

A gander at the features of agro-based mobile apps

Manu Pattar¹ and Dr. K. C. Prashanth²

1: Research Scholar, Vijayanagara

Sri Krishnadevaraya University, Ballari, Karnataka

2: Associate Professor, Vijayanagara

Sri Krishnadevaraya University Ballari, Karnataka

Abstract:

Information is the elemental necessity for making any kind of decisions across industries. Decision making becomes more effective with the availability of required and apt information. Information availability not only upgrades the knowledge but also increases productivity by aiding effective decision making. Resembling the importance of information across different industries, information plays a paramount role in agricultural industry too. To make the information more easier to access and understandable by the farmers, ICT (Information and Communication Technology) has taken a step ahead to come out with agro-based mobile applications to facilitate farmers with required, scientific and reliable information to ease their decision making process and make it more effective and contributory to increase productivity and even reduce the harm caused by excess use of chemicals on the environment and human health too. In this paper, a broad literary review is made to understand the features available in the agro-based mobile applications and a three phased survey is made on the android applications store (Play store) to find out the diverse range of features embraced by the agro-based mobile applications acting in India. This paper helps the aspiring users and users of such applications to understand the features in detail which will help them to make optimum utilization of the applications, the entrepreneurs in this domain can get an insight about the features that are most commonly adopted by the agro-apps in India and this paper adds to the knowledge of role of ICT in information dissemination to the farmers, scientific agriculture and sustainable development.

Key words:

ICT in agriculture, Agro-based mobile apps, Scientific agriculture, Agro-apps survey, Features of agri apps, Sustainable development

1. Introduction:

Scientific farming is utmost required in today's world to meet the increasing demand for quality food. The amount of chemicals that are being used are at an alarming rate and the idea of sustainable agribusiness through scientific farming is at stake. Right information is a foot for progressive agriculture. Resembling the importance of information across industries to make better decisions, agriculture is not far from this paramount importance of information for making unerring decisions in agriculture. Decision making in agriculture becomes more effective with the availability of required and apt information (Bachhav, 2012). Information availability not only upgrades the knowledge but also increases productivity by aiding effective decision making. Majority of the decisions that a farmer makes in his cultivation process are information driven. Activities like selection & procurement of seeds, scientific way to treat soil, right procedure to detect, diagnose and treat diseases & infections, decisions that reflect changes in weather, decisions in relation to the changes in market prices for the crops, decisions about usage of technological interventions in farming, decisions in the marketing and selling efforts, etc., require the right information as well as right platforms to facilitate activities. With the availability of right information and right facilities, a farmer will be up to make right decisions and walk the scientific ways of farming.

To make the information more easier to access and understandable by the farmers, ICT (Information and Communication Technology) has taken a paramount step ahead to come out with agro-based mobile applications to facilitate farmers with required, scientific and reliable information to ease their decision making process and make it more effective and contributory to increase productivity and reduce unnecessary expenditure and reduce unnecessary usage of chemicals on the crops which reduces the harm caused on the environment and human health too (Anand et al., 2015) (Mandi & Patnaik, 2019). In this paper an extensive literary review is made to understand the features available in the agro-based mobile applications and a survey is made on the android applications store (Play store) to explore the range of features included in the agro-based mobile applications acting in Indian market and throw light on each feature to understand them in detail.

2. Objectives of the study;

- i) To understand the status of agro-based mobile apps in India
- ii) To understand the features of agro-based mobile apps acting in India in detail

3. Scientific farming for sustainable agri business and environment:

Moving along with reaping higher yield, ensuring good quality of the yield, earning elevated income, the agricultural sector should even corroborate protection of the environment. This "aspiration to excel in the agri-business, clinching with the safety of the environment by maintaining fertility of the soil, calculated usage of chemicals, planned way of managing economic activities, intended efforts towards water conservation, etc., by large, contributing to social wellbeing and environmental systems" is termed as sustainable agriculture by (Inwood & Dale, 2019) in their study made on finding the gaps in the agro-based mobile applications in providing the information and facilities to farmers and other agricultural stake holders in order to achieve sustainable agriculture.

