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A Review on Agricultural Mobile Apps for SustainableAgribusiness: before and during Covid-19 Pandemic

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ABSTRACT

The spread of novel coronavirus Covid-19 at the beginning of March 2020 significantly impacted agribusiness especially fruits and vegetables. The closure of schools, restaurants, offices, and others has shifted supplies of agribusiness to retail channels. One of the prevailing issues faced by farmers in managing crops and finding a conducive place to market their products. In this view, the farmers' marketplace needs to evolve to continuouslysupply farmers' productsto consumers. Agriculture itself is undergoing a fourth revolution triggered by the use of information and communication technology (ICT).This paper provides insights into how mobile app technologies can assistto solve the agribusiness problems likesoil degradation, excessive water, emissions, pollutions, the marketplace,etc.We find mobile app features have widely developed for farmers, distributors, and producers to gather valuable data, observe fields, and manage crops to optimize the processes. Mobile apps and cloud computing become a center of solutions. In this global pandemic, providing support to farmers with useful and practical agricultural information can improve their economic development and eventually give a good impact on the country.

Keywords—*mobile apps; agribusiness;covid19;sustainable*

I. INTRODUCTION

The Covid-19 pandemic has impacted the supply chain worldwide and someinternational industries have been scale back to the domestic level. Farmers are a crucial part of the supply chain whohave to adapt to a new and uncertain future.Fortunately,in these few years before the pandemic, farmers and the agribusiness industry were actively embracing technologies. One popular article has reported the rapid growth of agriculture technologies and predicted technologies like IoT devices, drones, and software to be worth over $15 million by 2025. Since purchasing technologies and farm management software is a pricey decision, moving directly to a smaller scale of agricultural apps becomes a strategic alternative. Especially variety of apps are available in the market and they can be installed on many platforms like Androids and IOS. Recently, plenty of mobile apps have appeared for individual farmers and demand is still increasing particularly in the pandemic situation. This trend has given room for mobile apps developers to meet farmers' demands.

The objective of this study is to review the current literature and popular articles regarding the available mobile apps that have been developed to support agribusiness especially farmers. This paper is organized as follows: Section II explains the methodology of the search that is carried out in this study, section III discusses the findings of the search, and section IV concludes the explanation.

II. METHODOLOGY

This paper applies a systematic search to identify relevant articles published in open databases from 1 January 2016 until 31 October 2020. The databases used were Directory of Open Database Journal and Ebscohost. Additionally, some publications were searched on Google Scholar from the reference lists of included studies and reviews by backward and forward snowball searches. In opposition to scholarly materials, this study includes popular articles that refer to the material for the general public. The popular articles were inspected on Google search engine using "mobile apps agriculture" keywords and review was conducted towards the top 3 of the Google results. Theselection criteria for both scholarly materials and popular articles are: English written articles and the mobile app's products are relevant to agriculture fields. For scholarly materials, the articles were from peer-reviewed journals or conferences. The overall searching methodology is depicted in the following figure.

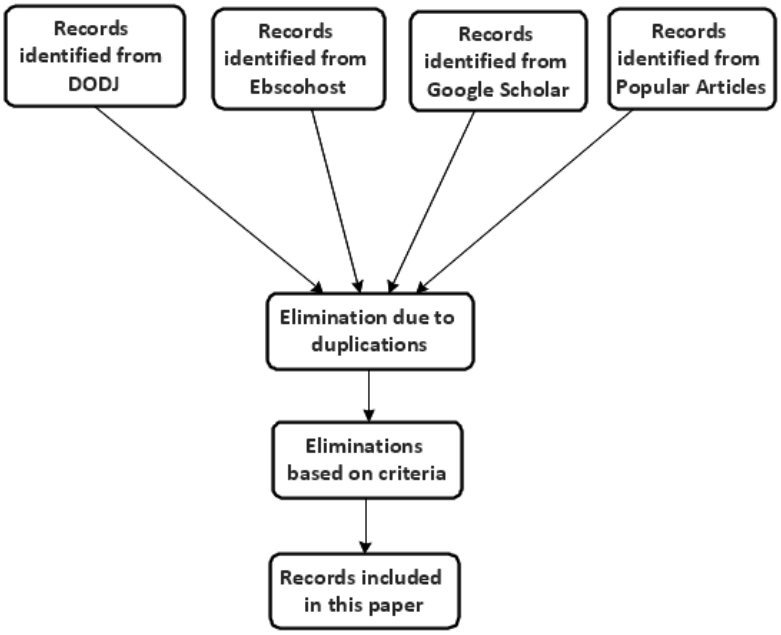

Fig.1. Search methodology carried out in this paper

III. RESULTS AND DISCUSSION

The keywords or query in searching are "mobile apps agriculture". Upon three databases that included this study, the highest results return by google scholar (>10,000), DOAJ (<20), and Ebscohost (<20). This reflectsa relatively small number of studies that focused on the availability and usability of mobile apps in agriculture. History shows that approximately ten years ago, some review papers focusing on mobile apps in agriculture has started to emerge. For example in the year 2011, this paper [1] highlighted the need for mobile apps in agriculture due to smallholder farmer systems show less productivity and profit than they could be. The offered solution was the embedded ICT in farming equipment and processes. Furthermore, the paper also suggested mobile agriculture initiatives as a solution to less farming productivity.

