements. Many mobile applications have appeared for farmers in recent years such as Kisan Suvidha, eNAM, Plantix, etc., Farming Mobile applications contribute to Agricultural and Rural Development (ARD) by providing the latest information, markets, and services to lot of rural people. This paper provides a systematic review of the current trends of mobile applications in farming for rural development. The research design employed here is the secondary data analysis. Previously collected data have been tabulated and analyzed by the researcher. Different project reports, research studies, and conference proceedings were analyzed to document the current trends of mobile applications in farming for rural development. Findings reported that mobile applications would unlock enormous benefits for the farming community and rural development sector, particularly in developing countries.

Index Terms - New media, ICT, E-Agriculture.

I. INTRODUCTION

Farming is central to the Economic Development of the Nation and is one of the largest contributors to the Gross Domestic Product (GDP) in India (Extension Digest 2017). It not only provides food and nutritional security to the nation but also income security to the farmers. Farming and the allied sector proved to be the most resilient to the Covid-19 shock as they registered a growth of 3.6 percent in 2020-21 and improved to 3.9 percent in 2021-22 (Business Standard 2022).

Information and Communication Technology (ICT) has opened the way for an important change in agricultural production management, decision-making, and information dissemination. Among ICTs, there has been increasing use of mobile phones, which is changing the farming communication process. The development of mobile communication technology is generating several opportunities for social and economic empowerment, and grassroots innovation in developing countries. Agricultural and Rural Development (ARD), is one such area where mobile applications have a potential impact by providing access to information, markets, and services to rural inhabitants (World Bank, 2012).

There is an increasing number of mobile applications providing access to farming and allied sector information. The main advantages of mobile apps for farmers are, easy to access information on farmers' mobile. They are helping the farming community by improving long-term productivity by enabling them to make more informed decisions regarding seed selection, identification of disease, appropriate IPM techniques, water management, soil management, harvesting, post-harvest technologies, government subsidies, raising livestock, and real-time market price tracking.

The government of India has launched various mobile-based applications developed by many agriculture institutes, NGOs, and private sectors, for utilization by farmers and other stakeholders. Mobile apps developed by various institutions to provide access to agricultural and allied information along the agricultural value chain. This study is designed to analyze the current trends of mobile applications in farming for rural development.

II. SCOPE OF THE STUDY

Farming and agriculture have always been basic needs in the past, present, and future. Smartphones have been identified as one the effective innovations which are an example of overcoming adversity by connecting the rural digital divide, bringing monetary benefits, and acting as a catalyst for rural development. Mobile applications are transforming farming and agriculture. This study aims to find out the current trends of mobile applications that are used in farming for rural development.

III. OBJECTIVES

1). To analyze the usage of mobile applications in farming.
2). To study the current trends of mobile applications in farming.
3). To find out the role of agricultural mobile applications in rural development.

IV. REVIEW OF LITERATURE

A1: R.K. Raman, Dhiraj K. Singh, Sudip Sarkar, Ujjwal Kumar, R.C. Bharti, Naresh Chandra, and Rakesh Kumar (2021) in the article "Agricultural Mobile Apps for Transformation of Indian Farming", noted that Affordability, wide ownership, voice communication, and instant and convenient service delivery are major benefits of mobile phones. Due to these, there is an 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).

A2: Wulystan Pius Mtega (2021) in the article "Veritable mobile phone applications for affecting the exchange of agricultural information among farmers in Tanzania", noted that Mobile phones may transfer voices, graphics, texts, images, and videos. Smartphones, which form the current generation of mobile phone technology have more computing abilities, powerful onboard computing capability, capacious memory, large screen, and open operating system (Vora, 2015; Boulos, Wheeler, Tavares, & Jones, 2011).

A3: Aravindh Kumar S and Karthikeyan C (2020) in the article "Factors Influencing the Utilization of "Uzhavan App" as Perceived by the Farmers in Tamil Nadu", note that for obtaining farming information through digital tools, 88 percent of farmers were in supportive of the agricultural app and 82 percent of a Facebook page in attempts to find information about the market price and weather forecast (FAO, 2019).

A4: Julierme Zimmer Barbosa, Stephen A. Prior, Guilherme Quaresma Pedreira, Antonio Carlos Vargas Motta, Giovana Clarice Poggere, Gabriel Democh Goularte (2020) in their article "Global trends in apps for agriculture", have emphasized that there was a notable increase in the number of apps and countries that developed apps for farming, indicating a fast-growing interest in this technology between 2015 and 2018.

A5: Manish Kumar, and Lalit Agrawal (2020) in the article "Empowering Farming Community Through Mobile Applications: Changing Scenarios", highlighted that Mobile based applications addressing the needs of agriculture and allied sector communities are bridging the information and communication gaps that exist between farmers, researchers, market and extension personnel.

A6: Victor Okoroji, Nic J Lees, and Xiaomeng Lucock (2020) in the article "Factors affecting the adoption of mobile applications by farmers: An empirical investigation", pointed out that the use of mobile phone applications has helped developing countries like India, Kenya, Uganda, South Africa, and Tanzania improve their agricultural productivity (Qiang et al., 2012).

