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Status of Mobile Agricultural Apps in the Global Mobile Ecosystem

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ABSTRACT

Smart phones can be regarded as one of the greatest invention of this century and have become inseparable gadgets from everyone's pocket. The diffusion of smartphones has been widening more rapidly due to its means for communication, gaming, education, entertainment, technical support, information, day to day news coverage, and trading and business. Mobile apps are software programs designed to run on smartphones, tablets and other devices. There is a need for the design and development of a mobile application for farmers, students and agriculture experts with improvisation of content/features in both educational and advisory services. This study aims to explore the present scenario of mobile agricultural applications in the global mobile ecosystem available in various platforms and to highlight the challenges in the upscaling of the mobile agricultural apps, while pointing out certain additional contexts to strengthen mobile agricultural applications. Developers and agricultural experts must review carefully to avoid the stereotypes and clichés and the new mobile applications must be user friendly to the farmers in advisory services and in education.

Keywords: *Smart phones; Mobile Agricultural Applications and Platforms*.

INTRODUCTION

According to the International Telecommunication Union (ITU), in 2017 mobile subscriptions reached 7.76 billion. Further, more than one-third of the world's population has owned a smartphone, and for every 100 inhabitants, 87.28 per cent have been using mobile phones in India. 51.2% (3.9 billion) people in the world use the Internet through any medium such as mobile phones, computers and tablets. ITU (2015) reports that 98.2 per cent of individuals in Bermuda used the Internet, followed by Falkland (98.31%) and Iceland (98.20%). India ranks 142 with 26 per cent of individuals using the Internet but the ITU (2017) report shows an increase in the proportion of individuals using the Internet from 26 per cent to 34.45 per cent. Smartphones are considered as pocket computers, with the same operational and functional mechanism that the computers use. The technology giant Apple was the first Information Technology organization to introduce Smartphones in 2007, but the development of mobile applications started to grow more from 2010 with the entry of the Motorola, Samsung and Nokia companies into the production of smartphones that are supported by the Android operating system.

The diffusion of smartphones has been widening more rapidly due to its means for communication, gaming, education, entertainment, technical support, information, day to day news coverage, trading and business. Technical aspects like optimal and rear cameras with greater resolution and recording features, multitask players with clear quality videos and audio, supporting various type of files, wide storage space, powerful processors, navigation and reminder tools, and social media to connect the world to a common platform. The impact is huge and has contributed to smartphones becoming a necessary evil. 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 et al. 2010). The use of mobile applications blend teaching styles with the learning styles of students making learning a new experience for the students (Rossing et.al. 2012). ICT has bonded a strong relationship between teachers and students in agriculture. Goodworkslabs.com (2017) report that 81 per cent of students use mobile phones for study purposes, while 77 per cent of students note that mobile technology has helped to improve their grades, and 62 per cent of students note that mobile technology has been useful for their daily preparation for classes. In addition, 42 per cent of students believe that mobile technology has helped them to save time.

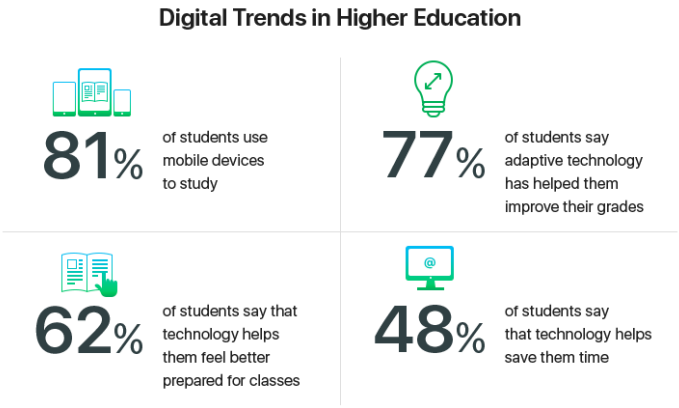

Figure 1: Digital Trends in Higher Education

Source: https://www.goodworklabs.com/2017

Mobile apps are software programs designed to run on smartphones, tablets and other devices. These applications were introduced as an alternative to computer programs and has reached various sectors such as commerce, banking, gaming, and information services, and now it has replaced the programming for the personal computer. Comparing the other fields, today the demand for mobile applications in the agricultural sector is limited but it is emerging. In the same vein, the availability of mobile apps in the mobile stores covers a gamut of activities from land [seed to seed cultivation, weather forecasting (Romani et.al, 2015), land preparation, nursery management, fertilizer calculations, pest and disease diagnostics, dairy farming (Gichamba & Lukandu, 2012), harvesting techniques, management of crop sensors (Lomotey & Deters ,2014) and postharvest management] to market [buying and selling of products, price forecasting, storage warehouses, crop loans and premium calculations].