In the following year 2012, another paper [2] wrote about mobile applications for agriculture and rural development. The paper emphasized development impact, mobile ecosystem, and business model. The study included several important keys to today's farming industry such as sustainability, pricing models, and cost that lead to commercial and non-commercial mobile apps. The author summarized that better access toinformation anda better market that links for distribution network has produced higher income for the small farmer, lower distribution cost, and improve traceability and standards for buyers. It creates new opportunities for many parties whichare directly or indirectly related to the agribusiness.

Started in 2014, more review papers have exposed and started revealing the development process of mobile apps in agriculture. For example, [3] provided a review of the use of smartphones and its capabilities in agriculture. The scope was wider by mentioning the role of the agro portal (e-government) in supporting agribusiness. The paper reported that the previous agro portal system has been extended to mobile users especially Android users in additionto the usage of web-based and SMS systems in the daily operation. With this, the government information and services are easily accessed by the public using the recent advancements in mobile apps technology.

In 2016, some papers more concentrate on the mobile apps itself. For instance, [4] and [5] clearly stated a survey or study mobile apps or Android apps for agriculture. The paper written by Constantina Costopoulou, Maria Italiani, Sotiris Karetsos [4] underlined the heterogeneous and complex information in the farming industry. The key solutions offered were accessibility to the information, markets, and services. The study exposed the data collection in Greece about the farmers' and stakeholder interest and willingness to use mobile apps in agricultural activities. The result had shown the majority of them have never used mobile apps in their agricultural activities, back then. Hence the paper proposed the development of mobile apps for agriculture is deem important and required the active involvement of public agencies and ministry. Even the paper had to make a comparison between theamounts of mobile apps for health care in the year 2016 amounting to 259,000 apps against the agricultural apps amounting to 1.300 only.

In the same year 2016, a paper from India [5] reported on the information dissemination of the agricultural sector to the degree of knowledge-intensive that had been transformed into mobile apps for farmers. The background of the study was the high percentage of the Indian population (65%-70%) who is depending on agriculture for their living. The paper suggested that apps are supposed to be able to bridge the gap between agricultural input and delivery of agricultural outputs and infrastructure. Moreover, the paper also discussed emerging technology such as cloud computing, machine learning, and soft computing.

In the year 2018, [6] a paper focused on new terminology in farming called "precise agriculture". Precise or precision agriculture is defined as a new approach in farm management with the use of IT to ensure that crops and soil receive exactly what they need for better health and productivity. The primary goal of precise or precision agriculture is profitability, sustainability, and protection of the environment. The solution offered was a digital platform and digital ecosystem that involves smart systems such as AI, service-oriented architecture, ontology-driven knowledge-based, and multi-agent technology. The paper presented the results of their application in Moscow, the expected results, and future steps in agriculture.

In the year 2019 [7], this paper proposed apps supporting the sustainability of agricultural landscapes. The paper mentioned the importance of multi and interdisciplinary expertise to identify the righttools to link extension agents, farmers, and decision-makers. The authors highlighted that mobile apps that focus on these matters are still lacking and important to be developed soon. The following Figure 2 was included in the paper as a recommended software system design features meant for broadly applicable knowledge sharing systemsto improve the sustainability of agricultural landscapes.

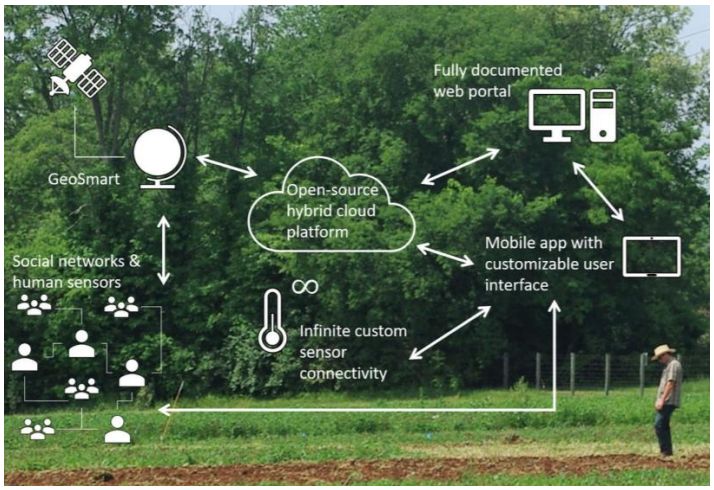

Fig. 2. Software System Design for Sustainable Agriculture [7]

In March year 2020, a paper [8] highlights the global trend in mobile apps for agricultural fields. The source for data collection was google play and windows phones in the years 2015 and 2018. The results had shown the largest number of agricultural apps i.e. USA, Brazil, and India. These results were generated from 843 apps survey that they conducted inclusive of 33 and 61 countries. The highest proprietary apps were found in the USA and Brazil. The study concluded that the global development of apps for agriculture is growing rapidly especially the ones without cost to users.