A7: Arpita Sharma (2019) in the article "IKHEDUT: Successful Case Study of Mobile App for Development of Farmer", noted that farming communities appreciate mobile phones as an easy, fast, and convenient way to communicate and get quick answers to various issues. Nowadays, the mobile phone has generated a space for the farmers mainly to get knowledge about marketing and weather.

A8: Nawab Khan Badar N. Siddiqui, Nanak Khan, Farhatullah Khan, Naqeeb Ullah, Muhammad Ihtisham, Rahmat Ullah, Sohaib Ismail, Syed Muhammad (2019) in the article "Analyzing Mobile Phone Usage in Agricultural Modernization and Rural Development" emphasized that mobile applications play a vital role in the advancement of the rural population. Growers can obtain knowledge about agriculture through various apps. There are various applications, such as soil health card applications, marketing applications, m-Kishan, etc., which deliver the best material at the appropriate time to the farmers and other stakeholders.

A9: P. Tamilselvi & P. Balasubramaniam (2019) in the article "The Usage of Mobile Apps in Agriculture", noted that Agri App is a revolutionary Android-based mobile application. It gives complete data on Crop Protection, Crop Production, and all-important agriculture allied services on your Smartphone. Agri App is also an online marketplace bringing farmers, Agri inputs, and retail & fulfillment services on a common digital platform.

A10: Anupam Barh and M. Balakrishnan (2018) in the article "Smartphone applications: Role in agri-information dissemination" noted that Information about policies, good agricultural practices, market prices of commodities, current demand of commodities, and various useful agriculture schemes are helpful to a farmer for reaping good profits. Mobile or Smartphone applications could avail all such information with changing seasons and climate.

A11: Paven Belakeri, C.Kotresh Prasad, Shankarappa Bajantri, M.T.Mahantesh, S.T.Maruthi, G.N.Rudresh (2017) in the article "Trends of Mobile Applications in Farming" emphasized that Mobile phones which helps in improving awareness, education among farmers will act as a catalyst for rural development and country's economic growth. For a true revolution in the farm sector to happen the farmers must be able to get information which need-based, location-specific, and individual-oriented which is made possible by mobile. As for mobile, "Accessibility, Affordability, Applications" will make mobile a universal tool in future extensions.

A12: Constantina Costopoulou, Maria Ntaliani, and Sotiris Karetsos (2016) in the article "Studying Mobile Apps for Agriculture", noted that the mobile agricultural apps show significant potential for the modernization of the agricultural sector, in both developed and developing countries. They can contribute to increasing the income of small-scale producers, reducing the transaction costs in supplying and distributing products, improving traceability and quality criteria for consumers, as well as providing new opportunities for financial institutions.

A13: S. Mohan Kumar, Umakanth P. Kulkarni, and Saurabh Suman (2015) in the article "Mobile Applications the Future Unfold in Indian Agriculture", pointed out that Mobile applications can integrate the agriculture value chain of Indian agriculture which could provide significant economic and social benefits. Mobile applications can provide access to beneficial information, which is lacking in Indian rural markets like price negotiation and other value chain support.

A14: Surabhi Mittal and Mamta Mehar (2012) in the article "How Mobile Phones Contribute to Growth of Small Farmers? Evidence from India" noted that the use of mobile phones has been found to strengthen poor farmers toward larger market participation and diversification to high-profit crops. This change has helped increase farm earnings through higher price realization and reduction in wastages.

V. THEORETICAL CONCEPT OF THE USE OF TECHNOLOGY

Technology acceptance is the decision of a group or individual to make use of an innovation. Beal and Bohlen (1956) state that people accept new ideas through a series of complex mental processes in which adoption is the final action. Rogers (1960:1995) shows technology diffusion from a global perspective to match a classical normal distribution curve, which can be explained by the demographic and psychographic characteristics of the adopters.

In 2003, Venkatesh and his research group reviewed the following eight theories of technology acceptance: Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM), the combination form of TAM and TPB (C-TAM-TPB), Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT), Motivational Model (MM), and the Social Cognitive Theory (SCT). As a result, they proposed a new theory named as the unified theory of acceptance and use of technology (UTAUT) to be as a unified form benefiting from the unique characteristics of all other older mentioned theories and models.