It is a fact that demand for increasing production on one hand leads to increasing agricultural land which is another way of deforestation and encroachment of the essential grassland. On the other hand, the excess usage of chemicals on the crop and land degrades the quality of the produce, degrades the fertility of the soil, causes harm for much essential life in the soil and other animals. Hence, ensuring the economic growth of the farmers and meeting the demand for food should be done more sensibly using sustainable agriculture and there is a huge requirement of sustainable intensification in the farming community (Garnett et al., 2013).

As the advancement is on its way towards sustainable agriculture, there are many inventions and interventions in agriculture like; stepping towards conservation agriculture which is a practice to conserve the soil and ensure protection of soil in the process of agriculture using conservation tillage technique to conserve the soil by minimum tillage and ensuring minimum harm to the essential life present in the soil (Hobbs, 2007), sustainable agricultural

practices in terms of reducing the usage of chemicals and involving in using bio inputs to the farm can not only increase productivity and enhance the quality of the produce, but also adds to the conservation of the ecosystem according to a study made by (Kassie et al., 2009) using a six year dataset of sustainable farming. The farmers and the society by large can get benefitted from embracing sustainable ways of agriculture. Another major finding of their study revealed that access to right information in the right time is very crucial factor that affect the adoption behavior of such sustainable farming practices.

4. ICT (Information and Communication Technology) in agriculture:

Computers, Information technology and communication technology together have paved way for tremendous possibilities. ICT is a bright ray of hope for the farmers and the agricultural industry. For realizing a vision of application of innovative and scientific ways of doing agriculture, ICT is a very well founded way. It focuses all its efforts in addressing the needs of the farmers providing scientific, timely and contextual information to the farmers in a user friendly way, facilitating sustainable agriculture. The anchored areas of ICT are scientific and ecofriendly ways of cultivation, ensuring proper water management and water conservation, calculated application of fertilizers, handling the harvest and post-harvest activities, transportation of the produce ensuring food quality and marketing (Mahant et al., 2012). A similar study made by (Bachhav, 2012) reveals that major area of agriculture like; New crop production, availability of seeds, availability of insecticides, water management, availability of fertilizers, weather information, information about new agricultural equipment are the most essential and most searched information by the farmers. Timely access to such crucial information will strengthen agricultural practices and even helps the farmer to walk the sustainable way.

There are many technological and technical interventions in every stage of agriculture which is in support to the sustainable development but the inventions are not reaching majority of our Indian farmers because of their illiteracy, ignorance towards new technology and even because of lack of awareness. Hence, most of our farmers are failing to reach the food production rate and ensure socio economic growth. They are facing lot of challenges in this grey area of access to right information at the right time (Prasad et al., 2013).

E-agriculture is striving hard in using ICT in rural domain by designing and developing innovative ways to reach farmers in effective way. In the action plan of “World Summit on the Information Society” mobilizing ICT using E-Agriculture to reach the rural agricultural stake holders is the primary focus. Organizing many activities towards application of E-Agriculture is the assigned responsibility to the (FAO) Food and Agriculture organization of United Nations (Mahant et al., 2012).

The study made by (Radhakrishnan & Sriram, 2020) focused on the Government’s Kissan Call Centers (KCC) are extending services all over India which answers farmers; queries in local languages on 1800-180-1551 which is a toll free number and Grameen phone is another initiative in providing cellular services in rural as well as urban areas of India for about 40000 customers. India is the preferred destination for smartphone manufacturers as already 75% is the tele density in India and more than 50% in case of Indian villages. India is regarding smartphones as the gadget for empowerment, supporting the dream of digital India. Research and development in this area is also being propped up from 2019 (Goswami, 2020). A study made in Maharashtra in 2012 reveals that majority of the farmers require reliable, scientific and timely information for agriculture and they need most of the information on a daily basis. 79% of the farmers use mobile phones for communication and other purposes and facilitate their agricultural activities (Bachhav, 2012).