In the year 2020, there are numerous researches found in the literature related tomobile apps or ICT for agriculture. However, the ones which highlight the condition during coronavirus pandemic is extremely limited. We found this paper [9] highlighted specifically agri-information dissemination during the Covid19 lockdown in India. During the lockdown, farmers are unable to get the latest information about agriculture, especially about the market to reach users. Hence, mobile apps namely "Kisan Rath" were developed to facilitate transportation of food grains and perishables during the lockdown period in India. The mobile apps can help farmers and traders to connect with the transporters. There are more than 500,000 trucks and 20,000 tractors included in the network to support farmers with their products. With these apps, the farmers' product can move to warehouses, collection centers, or wholesalers. The mobile apps are developed in many languages including Hindi for farmers' ease.

Another paper in the year 2020 [10] has highlighted the impact of the Covid19 pandemic in the agriculture field in Bangladesh. This paper reported the use of the existing mobile apps in the country to minimize the disruption of agricultural services due to the Covid19 pandemic. This paper suggested parallel research to identify an effective pathway to enhance information flow and analysis. The output of this type of research will benefit the value chains in terms of efficiency and reliability. Apart from that, a paper [11] reported that in Africa, several actions have been taken to promote agricultural innovations and technologies during the Covid19 pandemic which one of them is mobile apps.

On the other hand, popular articles published for the general public have promoted mobile apps for farmers. Many short articles highlighted the name of the mobile apps that can be easily downloaded and used for the farmer to sustain their productivity. To name it a few, the best agricultural apps suggested by many articles are Agronote, AkerScout, Bushel, Crop Nutrient Advisor, and CropRecords. Due to language issues, these apps are popular in countries where English is widely spoken. The popular articles generally agreed that mobile apps for smallholder farmers should provide links for the farmers to reach products for farms operation, output markets, and distributors.

The following figureis presented in this paper to provide insights into agricultural apps. Figure 3 was taken from details provided in this paper [1] regarding the agricultural apps category that is usually needed by the farmer. We can see from the figure, the business and financial apps ranked higher in terms of use to support better productivity.

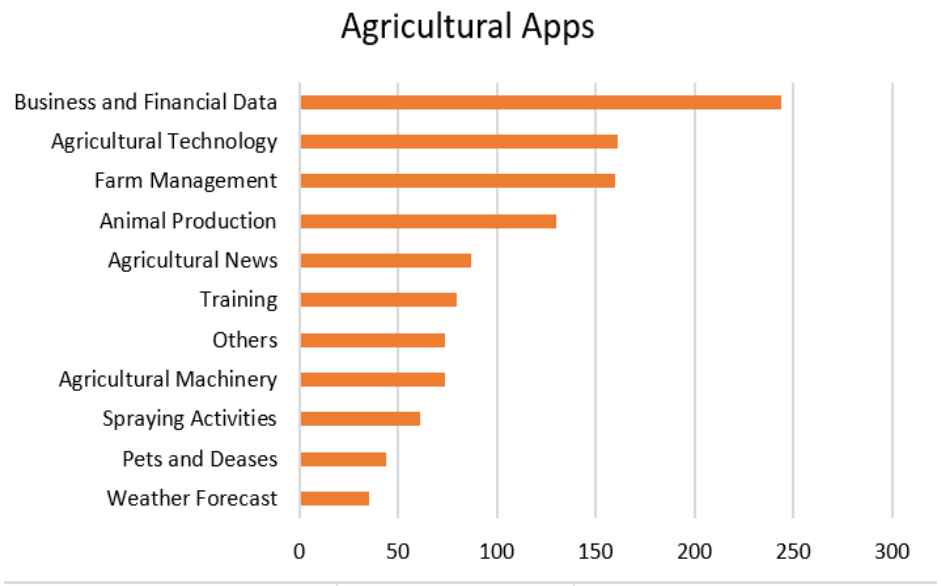

Fig. 3. Types of Agricultural Apps [1]

IV. CONCLUSION

The study under review shows that mobile apps indeed a global solution for farmers in many countries around the world. During the Covid19 pandemic, the mobile apps continuously supported farmers in many ways to ensure their productivity sustain and reach the market in time. Mobile apps have made farmers easier to search for agricultural-related information. It helps farmers in terms of productivity, market, and management decisions.

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