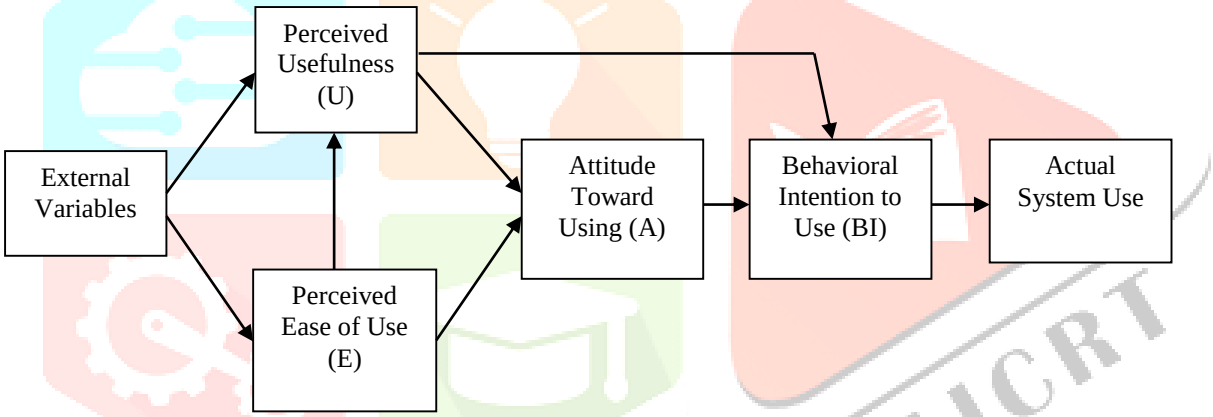

Figure 1. Technology Acceptance Model (TAM) (Davis, 1989) - (Source: M. Sirajul Islam, 2011)

The Technology Acceptance Model (TAM; Davis, 1989) was initially developed for new end-user of information systems for organizations and is one of the most influential models in the study of technology use (Gefen & Straub, 2000). TAM explains the factors affecting the behavior of an individual regarding accepting and using new technology. Perceived usefulness (PU) is the key determinant of acceptance, meaning the user's "subjective probability that using a specific application system will increase his or her job performance within an organizational context" (Davis et al., 1989, p. 985). Perceived ease of use (PEU), is "the degree to which the user expects the target system to be free of effort" (Davis et al., 1989, p.985). Together, PU and PEU determine the attitude (A) of a person towards using the system. Finally, with the influence of PU and Attitude, Behavioral Intention (BI) influences the actual use of the system. However, despite its robustness across populations, settings, and technologies, Malhotra and Galletta (1999) argue that TAM is incomplete, as it does not account for social influence in the adoption of new information systems. Therefore, they suggest considering the effect of social influence on the commitment of the IS user. Furthermore, Mathieson et al. (2001) remark that TAM has limitations in assuming that usage is voluntary and free of barriers that would prevent individuals from using an IS.

The inclusion of social influence was indeed the motivation for TAM-2, proposed by Venkatesh and Davis (2000). TAM-2 provides a detailed account of the key forces of the underlying judgments of perceived usefulness, "explaining up to 60% of the variance in this important driver of usage intentions".

The Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. (2003) is a further development that combines some major theories (e.g. TAM, Theory of Planned Behavior, and Innovation Diffusion Theory) from the IS literature. Venkatesh et al. (2003) suggest that 'given that UTAUT explains as much as 70 percent of the variance in intention; we may be approaching the practical limits of our ability to explain individual acceptance and usage decisions in organizations'.

UTAUT model was designed to have three direct effects from three determinants on behavioral intention, which are performance expectancy, effort expectancy, and social influence. In addition to the effect of two, direct determinants on usage behavior: the intention of use and facilitating conditions. Figure.2 illustrates the model of UTAUT with all its constructs (determinants) and moderating variables. Table.1 shows the definitions of these constructs.