5. Understanding the agro-based mobile apps as a part of ICT;

Due to ineffectuality of field level extension workers to disseminate required information to the farmers using offline mode (Mandi & Patnaik, 2019), ICT Systems like SMS (Short Message Service) and IVRS (Interactive Voice Response System) are already playing their prominent role in disseminating required information to the farmers. Amidst such initiatives, agro-based mobile applications are paving their way in reducing the complexity and increasing the accessibility to the required information in an effective way (Anand et al., 2015). The mobile applications provide wide range of information like; seeds/crop selection, cultivation, weather forecast, fertilizer management, disease & pest management, etc., based on the geographic location, soil and climatic conditions and the crop that is under cultivation (Mandi & Patnaik, 2019). In this direction (Prasad et al., 2013) made a research and came up with MCC (Mobile Cloud Computing) as a solution to problems in information dissemination and introduced a mobile application “Agro Mobile” to address many problems in areas like disease and pest management, following package of practices, managing the marketing efforts and reducing their loss.

Conducting an extensive study of the literature available from a search on the web of science and as well as the survey conducted on the IOS and Android apps platforms, the agro based mobile applications were categorized based on the services provided by the applications as follows; agronomy reference, consumer education, equipment optimization, games, information management, pest identification & product tracking. They concluded that performance, reliability and user experience are the essentials of the success of such technologies (Inwood & Dale, 2019). This shows that there are many upshots in the mobile applications industry already enduring in serving the agricultural community. Overcoming the barriers of literacy level of the farmers, language barriers, and internet connectivity barriers, Jayalakshmi agro tech. in India came up with an eminent aid to the farmers with respect to providing information regarding the package of practices for cultivation which included scientific information about;

- Seed/crop variety selection
- Soil/land preparation
- Fertilization
- Nutrition
- Harvesting
- Post-harvest management
- Safety measures to be followed
- Disease detection and treatment repository, etc.,

all on offline mode, in regional language and embracing audio visual aid to disseminate the information in a more user friendly way (Anand et al., 2015).

(Arrova & Author, 2020) conducted a study on mobile phone application as a potential solution to the farmers during COVID situation using literatures from DODJ (Directory of Open Database Journal), Ebscohost,

Google scholar and found that the applications that are available can be categorized as follows;

- Business and financial data
- Agricultural technology
- Farm management
- Animal production
- Agricultural news
- Training
- Agricultural machinery
- Spraying activities
- Pest and diseases
- Weather forecast etc.,

as the main features of the mobile applications.

6. Agro-based mobile apps survey on android play store

(Costopoulou et al., 2016) in their study on agro based mobile applications used the Android and IOS apps platforms Play store and App store respectively and listed all the available agro based mobile application and filtered the applications for further study based on the following criteria; Category of the application, Language of the application, country of origin of the application, size of the application, number of downloads of the application, ratings given by the users of the application on the platforms, date of launching the application and date of updating the application. They further categorized the selected applications based on the following features/services that the application provides;

- Business and financial data
- Animal production and management
- Farm management
- Pests and diseases management
- Agricultural technology and innovation
- Agricultural machinery
- Spraying related activities
- Weather forecast
- Training and
- Agricultural news

Influenced form the direction of the above study, the author here has surveyed the android application platform (Play store) to understand the features that are discussed above in the literatures. For this study, the researcher divided the survey into three phases. In the first phase “Agriculture apps India” was the keyword that was used to find agro-based mobile apps on the play store and 252 apps were found as the result of this search. Further the apps were filtered using the following criteria; All the apps with below 10000 downloads, less than 3 star ratings, less than 100 reviews, and the date of the recent update before 2019 were eliminated from the study and 85 apps were selected. In the second phase, the key word “Indian Agricultural apps” was used where 251 apps were found among which 64 apps were repeated from the first phase results and 142 apps were eliminated as they fall under the above discussed criteria and finally 45 apps were selected in the second phase. In the third phase, combining the results of both the phases, 130 apps were selected for studying and understanding the features that these applications extend for benefiting the stake holders.