This study aims to explore the present use of mobile agricultural applications in the global mobile ecosystem available in various platforms and to understand the challenges with regard to the upscaling of mobile agricultural apps, while highlighting additional contexts to strengthen the use of mobile agricultural applications in advisory services and in education.

M-AGRI APPLICATIONS

In India, there are more than 200 million agricultural laborers. Government and private sector entities need to consider them before taking any primary decision because they alone contribute to more than 13.7 % of the GDP growth of India, (Ministry of Labor & Employment Labor Bureau, 2010).Technology has an incredible power to inform the way in which agricultural tasks can be

better performed, starting from collection of high tech seeds to dissemination of products at the most profitable value. Mobile phones have now became the obligatory tool to transfer technologies and the rate of diffusion appears to be faster and wider. The use of ICT tools in the agricultural sector for rural farmers, while emerging as a potential for improving the livelihoods of farmers still has not been adopted fully by all farmers, (World Bank, 2011). Mobile devices equipped with Internet connections have created the impetus for a new form of electronic learning, called mobile learning or m-learning (Fu, Su, & Yu, 2009). M-learning is a form of e-learning that uses mobile devices and wireless transmission (Pinkwart *et al,* 2003,).

M-Agriculture is a subset of e-Agriculture, referring to the delivery of agriculture-related services via mobile communication technology. Mobile communication technology includes all kinds of portable devices like basic mobile phones, smartphones, and tablet devices (for example, iPad). M-Agriculture can also involve gathering relevant data through mobile technologies like automated weather stations (AWS) or systems and sensors for location-based collection (Brugger, 2011). The developers and the application platforms have used mobile technology as a connecting bridge between the astuteness of new agricultural approaches and the agricultural stakeholders. Until June 2016, the number of mobile apps available to download through the Google Play store was 2.2 million, and through the Apple's App Store, 2 million apps were available. More than 102 billion mobile apps were downloaded, which produced $22 billion compared to $8 billion in 2012. (The Statistical Report, 2016). According to the World Bank (2012) the benefits of these apps in the development of the agricultural sector could be accomplished through the following way:

- *Enhanced access to information:* The data must be worthy, needy and timely. By creating an immediate access to the information regarding price forecasting, available market demands and nearby markets for sales, could help farmers to reduce the market cost and earn higher farm income. Also, by accessing accurate information regarding weather, pest and diseases, better risk management and preventive measures can be achieved.
- *Better access to agricultural extension services:* Accurate and expert advice for good cultivation practices and support can be given. This could result in improvements in the crop yield.
- *Better linkage between market and distribution networks:* By improving the links among producers, suppliers and buyers the supply chain becomes more transparent and efficient, and less disturbed by intermediaries. Further, better accounting and perceptibility helps to increase efficiency and forecasting, and reduce administrative burden and scams.
- *Better access to funding opportunities:* Through generating access to funding and insurance opportunities and alternative payment methods, farmers can attain an increase in crop yields production and reduction of economic loss.

  Source: (World Bank, 2012)

Mobile applications indeed have a widespread penetration worldwide in all sectors; and to a lesser extent in the agricultural sector, (Bhatnagar, 2008; Mittal, 2010; and Manimekalai, 2013). In developing countries like India some mobile agricultural apps are released and they are successfully adopted by the farmers. Android apps on expert system in five crops (paddy, banana, coconut, ragi and sugarcane) and cattle developed by Tamil Nadu Agricultural University, contains a decision support system, crop doctor for diagnostics of pest and diseases and an information system to provide knowledge for better farming (Karthikeyan, 2018). The *M-kisan* portal developed by the Government of India, provides the pathway for download of mobile applications regarding agriculture, horticulture and animal husbandry. In Kenya, *M-Farm* offers real-time market prices of crops, matching Kenyan farmers with buyers. As a transparent tool for Kenyan farmers, the app allows them to simply SMS the number 3535 to get information about the retail price of their products, buy their farm inputs directly from manufacturers at favorable prices, and find buyers for their produce (Costopoulou, et.al, 2016). *Jigyasha 7676* a call centre based service was launched by the second largest mobile operator, Banglalink, in December 2008 as the first mobile-based