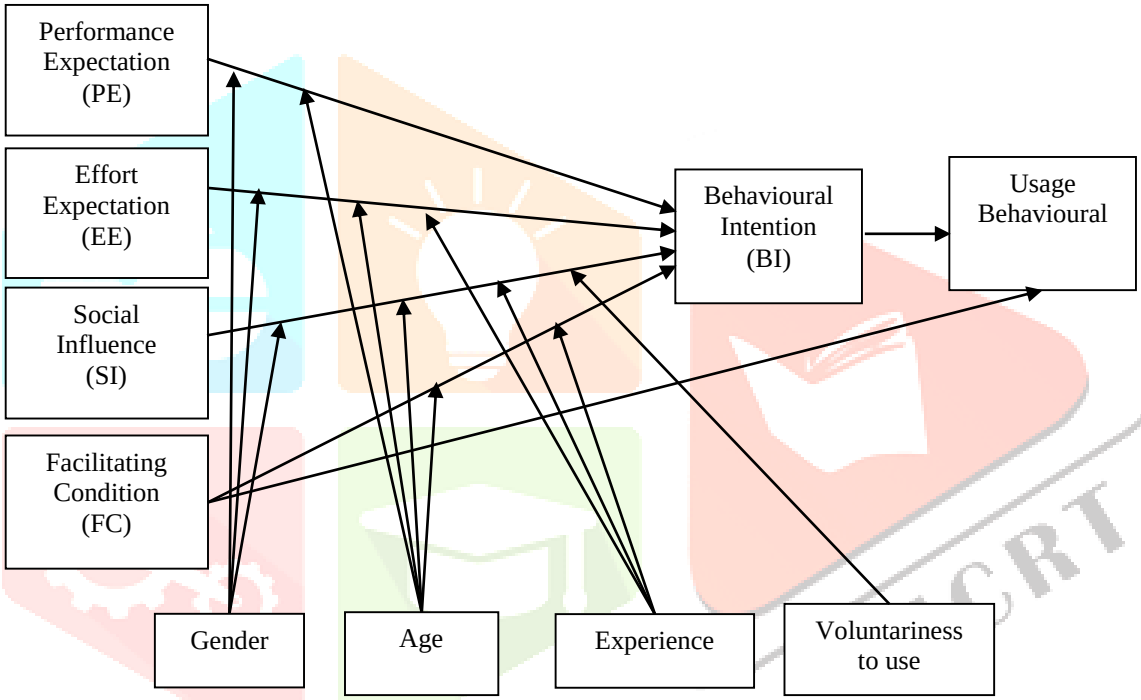

Figure.2. UTAUT Model (Venkatesh et al., 2003) - (Source: Johannes Krümpel, 2019)

Table 1. Definitions of Constructs of the UTAUT Model.

Constructs	Definition
Performance Expectancy	The capability of the technology to provide benefits and enhance the performance of the user according to his/her expectations (Venkatesh et.al. 2003).
Effort Expectancy	User expectations about the ease of use of technology (Venkatesh et.al. 2003).
Social Influence	The expected influence of others on the user to start and continue using the technology (Venkatesh et.al. 2003)

Facilitating Conditions	The expected level of organizational and technical infrastructure that can support the use of technology (Venkatesh et.al. 2003).
Behavioral Intention	The expectation of the user's intention to perform plans and decisions regarding the use of technology (Venkatesh et.al. 2003).

VI. APPLICATION OF UTAUT MODEL

UTAUT model has been discussed, reviewed, and utilized in several research works and studies on many technologies within the two styles of usage settings since its introduction until present, and the quantity of research on this model is increasing rapidly day by day.

Table 2. Application of UTAUT Model in the Utilization of Farming Mobile Apps.

Constructs	Application in the Utilization of Farming Mobile Apps
Performance Expectancy	Farmers' beliefs that farming mobile apps can reduce external environmental effects and costs have a positive effect on their general willingness to pay.
Effort Expectancy	Farmers' perceived ease of use has a positive effect on the frequency of Farming mobile apps use, ultimately.
Social Influence	If farmers' colleagues believe that farming mobile apps are very beneficial, for instance, to facilitate documentation, a farmer may come to the belief that a farming mobile app is useful for that purpose.
Facilitating Conditions	Insufficient mobile internet coverage could limit smartphone adoption. Likewise, some farming mobile apps may need mobile internet access to retrieve data for the identification of weeds or weather updates.
Behavioral Intention	Behavioral intention to use a farming mobile app has a positive effect on the actual farming mobile app adoption.

VII. RESEARCH METHODOLOGY

'Secondary Data Analysis' was employed as the research design. Previously collected data has been analyzed and tabulated by the researcher. Secondary data was available at a level of analysis relevant to answering the researcher's questions. Various research studies, project reports, and conference proceedings were analyzed to document the current trends of mobile applications in farming for rural development. Papers were initially identified by online literature and database searches and by snowball references from bibliographies of studies already in hand. Secondary data were collected using a literature search and by analyzing the contexts and existing theories as advised by Walsham (1995). In this case, both academic and general search engines were used. A 'snowball' approach (Oates, 2006) for locating relevant papers was also applied by analyzing the lists of references of the suitable papers found.

VIII. ANALYSIS AND INTERPRETATION

The current trends of mobile applications in agriculture for rural development were analyzed based on the following objectives:

8.1 Usage of Mobile Applications in Farming

The findings clearly show that a majority of farmers own and use mobile phones for a variety of purposes. Farmers are efficient and open to use mobile phones for receiving a variety of information. In addition, mobile applications are also being used for agricultural marketing, to obtain agriculture credit, etc. The use of mobile phones has been found to strengthen poor farmers towards larger market participation and diversification to high-value crops. This change has helped increase farm earnings through higher price realization and wastage reduction. Eventually, it is expected that mobile-based information services will influence the behavior pattern of farmers and this will facilitate the adoption of improved techniques leading to better yields. Mobile phones have been spreading fast among farmers and they are exchanging their marketing, weather, and business information with fellow farmers. Farmers directly contact market brokers and near cities to sell their products.

Mobile applications help in providing up-to-date information services to the farmers such as package of practices, market information, weather forecasting, the input supply, and credit availability. Farmers get timely and accurate information about the latest technologies and market information and get contact with the experts for any query about agriculture.

Mobile applications provide agricultural advisories through text and video messaging services. They are used to access information on real-time weather data like temperature, rainfall, sunshine hours, etc., which directly affect agricultural decision-making. Online monitoring and management of crops/livestock/poultry/fisheries etc are possible through mobile apps.

Mobile apps can be utilized for delivering services offered by the Government to farmers in the form of inputs and subsidy distribution. It can be used in the management of irrigation systems in large fields, sensor-based farming, identification of different soil types, etc. It facilitates effective farm management by recording data, analyzing it, and giving suitable recommendations for different enterprises. It helps in better marketing and storage of agricultural produce.

