MAPLE TREE PUBLISHING HOUSE

INTERNATIONAL RESEARCH JOURNAL OF MULTIDISCIPLINARY TECHNOVATION (IRJMT)

http://www.mapletreejournals.com/index.php/IRJMT
Received 21 August 2019 ISSN 2582-1040
Accepted 26 October 2019 2019; 1(6); 588-596
Published online 02 November 2019

Study on Mobile Applications for Water Quality in Specific to Irrigation Sector

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Doi: https://doi.org/10.34256/irjmtcon84

ABSTRACT

Since the Water Quality monitoring in the agricultural sector for irrigation activities is complex, this study focuses on investigating the contribution of existing Mobile applications for better monitoring and managing the irrigation water quality. The native platforms so-called 'Apps Stores' acted as a source for this study for revealing the contemporary status of mobile application users worldwide in the irrigation sector. This study narrow-down to a detailed study on the usage of Mobile applications for performing the irrigation activities in the Indian region. It reveals the immediate need for a significant number of mobile applications to enhance the farming activities by effective farmer's participation in India. Lastly, this review proposes the suggestions for new developments in the mobile applications for satisfying the target group with the support from the public and private sectors.

Keywords: Agricultural, India, Irrigation, Mobile Apps, Water Quality.

INTRODUCTION

The day-to-day life of the citizens' has changed significantly with the usage of Mobile communications. The adaptability and flexibility of mobile communication systems with all types of mobile devices (cellular phones, smart phones) leads the usage of mobile technology to a greater extent. As per the International Telecommunication Union statistics at the end of 2017 [1], among the total mobile communication users, nearly 40 % falls in the Asian region alone. In the same fashion, the number of mobile phone users in 2018 is 5.135 billion, up 4 percent year-on-year. This increment in mobile usage is predominantly contingent on the mobile device development specifically the smart phones. Over 36 percent of the world's population is projected to use a Smartphone by 2018 [2], up from about 10 percent in 2011. The dominant factors that considered for the deeper penetration of smart phones are the speedy global communication, vast information exchange for daily and business existence and delivering entertainment with no time. The technological advancements in smart phones namely the wider touch screen for convenient visualization and readability, high resolution cameras and camcorders for instant capturing and data recording, geographical positioning capabilities for navigation, powerful processors for instant data processing capabilities with larger memories and additional skills like video and audio players etc. have their individual contribution for this growth. All these characteristics are carried out with the help of software packages and mobile applications shortly known as Apps.

By definition, Mobile application is a software application developed to run on smart phones, tablets rather than desktop or laptop computers [3]. At the beginning of Smartphone development, Mobile apps designed for creating the basic features of mobile programs like calendar, calculator, clock, photo-editor, browser, data-transfer, etc. The public and private sector organizations are in an urge to develop their mobile applications for providing services in agriculture, health care, business, commerce, recreation, entertainment, and media divisions to meet the competitive environment and customer demand for upgraded mobile products. Based on these facts and prospects, it is evident that the Smartphone with mobile applications has already become one of the most omnipresent techniques that it can be the widely used in all types of sectors including natural resources management.

Water pollution is happening to a greater extent because it is the basic need and the primarily available natural resource. Within the 70% of the open fresh water on the mother earth, agricultural activities consume 70% of it [4]. According to the executive summary by the FAO of the UN, the progressive deterioration of water quality in many countries, reducing the quantity of water that is safe to use [5]. During the past few decades, there are several technological inventions found on the monitoring of water quality in the agricultural area, but their utilization is not up to the measurable scale. In this line, the smart phones and the related applications stood in a prominent position. These apps cover a spectrum of fields using the water as a resource specifically in agriculture, residential sectors, industries, recreational sectors and so on. However, the development of mobile applications for water quality studies in the agricultural sector compared with the other areas is inadequate. By this context, the mobile applications on the term 'water quality' is used to categorize the apps having their utilization on the irrigation water quality aspects. More particularly, mobile applications for various kinds of services on water quality are taken into consideration.

This study focuses on discovering the present status of water quality apps for agricultural (meant for irrigation) usage. Mobile applications are there for all aspects of water quality on a global scale. Later, the study focuses on the Indian mobile applications on water quality, the agriculturist willingness, and interest to use the water quality mobile apps in their daily farming activities. Besides the introduction, the study is prearranged in the following sequence: The second session is an overview of the implications of mobile apps on water quality to the agriculture sector. Detailed investigations of the prevailing situation of mobile water quality apps worldwide are done in the third session. Session four is on observed finding from a case study for India. In the end, the summarization and conclusions made. Based on the results, I aspire to explain the challenges of mobile applications for water quality assessment in the agricultural sector.