agro-info service in Bangladesh. The Banglalink call center service has generated enormous response among the target farmers. 700,000 calls came in within six months of launching the service, 40 per cent of which were repeat calls. More than 1,000,000 calls were received in 2009. The trend in mid-2010 was around 100,000 calls/month (Costopoulou, et.al, 2016)**.** '*icow'* pioneer mobile application in Kenya provides diverse information under a subscription service by experts to enhance productivity of dairy farms. '*Plantix*' a diagnostic m-agri app now trending in the agriculture sector, is simple to use and farmers can just snap the infected leaf portion to get the entire details of the infection and remedies to cure the infection. Similarly, in developed countries like Australia, *F-Track Live* is an on-the-go farm management app that lets multiple users record and access all of their farm information in real time (Costopoulou, et.al, 2016). With the advent of smart phones in the last 5 years, the providers have seen a huge potential in developing applications on Apple, Android and Microsoft platforms and introducing them worldwide at attractive pricing models (Brugger, 2011; Payne et al. 2011). Tables 1, 2 and 3 below show some of the mobile agriculture educational apps and their features.

Table 1: *M-agricultural education apps developed in India*

M-agriculture educational apps	**Content**
Agriculture student (B.SC agri notes) Agrilearner	One of the guide for agricultural students, it contains articles, agricultural news, current affairs, B.Sc. and M.Sc. notes. Agricultural books can be downloaded as pdf. The source of information are from TNAU agritech portal.
B.Sc Agri notes	User friendly app, contains notes for Under graduating Agriculture Students.
Agriculture quiz	More than 10000+ multi choice questions and awareness from basic GK to high level agriculture covers lot of new and Interesting topics.
Agricultural dictionary	It contains terms related to Agriculture, Farming, Animal Husbandry, Crops, Fruit, Livestock, Products, Agricultural Machines and Engineering, Agricultural Policy, Weather, Environment, Economics, ICT. It helps farmers, teachers, students and it contains more than 7500 terms and abbreviations.
Agri quest, IBPS, JRF, SRF, Msc, SSc &So	Agriquest is knowledge sharing platform for agriculture students and professionals. This App concentrating on providing enlarged information on agriculture. The main features of this app are Agri quiz, Agri forms, Agri news, Agri notes, Agri articles, Agri jobs, Quick links to agriculture related websites, Learn by pictures and Agri business plans to boost agri graduates to enter into agri entrepreneurship.
Horticultural quiz	This is a complete study app for student's covers from base level to the highest level which contains 1000 questions as MCQ.
Agriculture Notes, videos, Links, Chat	In this app from small agriculture definition to complex concepts of agriculture are available in notes, video and link format.
IBPS SO-AO	Solved questions and practice tests on various Agricultural subjects are available.
Agriglance	Online mock test for agricultural exams, updates for agricultural jobs and recruitment's, old question papers, study material, syllabus for ICAR and other agricultural and horticultural competitive exams and PPT on important topics and relevant articles.

Table 2: *Categorization of Agricultural mobile applications according to push and pull factors*

Category	Frequency	Usability / Applicability
Service	Push: timely/ frequency set by feed providers / can be made immediate as well Pull: On need basis	1. Weather broadcast 2. Rainfall broadcast 3. Need based articles 4. Government updates / mandates 5. Calculators on soil quality, waterfall, moisture etc., which help in effective planning and decision making 6. Information broadcast on events like instruments, training either public which are government supported or company specific.
Interactive Markets	Push : Immediate Pull: On need basis for market data	1. Market updates on falling / rising prices 2. Trading platforms
Support	Push : timely / frequency set by feed providers / can be made immediate as well Pull: On need basis	1. Accounting systems of Sale and Purchase 2. Logistics like Goods tracking and Inventory Management 3. Payments, Claims and Renewals
Repository	Push : on occurrence	1. Surveys / Electoral data 2. Policy changes / deadlines broadcast
Education	Push : On update availability Pull: Request for more info via suggestion boards in the application	1. Information on Insects, diseases, pesticides 2. Information on machinery, usage of machinery, comparison of different make and prices 3. Information on soil, seeds, moisture, regional based rainfall predictions 4. Case studies or real experiences with facility to add one of your own