8.2 Current Trends of Mobile Applications in Farming

There are many applications present today in the area of farming. The usage depends on the information, content, and mandate of application development.

8.2.1 Production Technology and Agro Advisory Services

(a). Kisan Suvidha - The app provides information to farmers on plant protection, market prices, Soil Health Card, dealers, IPM practices, seeds, expert advisory, weather, god owns, and cold storage.

(b). Pusa Krishi - 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.

(c). Soil Health Card (SHC) - A Soil Health Card gives soil nutrient status to each farmer for his/her land holding and also advises on fertilizer dosage and soil amendments needed to maintain soil health.

(d). Crop Insurance - It can be used to calculate the Insurance Premium for notified crops based on area, coverage amount, and loan amount in the case of a loanee farmer.

(e). Bhuvan Hailstorm App - This mobile app can capture the photograph of the field with latitude and longitude, name of the crop, date of sowing, date of likely harvesting, and source of irrigation.

(f). Crop Cutting Survey (CCE-Agri) - This app is for capturing crop-cutting experiment data. The app works in both Online and Offline modes. 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 an internet connection. As and when internet connectivity is available, data can be pushed to the server.

(g). Krishi Video Advice - Krishi Video Advice project aims to provide advisory services related to agriculture and allied sector on farming issues with the help of a mobile app/smartphone/tab.

(h). Plantix - Plantix is a mobile app for plant disease diagnostics and monitoring. 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.

(i). IFFCO Kisan Agriculture - This app enables access to various modules including agricultural advisory, weather, market prices, and agriculture information library in the form of text, images, audio, and videos in the selected language.

(j). APEDA Farmer Connect - This mobile app allows a farmer to apply online for farm registration and approval by the state government and lab sampling by authorized laboratories. The farmer can track the status of applications. An authorized State Government Officer, farmer, or registered laboratory can log in to access the information.

(k). Shetkari Masik - It is one of the popular monthly magazines in the Agriculture sector, published since 1965 by the Department of Agriculture, Maharashtra.

(l). Krishi Vigyan - This app provides information in Telugu on modern scientific management practices for Agriculture & Horticulture crops growing in Andhra Pradesh, along with photographs.

(m). Havaamana Krishi - It is an Agrometeorological Application that provides information on weather, short-range weather forecast, and agro met advisory for seven districts under the jurisdiction of UAS Dharwad in north Karnataka, India.

8.2.2 Marketing

(a). eNAM Mobile App - It is used to facilitate remote bidding by traders and access to arrivals and price-related information to farmers and other stakeholders on their smartphones.

(b). AgriMarket - AgriMarket mobile app can be used to get the market price of crops in the markets within 50 km of the device's location. This app automatically captures the location of a person using mobile GPS and fetches the market price of crops in those markets, which fall within the range of 50 km.

(c). Digital Mandi India - This App helps in checking the latest Indian agricultural commodities Mandi prices from different states and districts. Easy to use and intuitive, the app enables farmers, traders, and all others to know the updated Mandi price from anywhere.

(d). Loop - Loop is a mobile phone application launched by Digital Green, in Bihar, to improve small land farmers' access to markets and to help them realize high income from the sale of their vegetables. The app improves farmers' access to markets by helping them to aggregate their perishable products.

8.2.3 Crop-Specific Apps

(a). riceXpert - This app 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 the e-advisory services module, and weather information.

(b). Mana Verusanaga App - Provides detailed information to the farmers and extension personnel on all aspects of groundnut cultivation.

(c). Mobile App on Castor - This mobile app provides information on castor production technologies, recommended hybrid varieties, intercropping, major insects, pests, and diseases and their remedies to castor farmers.

(d). Solapur Anar - This app aims to educate pomegranate growers about scientific pomegranate production practices.

(e). Cane Adviser - 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.

(f). Expert Systems for various crops - Sugarcane expert system is a mobile app that covers aspects related to cultivation practices, irrigation management, nutrient management for sugarcane, crop protection, farm implements, post-harvest technology, marketing, institutions and schemes, and related links for Sugarcane.

8.2.4 Allied Sector Apps

(a). Pashu Poshan - With the help of this app, a balanced ration can be formulated while optimizing the cost by 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 the mineral mixture.

(b). Cattle Expert System - It 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.

(c). Dairy Telugu and Dairy Kannada - These apps are equipped with analytics and a decision support system with language support. The mobile app content is presented in the form of interactive audio-video content, to help farmers understand easily.

(d). mKrishi Fisheries App - INCOIS generates Potential Fishing Zone (PFZ), a fish shoals prediction information based on the remote sensing data received from NOAA satellites, sea surface temperature, and the presence of phytoplankton which form the food of several fish species. The app consolidates this information and presents advisories in the local language.

(e). Fisher Friendly Mobile Application (FEMA) - The app provides vulnerable fishermen access to knowledge and information services on weather, potential fishing zones, ocean state forecasts, disaster alerts, and market-related information.