Mobile Applications on Water Quality for Irrigation and Their Contemporary Significance

The rapid usage of mobile apps has escalated the demand for new mobile applications in all fields. A new digital ecosystem has to be developed with thousands of potential application developers, lakhs of software platforms and millions of its users to meet the market. Usually, the owners of the successful mobile operating systems are the authority having the distribution platforms of these mobile applications. These native platforms so-called 'App-stores' are having the mobile applications, and Google Play Store, Apple App Store, Windows Phone Store, and Blackberry App World are mentionable among them. This study uses data on the number of apps available for download in leading app stores as of the first quarter of 2018. As of that quarter, Android users were able to choose between 3.8 million apps. Apple's App Store remained the second-largest app store with 2 million available apps [6]. Most recently 2018, the mobile growth in the Apple App store decreased by 20% compared to the year 2015. Up to June 2016, the number of mobile apps available to download through Google Play was 2.2 million apps, and through Apple's App Store were 2 million apps. More than 102 billion mobile apps were downloaded, which produced $22 billion compared to $8 billion in 2012 [6]. Mobile apps

significantly cover the entire categories of humans' lifestyle such as Business, Entertainment, Education, Travel, Utilities, Health and fitness, Finance, Sports, Social Networking, Medical productivity and so on.

Private organizations mainly own most of the mobile applications. Besides, the governmental bodies offer a limited number of apps in a similar field as it has a massive volume of stakeholders. Also, the end users should be provided with nominal prices.

Study of Water Quality Apps

To discovery of characteristics of Water Quality-based Mobile Apps, an investigation has been made from the most well-known app store so-called 'Google play store'. Because the fact that the Windows phone store and IoS are relatively recent and having lesser adaptability to other OS, the apps on these stores are not taken into consideration. 'Google play store' has been selected for its more significant usage worldwide. It provides a variety of apps with flexible OS support.

A. Study flow

The flow diagram presented in Fig. 1 wind up the steps and methods taken to search in the Google Play Store apps for filtrating the results. Initially, the search terms are entered into the Google Play Store apps search engine with the keyword 'Water Quality' resulted in 116 Mobile applications.

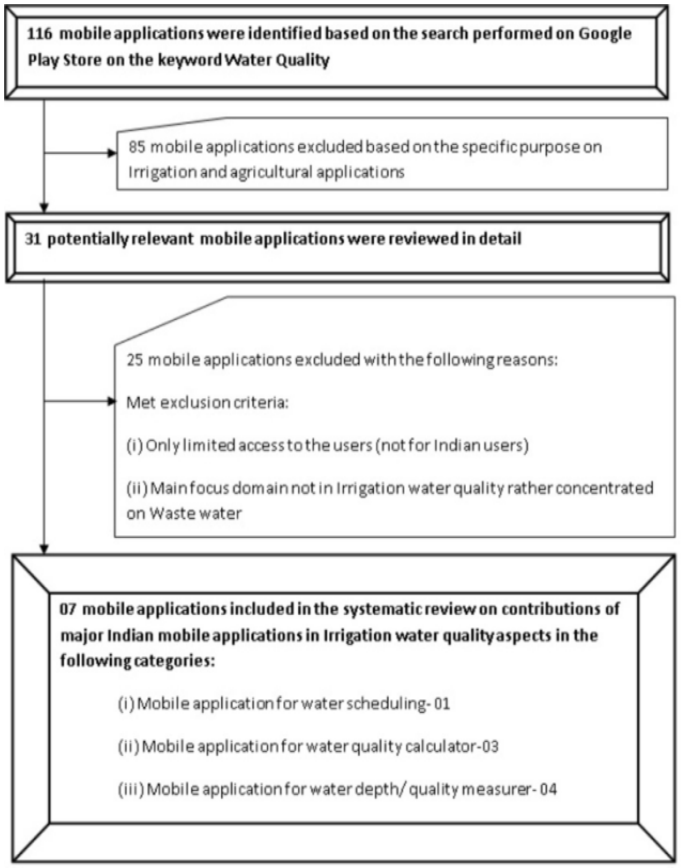

Fig 1. *Flow Diagram of the systematic review of the Mobile application for Irrigation water quality*

Then, the screening was done for the applications following the exclusion criteria shown as a Flow Chart in Fig. 1. resulting in leaving out of 25 applications. The final app list consisted of 07 refined mobile applications for a complete review of their contents relevant to Indian Mobile Applications contributed to the Irrigation water quality aspects.