(Source: Brugger, 2011; Woodill et al. 2012)

Table 3: *Subject matter wise distribution of apps based on the nature of accessibility*

S.no	Categories	No. of. Apps		Total
		Free	**Paid**	
1.	Livestock	67	23	90
2.	Crops	94	14	108
3.	Technology	100	18	118
4.	Weather	20	02	22
5.	Pest	27	-	27
6.	Education	38	12	50
7.	Business	139	09	148
8.	News	53	-	53
9.	Machinery	44	02	46
10.	Spraying	30	05	35
11.	Events	25	-	25
12.	Gardening	17	07	24
	Total	**654**	**92**	**746**

Source: http://www.farms.com/agriculture-apps

From the data in Table 3, we note that the majority of the apps (654) were accessible to the public on a cost free basis whereas 92 apps were provided on a payment basis and a total of 746 agricultural applications were found to be available in the public domain either free or on a cost basis. Among the agricultural applications, the areas such as agribusiness, agritechnology and crops dominated the total number of apps, ranked in the order of first, second and third respectively. Further, we note that 12 categories of Agricultural mobile apps are listed, as shown in Figure 2 below. These apps were developed to function via various operating systems such as Android and iOS, and they are also available from different providers such as Google Play Store, Apple App store, Windows phone store, Amazon App store, Blackberry mobile window, and Oppo App store.

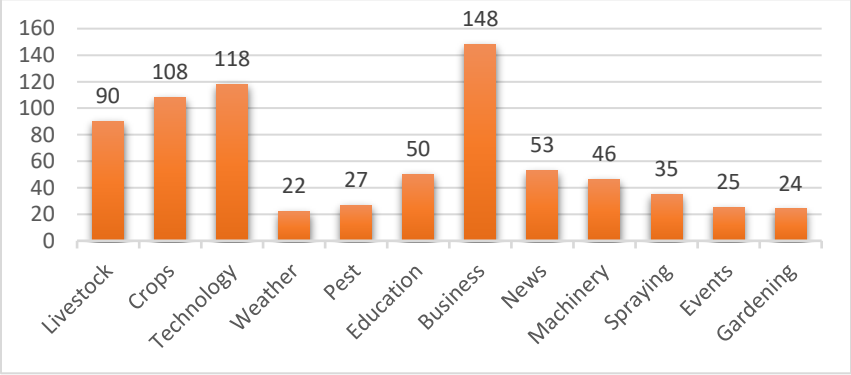

Figure 2: Subject matter wise distribution of apps available in agriculture

The distribution of agricultural apps in regard to the android market and Apple Store are shown in Table 4.

Table 4: *Distribution of Mobile agricultural applications according to various platforms*

S.no	Categories	Android Market		Total	Apple Store		Total	Others		Total
		Free	Paid		Free	Paid		Free	Paid	
1.	**Livestock**	50	17	67	53	15	68	02	01	03
2.	**Crops**	67	08	75	86	12	98	07	-	07
3.	**Technology**	73	10	83	88	13	101	07	01	08
4.	**Weather**	19	02	21	19	01	20	01	01	02
5.	**Pest**	22	-	22	26	-	26	01	-	01
6.	**Education**	33	09	42	31	09	40	02	-	02
7.	**Business**	116	08	124	122	06	128	03	-	03
8.	**News**	44	-	44	49	-	49	05	-	05
9.	**Machinery**	39	01	40	34	02	36	04	01	05
10.	**Spraying**	26	05	31	29	03	32	02	-	02
11.	**Events**	24	-	24	21	-	21	02	-	02
12.	**Gardening**	14	05	19	12	07	19	-	01	01
	Total	**527**	**65**	**592**	**570**	**68**	**638**	**36**	**5**	**41**

Source: http://www.farms.com/agriculture-apps

It is evident from the data shown in Table 4 above and Figure 3, Figure 4 and Figure 5 below, that among the different categories of agricultural apps, Agribusiness apps lead all the domains with 21 per cent and 20 per cent in Google play store and Apple app store respectively. Agribusiness ranked at the top with 128 and 124 applications in Apple app store and Google play store respectively. Agricultural Technology fixed its position at rank two with 101 applications in Apple app store and 83 applications in Google play store, Crops take the third rank with 98 applications in Apple app store and 75 applications in Google play store. Most of the apps in top ranked categories in all the platforms were accessible on a cost free basis to users.