8.2.5 Other Apps Providing Agro Advisory

(a). RML Farmer - Farmer can access information related to the weather forecast, market price, crop advisory, and farm-related news as per their location in their preferred language. The app gives personalized recommendations and keeps track of pest and disease attacks.

(b). MyAgriGuru - MyAgriGuru connects farmers and agri-experts across the country. The farmer agri-expert interactions cover over 90 diverse crops – ranging from Cotton, Wheat, and Tomato to non-traditional crops like Tulsi, Aloe vera, Flowers, etc.

(c). Kultivate - The platform enables a crop expert in the country to provide precise crop advisory to his/her member farmers. Kultivate equips the experts with the weather, epidemiological, remote sensing, and market price data to customize the advisory to the farmer's field.

(d). FarmersGrid - Farmers grid provides information on agriculture & farming. The app includes content on topics like organic farming, gardening, sustainability, growing different crops & vegetables, productivity improvement, tips, tools, etc.

8.3 Role of Farming Mobile Applications in Rural Development

Farming Mobile applications offer innovative, dynamic, interdisciplinary services. These new services could increase livelihood and establish more opportunities for people in rural communities in developing countries. Improved internet speed is enabling effective use of a range of farming apps that look promising, especially in the rural scenario where the mobile revolution is fast catching up. Spreading agricultural-related information to farmers in the poorest communities is made easier with the help of mobile apps. One of the benefits of such connectivity and information flow is that it helps farmers make better land management decisions. The overarching benefit of mobile apps in agriculture is that it reduces transportation, transactional and corruption waste. It can bring about product traceability, disease and pest tracking, and storage.

M-apps can integrate the agriculture value chain of Indian agriculture, which could provide significant economic and social benefits. M-apps can provide access to valuable information, which is a weakness of Indian rural markets like price negotiation and other value chain support. It can provide timely information access to extension services such as advice on agriculture production, marketing, and technology. It can be further expanded to access finance and insurance products.

XI. FINDINGS AND DISCUSSIONS

Access to smartphones offers the scope for instant access to a wide range of information needed by farmers to combat various challenges viz., changing weather patterns, market fluctuations, etc., confronting them. Farmers who owned smartphones were considered to have direct access and farmers who used to access smartphones through their family members were considered to have indirect access.

The smartphone is now being widely used by farmers both as a source of information and as a medium to obtain information regarding farming to make better decisions. As a media, farmers to make phone calls to relatives/friends, progressive farmers, extension officials, use smartphones, private input dealers, Kisan call centers, etc. to gather information. As a source, the use of smartphones with internet access enables farmers to get information from different websites, portals, mobile applications, and social media in different forms viz., written, video, pictures, and animations for their improved understanding and application of scientific information at the field level. Farmers were using Whatsapp to record field-level problems in the form of pictures, videos, etc., and send them to the extension agents or post them in Whatsapp groups to get appropriate solutions. The ease of use of different features of Whatsapp might be the probable reason for its regular utilization among farmers.

X. SUGGESTIONS

Smartphones among farmers are increasing, but there are still gaps among customers, growers, and businesses. Various projects on cell phone technology are necessary to be improved so that growers can easily connect with citizens to sell their commodities on the market. The government and other relevant departments must also plan to link these growers and provide timely updates on seeds, markets, and weather, and deliver reasonable product prices.

XI. CONCLUSION

Smartphones have been identified as one of those effective innovations, which benefited a large number of people in the developing world. In India, mobile applications are transforming agriculture. To make agribusiness productive, smooth and respectable it is important that, it should be linked to recent technologies. These technologies need to be smarter, faster, and cheaper to use. Mobile application is one such technology that can be used directly in agricultural growth. Mobile applications are potential digital tools that can be effectively utilized to reach agricultural information to a large number of farmers within a short time. They can be used to enhance farm income and productivity through providing correct information, better input and farm management, easy marketing and linkage with a government agency for policy support to farmers, etc. With the use of mobile technology, information can transcend physical and geographical barriers, empowering the farming community. Indian farmers desperately need mobile applications that can share and schedule farming information within the Indian typical Indian village boundaries.

REFERENCES

[1] Abdul Razaque Chhachha and Md Salleh Hassan. 2013. The Use of Mobile Phone Among Farmers for Agriculture Development. International Journal of Scientific Research (IJSR), 2(6): 95.

[2] Ansari M. A. and Neha Pandey. 2013. Assessing the potential and use of mobile phones in agriculture. Karnataka Journal of Agricultural Sciences, 26(3): 391.

[3] Anupam Barh and Balakrishnan M. 2018. Smartphone applications: Role in agri-information dissemination. Agricultural Reviews of Agricultural Research Communication Centre, 39(1): 82-85.

[4] Aravindh Kumar S and Karthikeyan C. 2020. Factors Influencing the Utilization of "Uzhavan App" as Perceived by the Farmers in Tamil Nadu. Madras Agricultural Journal, 443.