7. Result and discussion:

Table 1: Showing the percentage of apps embracing the language

Language	Percentage	Language	Percentage
English	73.84	Malayalam	15.38
indi	60.76	Punjabi	15.38
Telugu	20.76	Bengali	12.3
Marathi	20.76	Odia	8.46
Kannada	20	Urdu	6.1
Gujarati	19.23	Assamese	3.84
Tamil	18.46		

It is found that majority of the apps (73.84%) embraced English language followed by Hindi (60.76%), Telugu & Marathi (20.76%) and Kannada (20%) and so on. English being the universal language 73% of the apps embracing English language can be expected and Hindi at 60.76% being Indian national language can also be expected but the other regional languages like Bengali (12.3%), Odia (8.46%), Urdu (6.1%), Assamese (3.84%), etc., are yet to be included by more applications in order to break the language barriers and reach the rural farmers of India. The application developers have to work more on reaching and extending their innovative solutions to more and more farmers.

Table 2: Showing the statistics about the downloads for the surveyed apps

Downloads	No. of apps
10000000+	1
5000000+	2
1000000+	9
500000+	12
100000+	43
50000+	26
10000+	37
Total	130

As the table above indicates that only one app has the highest downloads of 1 Crore, followed by 2 apps with the next highest downloads of 50 Lakhs the results show that other application have to strive in reaching more farmers and they should even consider the reviews given by the users and keep updating the application frequently and try focusing on the real grey area of the farmers and reach them more effectively and in more user friendly way. The only application found so far with the highest downloads is Plantix which is an application with a plethora of features included in it.

Table 3: Showing the percentage of apps embracing different features

Features	Percentage of apps
POP	64.61
E-Commerce	50
Weather Forecast	40
Expert Advice Service	39.23
News & Updates	33.07
Market Value Indicator	31.53
Disease and pest management	28.46
Farmers' Community	27.69
Govt. Schemes	14.61
Crop Calendar	13.07
Animal/Livestock management	10
Calculators	8.46
Record Keeping	8.46
Document access	6.15
Contact information	6.15
Hiring Solutions	2.3
Transportation	2.3
Documents Upload	1.53

The above table shows that POP (Package of practices) is the most included feature in 64.61% apps from the survey, followed by E-Commerce with 50% of the apps, 40% of apps with expert advice feature in them and the remaining features are included only by below 30% of the apps surveyed. By this it can be inferred that POP is the most included service in the apps and can be assumed that it is the most used feature by the farmers followed by E-Commerce, expert advice and so on. This does not mean that the other features are not worth using. The farmers might not be aware of those features, or they might not be as user friendly as other features. Due to many such reasons these

important and very useful features are not yet reaching the farmers in an effective way. If these features reach the farmers and if they are user friendly, the farmers might reap a lot of benefits from these apps which is a yet to be researched area in India.

7.1 Understanding the features:

The selected apps after a three phased survey were further inspected exhaustively to grasp the features available in the selected Indian agro-based mobile apps and it was found that a few apps are meticulously worked on and a few features are made very user friendly keeping languages into consideration. Majority of the features converge at the requirements of the farmers.