Education apps accounted for only 7 per cent in Google play store and 6 per cent in Apple app store respectively.

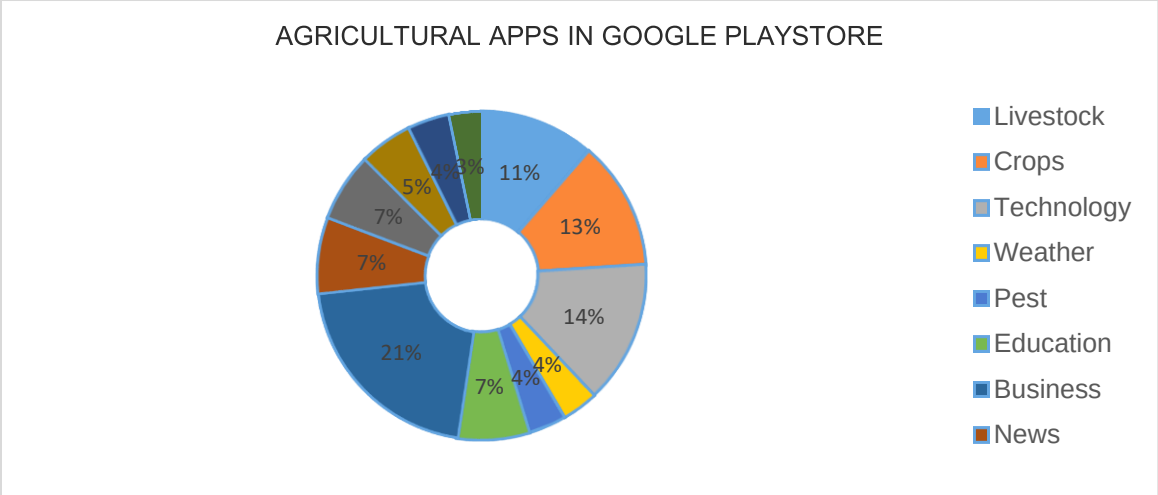

Figure 3: Agricultural apps in Google Playstore

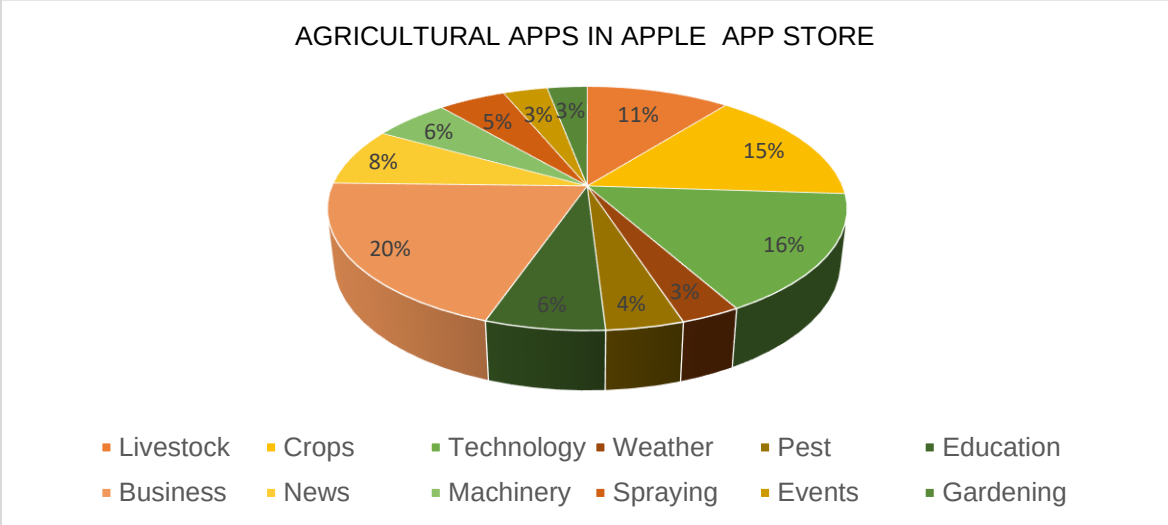

Figure 4: Agricultural apps in Apple app store

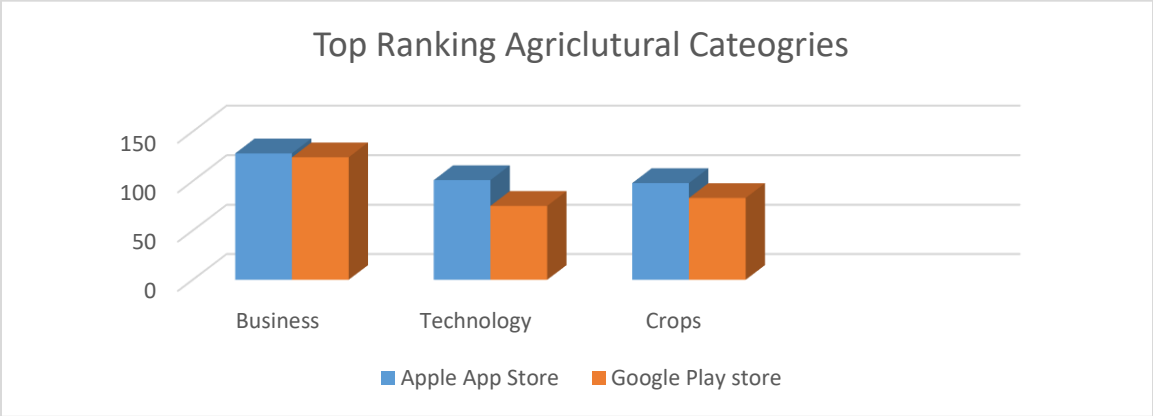

Figure 5: Top ranking Agricultural Apps

The data shows that Agribusiness interests are addressed given the number of applications in the app stores. The reason may be due to the fact that Agribusiness firms attract a large number of customers by providing a common platform to buyers and sellers for marketing their products. Some firms market their products to the customers very easily by single touch transactions. Thus Agribusiness apps allow for easily accessible services to agribusiness clients and an increase in their market shares in the society.

FUTURE IMPROVISATION

Farmers need accurate, brief, timely and trustworthy information to practice and perform agricultural activities. 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 (Cantor, 2009; Goyal, 2010). In the contemporary period, transfer of technology has been faster and quicker due to the introduction of smartphones. Mobility has been suggested to have an important role in sustainable rural poverty reduction, (Silarszky et al, 2008; Muto et al, 2009). The inevitable and growing importance of mobility in agriculture offers various advantages. All types of information on crop, soil, climate, rainfall, seeds, and machinery at any point in time, and any number of times is available to farmers, (World Bank 2011). The available information is compiled and very well organized such that farmers do not have to waste time while retrieving, but at times, due to network issues, speed of the data delivery, and legal restrictions, farmers may be prevented from getting the updated and complete information, (Kirk et al, 2011).

Mobile context, connectivity, screen size, and different display resolution features have influenced the usability of apps. Factors include effectiveness, efficiency, satisfaction, learnability, memorability, errors, and the cognitive load (Harrison et al., 2013). Hinze et al., (2017) note that nearly 80% of mobile app users felt their academic activity had benefitted from this inclusion; there was greater parity of attitude regarding knowing where to seek help or finding a suitable app for academic purposes. The availability of educational apps has created an array of learning opportunities for student (for example, Google Earth made geography an easier and more interesting subject for students), it has also made it easy to access many resources to advance knowledge, and it has integrated students, teachers and parents for sharing of information (for example, apps like Dropbox and Evernote).