The selected 116 mobile applications apps are regarded with the following Google Play store categories: Adventure, Art & Design, Books & references, Business, Casuals, Education, Engineering science students and Engineering professionals, Entertainment, Events, Food & Drink, Government Organizations, Health & Fitness, House & Home, Lifestyle, Medical, Personalization, Productivity, Shopping, Simulation, Social, Tools, Travel & Local and Weather [7]. The numbers of Mobile applications for each category are shown in Table 1 from the Google App store.

Though all the apps are under the general category 'Water Quality,' this study focuses on the Water Quality Applications specifically meant for Irrigation Activities. Out of the 116 apps surveyed, 31 were studied. The apps selected for the research described with following characteristics: Title; Country of the developer; launched language; App provider; Date of launch and updating; Storage size; supporting platform; and Rating. As per the analysis of the above-surveyed apps, we derived the following results.

B. The general categories of Mobile Applications studied

Country of the developer: Though nearly 25% of the apps are developed in the USA, India has an equivalent contribution among the applications. As English is considered as the Universal communicative language, the classification is by keeping the primary language as English. Based on the language categorization, 26 apps support by the English language alone. Besides, three apps support English and another language. One app supports more than two languages, and another app is supporting the other two languages by not considering English.

App Provider: Among the 31 apps, six apps are developed and maintained by the Governmental agencies
And the Private organizations provide the remaining 25.

Date of Launch and updation: In this study, all the apps are launched or updated between the last four years 2015-2018. Out of them, 12 apps were launched by 2018, 11 were initiated by 2017, four were launched by 2016, and only three were started by 2015. The older versions of some of the apps are updated with the recommended features in the last three years.

Storage size: All the apps studied are less in storage and compatible with the mobile devices available in the market. Three apps which handle the maps are above 25 MB, 4 of them are between 15-25 MB, 12 apps are having the size of 5- 14 MB and only one app fall under the size of less than 1 MB.

Supportive platforms: Among the 30 apps that are taken for this study, two of them is providing its function with iOS. It depicts that the end users support the accomplishment of Android Mobile with these apps.

Table 1. *Categories of Mobile applications on Water Quality aspect from Google Play Store*

Categories	**No. of Apps**
Adventure	1
Art & Design	1
Books & References	4
Business	12
Casuals	2
Education	17
Engineering Science & Student Professionals	1
Entertainment	5
Events	1
Food & Drink	1

Government Organizations	1
Health & Fitness	5
House & Home	5
Lifestyle	5
Medical	3
Personalization	2
Productivity	13
Shopping	2
Simulation	4
Social	1
Tools	18
Travel & Local	3
Weather	8

The Ratings are given for Five scales based on the app features, the number of times downloaded and the positive feedback for the customers/ users. All the selected apps are rated above '3', which depicts that the selected apps for this study are satisfied with the primary customer need.

Indian Mobile Application Filtration

Once the irrelevant applications are removed, the remaining 07 applications are installed in the author's mobile phone to gather comprehensive information about them. Among them, one mobile application describing the irrigation water scheduling, two applications describing the irrigation water quality parameter calculations, and four on water depth measurements. The data about the origin and source of the applications, usage procedure, tools and app specifications, modules in a particular application and user comments are taken into considerations

The selected apps are again categorized based on their usage:

The primary classification has been done as Drinking water, Irrigation water, Groundwater, Surface water, Freshwater, Wastewater and standard Water Quality depicted in Figure 2. In secondary classification, they are classified under the categories namely, calculator, recorder, scheduler, controller, mapper, quality checker, educator, notifier and components.

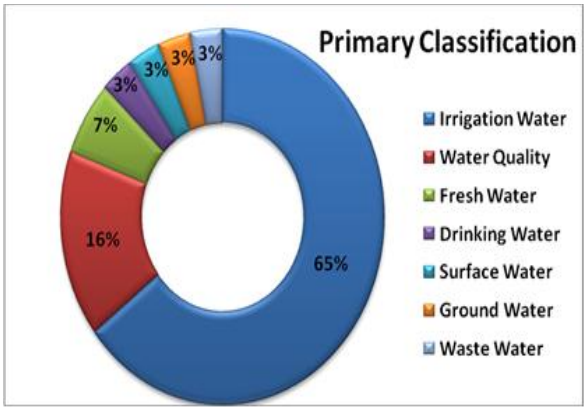

Fig 2. *Primary Classification of Indian mobile applications on Water Quality*

Study of Indian Mobile Applications on Irrigation Water Quality

In India, 54.6% of the total 1.35 billion populations are engaged in Agricultural and its allied activities [8] and as per the statistical report, 87.28 habitats in every 100 habitats are availing mobile communication subscription. From the above study, it is notable that a significant number of mobile applications are created and used for assessing irrigation water quality. As the classification has been already done in primary and secondary aspects, the focus on this study has been narrow down to the mobile applications that are contributing to the irrigation activities in

India. Under the primary classification of water apps on Irrigation, the apps fall under the following usage.