[5] Aravindh Kumar S and Karthikeyan C. 2019. Status of Mobile Agricultural Apps in the Global Mobile Ecosystem. International Journal of Education and Development using Information and Communication Technology (IJEDICT), 15(3): 65.

[6] Arpita Sharma. 2019. IKHEDUT: Successful Case Study of Mobile App for Development of Farmer. Research
Explorer, 7(24): 10-15.

[7] Constantina Costopoulou, Maria Ntaliani, and Sotiris Karetsos. 2016. Studying Mobile Apps for Agriculture.
IOSR Journal of Mobile Computing & Application (IOSR-JMCA), 3(6): 45.

[8] Dharanipriya A and Karthikeyan C. 2019. Use of Smart Phones by Farmers as a Tool for Information Support
in Agriculture. J Krishi Vigyan, 7(2): 253-254.

[9] Dirk Landmann, Carl-Johan Lagerkvist, Verena Otter. 2021. Determinants of Small-Scale Farmers' Intention to Use Smartphones for Generating Agricultural Knowledge in Developing Countries: Evidence from Rural India. The European Journal of Development Research, 58-51.

[10] Extension Digest. 2017. Mobile Apps in Agriculture and Allied Sectors. National Institute of Agricultural Extension Management (MANAGE), 1(2): 3-4.

[11] Henze, J. and Ulrichs, C. The Potential and Limitations of Mobile-learning and other services in the Agriculture Sector of Kenya Using Phone Applications, 9.

[12] Julierme Zimmer Barbosa, Stephen A. Prior, Guilherme Quaresma Pedreira, Antonio Carlos Vargas Motta , Giovana Clarice Poggere , Gabriel Democh Goularte. 2020. Global trends in apps for agriculture. Multi Science Journal, 3 (1): 45.

[13] Kalyan Mandi and Rahul Mandal. 2020. Mobile Apps in Agriculture: A Boon for Farmers. AGRIALLIS, 2(1): 19-24.

[14] Manish Kumar, Lalit Agrawal. 2020. Empowering Farming Community Through Mobile Applications: Changing Scenarios. International Journal of Scientific & Technology Research (IJSTR), 9(3): 227 -228.

[15] Mohan Kumar S, Umakanth P. Kulkarni, Saurabh Suman. 2015). Mobile Applications the Future Unfold in Indian Agriculture. International Journal of Current Engineering and Scientific Research (IJCESR), 2(10): 227-228.

[16] Nasir Abbas Khan, Gao Qijie, Shoukat Ali, Babar Shahbaz, Ashfaq Ahmad Shah. 2019. Farmers' use of mobile phone for accessing agricultural information in Pakistan: a case of Punjab province. Ciencia Rural (CR), 49(10): 10.

[17] Nawab Khan, Badar N. Siddiqui, Nanak Khan, Farhatullah Khan, Naqeeb Ullah, Muhammad Ihtisham, Rahmat Ullah, Sohaib Ismail, Syed Muhammad. 2019. Analyzing Mobile Phone Usage in Agricultural Modernization and Rural Development. International Journal of Agricultural Extension, 08 (2): 139-143.

[18] Paul Mansingh, J. and Fikadu Abdese Erena 2016. Impact of Mobile phone Technology on Agriculture and Rural Development: An Analysis. International Journal of Current Research, 8(5): 31312-31316.

[19] Pavan Belakeri, C. Kotresh Prasad, Shankarappa Bajantri, M.T. Mahantesh, S.T. Maruthi, and G.N. Rudresh. 2017. Trends of Mobile Applications in Farming. International Journal of Current Microbiology and Applied Sciences (IJCMAS), 6(7): 2499-2500.

[20] Prabha D and Arunachalam R. 2019. Mobile phone technology: An impact of farming community. Journal of Pharmacognosy and Phytochemistry, SP2: 719.

[21] Rajasekaran R, Jothika V and Panneerselvam R. 2021. Assessment of Tamil Nadu Agricultural University (TNAU) Mobile Apps among Mobile User Group in Tiruvallur District. International Journal of Current Microbiology and Applied Sciences (IJCMAS), 10(2): 311.

[22] Raman R.K, Dhiraj K. Singh, Sudip Sarkar, Ujjwal Kumar, R.C. Bharti, Naresh Chandra and Rakesh Kumar.

2021. Agricultural Mobile Apps for Transformation of Indian Farming. Agriculture World (AJMR), 7(4): 27-
28.

[23] Sirajul Islam and Anders Avdic. 2011. Adoption of mobile phones among the farmers: A case study from rural Bangladesh. Örebro University, Swedish Business School, 5.

[24] Subhrajyoti Panda, Tarun Kumar Das, Pal P.K. 2019. Use of Mobile Phone by the farmers for Agriculture and Allied Activities. International Journal of Inclusive Development, 49-51.

[25] Subhrajyoti Panda, Tarun Kumar Das, Yanglem Lakshimai Devi, Litan Das, Sabita Mondal and P.K. Pal. 2019. Role of Mobile Phone in Agriculture and Allied Activities of Rural Household. International Journal
of Inclusive Development, 5 (1): 28.