The data shows the existence of apps that facilitate agribusiness, agricultural technology and crops, but there is a need for the design and development of a mobile application for farmers, students and agricultural experts with the following content/features in both educational and advisory services:

1. **Location specific:** The information delivered must be specific to the locale of the farmers. For example: giving information about Paddy fallow Pulses to the delta farmers of Tamil Nadu.
2. **Time bounded:** The information must reach the farmers instantly or it will be useless. For example: Onset of mango showers must be disseminated to the Kerala farmers before onset so that they will prepare their field for cultivation.
3. **Accurate and Brief**: The message sent to the farmers must be short and crystal clear in the concept. For example: If a farmer enquires about the cost of establishment of a vermicomposting pit, the message should focus on the cost of establishment only and not on the process of vermicomposting or something else.
4. **Gaming:** The applications developed for agricultural education should involve gaming, thus affording users the opportunity to learn agriculture by playing. Games will bring out and sharpen the practical applications of agriculture.
5. **Regional language:** At present, most of the mobile applications at the global level are produced in English and mobile applications available in India are in English and Hindi languages, but the mobile applications should include use of regional or local languages. For most of the farmers and for students in the regions of India, it is easier to interact with the technology when information is available in their regional language.
6. **Creation of Group:** The application must be on a common platform where there is interaction between Farmer-Farmer and Farmer-Expert. In addition, farmers from different locality aggregates (such as same crop, same area, or innovators) should form a group and there must be a healthy social networking between them. The group members can transfer photos, text, and videos about farming, but it is also to be noted that certain regulatory actions are needed when the groups are formed. In education, the groups must be created for competitive exams that prepare students across the country, where they can share study materials and engage in discussion on trending topics.
7. **Easy entry and exit**: Login id and password must be created to support the farmer before actual use of the application. Once created the information must be stored and be accessible if the farmer forgets his/her password. There must be easy steps for the recovery of the password.
8. **Learning without boundaries:** Some apps have made it easy for the smartphone user to take any course at their own pace and at any time. An example is Goodworkslab where learning is fun, easy and accessed at the convenience of the learner. Similar applications are needed for learning in the agricultural sector.
9. **Innovative and Attractive:** The content flow in most of the applications are similar so there must be innovative design and development of applications. For example, if a Cotton farmer in Maharashtra is registered, the application should display the success stories of the cotton farmers in Maharashtra in their local language and to assist with the spread of new technology, the app should give points to the progressive farmers who follow the information provided by the app. In addition, photographs of the progressive farmers must be shared and a list produced with their ranking on a regular basis. Those progressive farmers who maintain a continuous ranking on the list must be awarded. These initiatives should motivate other farmers to adopt the technology.
10. **Diagnostic:** The application must provide the diagnostic tool, by one snap of the infected parts or leaf. The app should display the name, symptom and preventive and precautionary measures to the particular diseases/ pest/ nutritional disorders. For example: the Plantix app (System matching), and Expert systems (Manual matching).

11. **Mock test centre:** A testing centre will help the students to know their weakness and knowledge can be updated easily. The application must contain provision for a mock test centre where users can easily check their agricultural knowledge.
12. **Grasp the outsiders:** Young educated people who are not farmers but want to engage in farming activities, need guidance from experts. Mobile applications must therefore support the newcomers by providing information on events such as expositions, conferences, meetings, training, and other activities occurring in their wider community or near to their homes, and also provide them with videos on technology and farming practices.
13. **Cover the uncover:** All the applications cover activities for farmers with landholdings, but a question arises when we consider what is available for landless agricultural labor. Any application that is developed must reach them too, they must also be the beneficiaries. For example, the app should provide information on availability of job opportunity during non-seasonal periods, announcement of availability of land for lease in their local area, and generating self-employment ideas by effectively using locally available resources.

CONCLUSION

The m-agri applications should facilitate the spread of new government policies, scholarship and fellowship details to various stakeholders regarding agriculture, rural development and livelihood; provision of a news corner where the farmers, students and other users can get updated, while ensuring the availability of an agricultural dictionary or agricultural glossary in the dashboard of the application. The educational and advisory agriculture applications must also contain a section for interactive learning, 24/7 accessibility, portability, e-books and e-journals, instant updates and effective utilization of users leisure hours. The application must be programmed to support all mobile operating systems and made available via all platforms working in both online and offline modes. The future of agriculture and agrarians is in the hands of mobile technology, so the developers and agricultural experts must address carefully to avoid stereotypes and clichés. New mobile applications must be user friendly and relevant to the farmers, students and other various agricultural stakeholders.

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