- Apps for recording the water level in irrigation fields,
- Apps for calculating the irrigation water requirement for the areas,
- Apps for checking irrigation water quality, and
- Apps for calculating nutrients in irrigation water.

SUMMARY AND CONCLUSION

Though Mobile apps pose exponential growth in many business sectors, such as entertainment, information, education, banking, tourism, and health, their contribution towards the Water quality applications specifically on Irrigation aspects are minimal. As a supporting point, the study on the participation of Mobile Apps to health care industries in the last ten years manifolds than the other type of application users [9]. Since the Agriculture (employing Irrigation activities) is considered to be the backbone of the Indian economy, the contribution of Mobile application development in Irrigation sector does not show a similar trend. This different matter is observed in this study where the number of applications found on the subject matter is about 116, but a negligible amount applies to irrigation through a huge significance of economy is on the agricultural activities.

According to the Indian geographic coverage, the contribution of mobile application in this domain is minimal. From the detailed survey on the existing Indian mobile applications on irrigation water, a very minimum contribution has been taken on analyzing water quality. The apps filtered under the water quality are mainly concentrated on wastewater quality assessment rather than on Irrigation water. It is also further proven by narrow down the study on the Indian Mobile Applications. This situation might be linked with any one of the following reasons; lack of extremely zealous apps development, lack of awareness about the contribution of apps among the user group, lack of app adaptability in terms of in language constraints and lack of promotion by the app developers and the developmental authorities. Though some of the applications are having crowd sourcing facility to upgrade the data, the dynamism and up-gradation are lost which makes the application obsolete. Table 2 provides the detailed usage of popular Indian mobile applications for Irrigation. As per the survey, it is evident that mobile apps are limited in this area in development and its usage. The popularization and adaptability get reduced due to its poor flexibility in the run on a variety of operational platforms, Mobile devices and so on. While rating by the users is concerned, the apps with more number of features and quick processing capabilities with reasonable accuracy are ranked higher. Visualization and user interface also plays a significant role in the success role of an application. Among the studied 07 Indian apps, only one of them is having a visualization tool, i.e., background satellite imagery. The reach ability factor of applications becomes yet another complication towards the successful implementation of it.

From the survey, the potential issues and challenges on the Mobile application on irrigation water quality are identified and listed below:

- The development of out-and-out mobile apps on the irrigation water quality measurement and management should be done with the combined effort of the domain experts in irrigation management and agricultural activities, researchers, policymakers along with the beneficiaries- farmers;
- The apps should not only develop with the mere concern on the regional aspect but with the consideration of the other relevant geographical regions too; even to precise, it should be flexible to the different geographic locations rather than for a single site-specific;

Table 2. Details on Leading Indian Mobile applications on Irrigation water quality (Source: https://play.google.com/store/apps)

Name of the Application	Secondary classification	Usage Context	Findings from feedbacks of the users and usage by the author
myWell	Water Information Recorder	MARVI project is funded by the Australian Centre for International Agricultural Research. Use the theme crowd sourcing to record groundwater level depth and rainfall amount data to and transmit those data to a central location. Improvise the participatory approach to monitor the groundwater level for irrigation. For real-time visualization of data collection points, it uses moderate resolution satellite imagery.	Till now 25 villages assisted and 410 well monitored with the 52 happy farmers. The development needed is to provide the SMS facilities to inform the current updates to the farmers with AI technology in regional languages .It does not give the water quality parameters in details.
Irrigation Water Quality Calculator	Nutrient Calculator	RSC, SAR, Na from measured EC, Ca +mg, Carbonates and Bicarbonates	Though the app has the good feedback from the user, it has limited to 4 irrigation water quality parameters. It does not provide the water quality parameters in details.
Irriga System	Irrigation water- Depth calculator	It recommends the water depth to be applied to each cropped field during the entire crop season.	The app meets its objectives, yet the number of users and review from the users is not significant. It does not provide the water quality parameters in details.
Discharge	Irrigation water Level Measurement	This app measure levels, velocity, and discharge of rivers and channels in 2 minutes with web-based database and interactions. Based on the video captured in the flow channel, the app calculates the depth of water flowing and by mean find out the velocity of the water with capturing channels cross profile.	The app met 100% of its purpose, and the rating by the users is 5. It does not provide the water quality parameters in details.
Quantoirrigar	Irrigation Water quality calculator	It calculates the daily irrigation time by making use of the available mobile sources.	The inputs have to be fed manually, and it is not having any visualization of data collection location or implementation. It is doing a limited water quality parameter check.
MeraBhujal	Groundwater Quality	Central Groundwater Authority provides groundwater resources information for users' current/desired location, augmentation, quality,	This app provides the information on local groundwater quality, groundwater quantity with the alarm of the current scenario of groundwater