- POP (Package Of Practices) included by 64.61% of the surveyed apps possess this as a prominent feature. POP is a repository of information that aids the farmers in his entire process of cultivation right from selecting the right seed/crop variety to cultivate, to harvesting of the crop. This feature is useful to the farmers throughout the crop life cycle which covers crucial information regarding activities like; choosing the right crop variety to cultivate, preparing the land/soil, seed treatment, sowing, providing the essentials in the seedling stage & sapling stage, transplantation, fertilization, irrigation, providing essentials in the growth stage & flower/fruitlet stage, harvesting, post-harvest soil treatment.
- E-Commerce included by 50% of the apps surveyed, encompass the facilities to conduct commercial activities like buying and selling of the agri inputs such as seeds, fertilizers, pesticides, fungicides, technological interventions etc. a few apps with this feature direct the users to the e-commerce platforms while providing them the information in POPs for different stages of the cultivation cycle. There are discounts and offers provided on different agri inputs in some apps. Some of them have a push notification feature to market the products through offers and discounts
- Weather forecast is another prominent feature in most of the (40%) apps and this feature provides the farmers with updated weather forecast information to help them make the decisions in relation to weather conditions. Some apps provide a week's weather forecast, some have a push notification feature to keep the user updated with the changes in the weather, some apps provide the forecast and related information in detail including the cloud behavior, rainfall, wind behavior etc.,
- Expert advice services is another feature which is embraced by 39.23% of the surveyed apps. This feature provides the user with a facility to get advices and required information/knowledge from the experts from the industry. The advices from an expert from the industry is always better than any non-scientific farmer and the user of this feature can get the solutions to their problems by asking queries to the experts in the industry. Some apps provide push notifications to ensure that the user does not miss any crucial advices given by the industry experts and officials.
- News and updates is the feature incorporated in 33.07% of the apps which furnishes the latest news from the agricultural industry, shares the cases of other successful farmers. Majority of the apps have chosen to share videos to share the news and updates a few of them provide link to the youtube videos which share useful information & latest news from the industry. A few apps provide the news in text format available in multiple languages.
- Market value indicator with 31.53% of the apps from the survey taking-in this feature in them are providing the users with the information about the market prices for the crops. Some apps provide a week's trend of the prices of different crops in the market and some provide the users with the information about the prices of the crop in the nearby mandis/markets. A few apps have even tried to establish the contact between the buyer of the produce and the seller.
- Disease and pest management is a very crucial and much required feature for most of the farmers. But the amount of apps (28.46%) that embraced this feature from the surveyed apps is of worry. Most of the farmers in India face challenges in tackling the diseases and pest infections and lose their crops. In order to avoid this, this feature extends commendable help to the farmers by providing a

database of different diseases and pests with the images of the symptoms of the infected crop to help in recognizing the infections and treatment procedure is provided. Some apps provide the information in audio visual aid, and some provide via text. There are a few apps which have embraced artificial intelligence and image learning techniques in their apps and have facilitated the user to click the picture of the diseased plant and the app will diagnose the infection/disease and provide the right treatment procedure to the user so that the users will not use the unnecessary chemicals and can avoid a lot of diseases and pest infections. In fact a few apps have gone a step ahead and provide alerts about the nearby disease, pests or infections based on GPS data and the farmer can take precautions to avoid the infections.

- Farmers' community is a social networking feature that is included in 27.69% of the surveyed apps. In this feature, the farmers can find means to connect with other farmers in the region and make collective decisions where every farmer can help every other farmer by sharing his experiences, his way of doing agriculture which will provoke a constructive thought process for a farmer. Some apps just provide information about the nearby farmers, some allow the users to create their profiles on the platform and connect with other farmers, and a few apps provide facility to click images and share them across the community to ask queries and get the solutions from the farmers community where a few apps have facilitated to differentiate between the experienced farmers/experts and other farmers.
- Govt. schemes this is a feature that provides the users with the information about the schemes, policies and subsidies extended by the government to the farmers. This is also a very crucial information that every farmer needs. Many farmers do not avail the schemes and facilities provided by the government because of unavailability of the information about them. A few apps even help the users in not only getting the information but also in reaping the benefits by aiding in availing the facilities. But among the surveyed apps only 14.61% of the apps have included this feature in them which need to be extended.
- Crop calendar with only 13.07% of the surveyed apps with this feature allows the user to key in the date of sowing seeds and the app will record the date and provide notification accordingly with respect to usage of fertilizers, nutrients & other chemicals and the allied activities throughout the life cycle of the crop. Notifications are pushed on the mobile screen to ensure that the farmer is not skipping and activity and performing every activity in time and on time.
- Animal & livestock management is a feature that guides the users in all the activities related to animal husbandry like; poultry farming, bee keeping, sheep rearing, dairy farming, etc. Only 10% of the surveyed apps have this feature in them among which a few apps provide step by step guidance to the users and helps them to follow scientific ways of handling animal husbandry activities and take precautionary measures to avoid diseases and infections to the animals and treat them in a scientific way to cure the diseases and infections. Some apps have even provided e commerce facilities or buy or sell animals online and carry out their economic activities too.
- Calculators with 8.46% of the apps including this feature allows the users to calculate various aspects of agricultural activities. It facilitates the user to calculate the right amount of fertilizers to be provided to the crops and a few facilitate the user to key in the data related to expenses, investment and so on, and estimate the final revenue from the crop. Calculators provide a user friendly way of keying in the data and getting the accurate output.
- Record keeping with 8.46% of the surveyed apps facilitating this feature has provided a platform for the users to record every activity in agriculture and keep track of each and every decision that is taken throughout the process of agriculture which helps them to assess the wrong decisions and correct them accordingly. A habit of keeping a record of every activity in any business is always suggested and this feature is an effort in this direction to make the farmers equipped with a platform to keep every record and be more precise in their farming activities.
- Document access with 6.15% of the surveyed apps including this feature helps the farmers in accessing to their documents like land