[26] Surabhi Mittal and Mamta Mehar. 2012. How Mobile Phones Contribute to Growth of Small Farmers? Evidence from India. Quarterly Journal of International Agriculture, 51 (3): 241.

[27] Tamilselvi P & Balasubramaniam P. 2019. The Usage of Mobile Apps in Agriculture. International Journal of Agricultural Science and Research (IJASR), 9(4): 311.

[28] Tapan Kumar and Nupur Prakash. 2020, Adoption of AI in Agriculture: The Game-Changer for Indian Farmers. International Conferences ICT, Society, and Human Beings, 206.

[29] Victor Okoroji, Nic J Lees and Xiaomeng Lucock, 2020. Factors affecting the adoption of mobile applications
by farmers: An empirical investigation. African Journal of Agricultural Research, 17 (1): 20.

[30] Wulystan Pius Mtega. 2021. Veritable mobile phone applications for affecting the exchange of agricultural information among farmers in Tanzania. University of Dar es Salaam Library Journal, 16(1): 6.

WEBSITES

[1] Andrew Gromenko. 2021. Agriculture App Development: Tips, Features, Process and Cost. Code & Care, Available at: https://code-care.com/blog/agriculture-app-development/ (Accessed: 15 July 2022).

[2] Anitha, Smart Agriculture on Smartphones, Agrivi, Available at: https://www.agrivi.com/blog/smart-agriculture-on-smartphones/ (Accessed: 04 July 2022).

[3] Apporve Gupta, Jacopo Ponticelli, Andrea Tesel. 2020. Farmers adopt advanced tech, raise productivity when
they have mobile phones: Study, The Print, Available at: https://theprint.in/opinion/farmers-adopt-advanced-
tech-raise-productivity-when-they-have-mobile-phones-study/563867/ (Accessed: 02 July 2022)

[4] Cropin, Why are Agriculture Apps Vital to Present-Day Crop Production? Available at: https://www.cropin.com/agriculture-apps (Accessed: 05 July 2022).

[5] Economic Survey 2022. Economy Survey: Resilient agriculture sector growth at 3.9% in 2021-22, Business Standard, Available at: https://www.business standard. com/budget /article/ economy-survey-resilient-agriculture-sector-growth-at-3-9-in-2021-22-122013100918_1.html (Accessed: 30 June 2022).

[6] Gaurav Tripathi. 2009. Impact of mobile phones on farmers, The Economic Times, Available at: https://economictimes.indiatimes.com/opinion/et-commentary/impact-of-mobile-phones-on-farmers/articleshow/5113887.cms (Accessed: 06 July 2022).

[7] Himansu Gupta. 2018), Use of technology in Agriculture and Agricultural mobile applications, ABC of Agri
Your Virtual Farm, Available at : https://abcofagri.com/use-technology-agriculture-agriculture-mobile-applications/#:~:text=Mobile%20phones%20that%20farmers,can%20manage%20their%20crops%20properly
(Accessed: 14 July 2022).

[8] Mohammed Makdoomi. 2022. Mobile apps and agricultural development, Greater Kashmir, Available at: https://www.greaterkashmir.com/op-ed-2/mobile-apps-and-agricultural-development (Accessed: 01 July 2022).

[9] Murray Ward. 2014. Mobile phone and agriculture in India, GGBP Case Study Series, Available at: https://greengrowthknowledge.org/sites/default/files/downloads/bestpractices/GGBP%20Case%20Study%20Series_India_Mobile%20Phones%20and%20Agriculture.pdf (Accessed: 09 July 2022).

[10] Rohit BR. 2017. 25,000 farmers use agriculture app for real-time weather information, The Times of India, Available at: https://timesofindia.indiatimes.com/business/india-business/25000-farmers-use-agriculture-app-for-real-time-weather-information/articleshow/57283453.cms (Accessed: 10 July 2022).

[11] Shagun (2021), Agri share in GDP hit 20% after 17 years: Economic Survey, *Down to Earth*, Available at:
https://www.downtoearth.org.in/news/agriculture/agri-share-in-gdp-hit-20-after-17-years-economic-survey
(Accessed: 12 July 2022).

[12] Source Trace, How Mobile Apps are Helping Agriculture in Achieving Sustainable Development? Available
at: https://www.sourcetrace.com/blog/mobile-apps-for-agriculture/ (Accessed: 13 July 2022).
Suzannah Schneidar (2022), Five ways cellphones are changing agriculture in Africa, *Food Tank*, Available
at: https://foodtank.com/news/2015/01/five-ways-cell-phones-are-changing-agricul ture-in-africa/
(Accessed: 16 July 2022).

[13] Sveta Cherednichenko (2022), 5 Best types of Agricultural Mobile Apps to consider for you Agribusiness, *mobindustry*, Available at: https://www.mobindustry.net/blog/5-best-types-of-agricultural-mobile-apps-to-
consider-for-your-agribusiness/ (Accessed: 03 July 2022).