		sustainable utilization of groundwater through this app.	with alarm. It partially provides the Water Quality details to the farmers.
PIS (Phule Irrigation Scheduler)	Irrigation water scheduling	It is developed for the project Irrigation Water Requirement Advisory Service (IWRAS) sponsored by Rashtriya Krishi Vikas Yojana(RKVV) and implemented by Department of Irrigation and Drainage Engineering, Dr.A.S.College of Agricultural Engineering, Maharashtra. It has ten modules with various operation involved in Irrigation schedules. The app provides irrigation scheduling for the farms that are registered in the farm registration module. It facilitates the report generation for ETr and Irrigation events.	From the users' review, this app meets its user's requirement by providing irrigation scheduling and time of operation to farmers, scientists, and users. In the future, it will be updated with the new database for crops. It does not provide the water quality parameters in details.

- Financial concerns on development tool and promoting the application should be taken care of by the public and private organizations who are a part of a beneficiary of the application;
- The dynamism in features namely serving in a range of languages and providing services in a variety of operating platforms (OS) with the market adoptability (nominal price/ open access options) has to be increased;
- Easy access with a readable background like satellite images or maps providing location information can be developed;
- The survey proved that even though the number of successful applications is funded, developed and promoted by the government bodies, the state of mind of the farmers on the public tool is unfortunate. This prediction can be overwhelmed by properly validating and certifying the developed applications by authorized bodies. Training and education on the app utilization have to be given to the target groups to improvise the penetration of these applications.

As this study had limited to a qualitative approach to Mobile applications for water quality in the agricultural area, the extension of this study could be qualitative research on the same topic. It can also be extended by concerning the additional aspects of agricultural inputs like Soil Quality and Crop Management.

REFERENCES

[1]International Telecommunications Union, (2016), Key 2005-2015: ICT data for the world, by geographic regions and by the level of development, Online at: http://www.itu.int/en/ITUD/Statistics/Pages/stat/default.aspx

[2]Statista, (2018), Number of smartphone users worldwide from 2014 to 2020 (in billions): The Statistics Portal Statistics and Studies, Online at: https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide.

[3]Constantina Costopoulou., Maria Ntaliani., Sotiris Karetsos., (2016), Studying Mobile Apps for Agriculture, IOSR Journal of Mobile Computing & Application, International Organization of Scientific Research- Journal of Mobile Computing & Application, 3(6), 44-99.
[4]Baroni L., Cenci L., Tettamanti M., Berati M.,(2006), Evaluating the environmental impact of various dietary patterns combined with different food production systems, European Journal of Clinical Nutrition, 61(2), 279–286.
[5]FAO, (2017), Water pollution from Agriculture: A Global Review, Executive summary, The Food and Agriculture Organization of the United Nations Rome, International Water Management Institute on behalf of the Water Land and Ecosystems research program Colombo,1.
[6]DoACFW, (2018), Annual Report - Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare Government of India, 2017-2018, pp. 1.
[7]Statista, (2016), Number of apps available in leading app stores as of 1st quarter 2019- The Statistics Portal, Online at: https://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/
[8]Economics, (2016), mHealth App Developer: The current status and trends of the mHealth app market, Research2Guidance,Online at: http://www.reseach2quidance.com.
[9]Andreas Biørn-Hansen., Tor-Morten Grønli., Gheorghita Ghinea., Sahel Alouneh., (2019), An Empirical Study of Cross-Platform Mobile Development in Industry Wireless Communications and Mobile Computing, Article ID 5743892, 12

Conflict of Interest

None of the authors have any conflicts of interest to declare.