documents, insurance documents, etc. the farmers need not go to the offices and wait there to get access to their documents. This feature has facilitated a simple way of getting access to the required documents by the farmers.

- Contact information with 6.15% of the surveyed apps with this feature helps the farmers to connect to the important contact points to get crucial information from them. Some apps establish contact with sellers/buyers, some with the input dealers, some with the concerned government officials, some establish contact with Varuna mitra, Kissan call centers and other similar helplines to extend help to the farmers.
- Hiring solutions with 2.3% of the surveyed apps with this feature in them, helps the farmers to get in contact with the sellers who rent out the agricultural machinery and equipment like; tillers, tractors, harvesters, spray pumps, agricultural labor, etc., which helps the users in procuring the technological interventions in their farming activities.
- Transportation as a feature is adopted by only 2.3% of the surveyed apps. This feature provides the users with the information about the transportation facilities available to transport the harvested produce to the markets. This feature helps the farmers with no transportation facility or with difficulty in finding a means for transportation. This is also a very innovative feature that is very low in the market which needs to be concentrated more and embraced by many apps.
- Documents Upload is another feature which facilitates the farmer to upload their documents related to the crop that they are growing the size of the area in which they are cultivating that crop. This was an initiative of govt. of Karnataka to get the crop survey details directly from the farmers. As of now, only 1.53% of the surveyed apps have this feature. This needs to be extended to facilitate more and more farmers with this aid.

8. Limitations of the study and scope for further research:

The study of the features of agro-based mobile applications are limited to a few select literatures and a few select apps acting in India from only the android play store using only "Agriculture apps India" & "Indian agricultural apps" as the search key words to find the apps and study them. The found apps were filtered using a few criteria like; downloads, ratings, no. of ratings, last updated year, etc.

More literature can be considered, more number of applications can be considered for the study by including a few more search key words, reducing the filter criteria and performing a survey on apple's IOS store are the further scopes to extend the search to understand the features in a much more profound way.

9. Conclusion:

The need for information to the farmers is very high and the farmers majorly depend on the availability of information to carry out their agri-business more scientifically and sustainably. ICT with the inventions and interventions in this area has made a lot of advancement on delivering / dissemination required and crucial information to the farmers in many creative and effective ways. Considering a fact that mobile penetration in the rural India and the internet connectivity penetration has paved the way for agro-based mobile applications which are extending a plethora of features to facilitate the farmers and other stake holders of agriculture to improve their ways of conducting agricultural activities and it is a fact that more research and development is required in this domain to reach the farmers more effectively and provide more reliable and accurate services. Any researchers, entrepreneurs and users (farmers) in this area would find this paper useful in understanding the features available in the agro-based mobile apps in India. This paper also adds to the knowledge of academics in the field on ICT, Scientific agriculture and Sustainable development.

References:

- Anand, B., Shivaprakash, L., & Hareesh, U. (2015). Bridging "Agriculture Information gap" through ICT tools and use of Mobility, Analytics and Cloud in Agriculture even in the absence of internet. Second International Conference on Agriculture in an Urbanizing Society, Reconnecting Agriculture and Food Chains to Societal Needs, 14 - 17 September 2015, Rome, Italy. Proceedings of the Conference, 479-482.
- Arrova, D., & Author, D. (2020). A Review on Agricultural Mobile Apps for Sustainable Agribusiness : before and during Covid-19 Pandemic. 4(6), 53-57.

Bachhav, N. B. (2012). Information needs of the rural farmers: A study from Maharashtra, India: A survey. *Library Philosophy and Practice*, 2012(1).

Costopoulou, C., Ntaliani, M., & Karetos, S. (2016). Studying Mobile Apps for Agriculture. *IOSR Journal of Mobile Computing & Application*, 3(6), 1-6. <https://doi.org/10.9790/0050-0304XXXX>

Garnett, T., Appleby, M. C., Balmford, A., Bateman, I. J., Benton, T. G., Bloomer, P., Burlingame, B., Dawkins, M., Dolan, L., Fraser, D., Herrero, M., Hoffmann, I., Smith, P., Thornton, P. K., Toulmin, C., Vermeulen, S. J., & Godfray, H. C. J. (2013). Sustainable intensification in agriculture: Premises and policies. *Science*, 341(6141), 33-34. <https://doi.org/10.1126/science.1234485>

Goswami, M. P. (2020). Mobile Phones : Empowering Young Women of Remote India Mobile Phones : Empowering Young Women of Remote India (A study to understand the penetration , consumption pattern and uses of the. January.

Hobbs, P. R. (2007). Paper Presented at International Workshop on Increasing Wheat Yield Potential, CIMMYT, Obregon, Mexico, 20-24 March 2006. Conservation agriculture: What is it and why is it important for future sustainable food production? *Journal of Agricultural Science*, 145(2), 127-137. <https://doi.org/10.1017/S0021859607006892>

Inwood, S. E. E., & Dale, V. H. (2019). State-of-apps-targeting-management-for-sustainability-of-agricultural-landscapes-A-review2019Agronomy-for-Sustainable-Development.pdf.

Kassie, M., Zikhali, P., Manjur, K., & Edwards, S. (2009). Adoption of sustainable agriculture practices: Evidence from a semi-arid region of Ethiopia. *Natural Resources Forum*, 33(3), 189-198. <https://doi.org/10.1111/j.1477-8947.2009.01224.x>

Mahant, M., Shukla, A., Dixit, S., & Patel, D. (2012). Uses of ICT in Agriculture Department of CSE 1, 4 Department of IT 2 Department of Management 3 man ishmhnt@gmail. *International Journal of Advanced Computer Research*, 2(1), 46.

Mandi, K., & Patnaik, N. M. (2019). Mobile apps in agriculture and allied sector : An extended arm for farmers. *Agriculture Update*, 14(4), 334-342. <https://doi.org/10.15740/has/au/14.4/334-342>

Prasad, S., Peddoju, S. K., & Ghosh, D. (2013). AgroMobile: A Cloud-Based Framework for Agriculturists on Mobile Platform. *International Journal of Advanced Science and Technology*, 59(June 2016), 41-52. <https://doi.org/10.14257/ijast.2013.59.04>

Radhakrishnan, P., & Sriram, N. (2020). A Review of Role of Mobile Based Advisory System for Transfer of Technologies for Sustainable Agricultural Development. *Asian Journal of Agricultural Extension, Economics & Sociology*, 38(11), 246-256. <https://doi.org/10.9734/ajaees/2020/v38i1130473>.

Appendix:

List of tables:

Table Number		Page Number
Table 1	The percentage of apps embracing the languages	16
Table 2	The statistics about the downloads for the surveyed apps	17
Table 3	The percentage of apps embracing different features	17