



Research Article

USEFULNESS AND ADOPTION OF GROUNDNUT PRODUCTION TECHNOLOGY BY FARMERS THROUGH ANDROID BASED MOBILE PHONE APPLICATION

KADIRI MOHAN*

Regional Agricultural Research Station, Tirupati, 517502, Acharya N.G. Ranga Agricultural University, Lam, 522034, Guntur, Andhra Pradesh, India

*Corresponding Author: Email - kadirimohan@gmail.com

Received: December 01, 2020; Revised: December 25, 2020; Accepted: December 26, 2020; Published: December 30, 2020

Abstract: A mobile application was developed with complete groundnut crop package of practices in Telugu language for technology transfer to farmers and extension functionaries during 2017-18. The app was downloaded by 7969 farmers from Google Play store and other sharing media. A study was conducted to assess the mobile app utilization, usefulness of information, extent of adoption of groundnut production technology. Further, the content analysis of the mobile and also the suggestions on the mobile app was studied. A sample of 100 farmers were selected who has used the mobile app for two consequent seasons during 2018-19. The results indicate that regarding utilization majority of users downloaded from Google Play store search, faced no difficulty in downloading the app, one-time registration was easy, regular in using the app information, completely understand the app content and visits weekly once. With respect to usefulness of information in the app, the users perceived that pest and diseases, varietal, fertilizers and manures, contact details of the scientists and land preparation information as most important by majority of the app users. Among the recommended practices adopted by the app users majority include application of gypsum, disease management, pest management, selection of varieties, time of sowing and farm mechanisation. Content analysis of the app results revealed that the content is standard, more adequate, clear, practical and Literic. App users suggested to develop similar app for other crops, videos on practices need to be added in the app, develop apps on other agricultural aspects, information on availability of farm machinery for purchasing, automatic pest and disease detection should be equipped in the app and finally government subsidy programmes information can be made available in the app.

Keywords: Mobile application utilization, Groundnut production technology, Transfer of Technology

Citation: Kadir Mohan (2020) Usefulness and Adoption of Groundnut Production Technology by Farmers through Android based Mobile Phone Application. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 12, Issue 24, pp.- 10486-10490.

Copyright: Copyright©2020 Kadir Mohan, This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Academic Editor / Reviewer: Sanjeev Kumar

Introduction

Groundnut (*Arachis hypogaea* L.), also known as peanut, is an important oil seed, food, and feed legume crop grown in over 100 countries covering 24 million hectares area across worldwide with production of 38 million tons during the year 2010. Most importantly, it is the main livelihood crop for millions of dryland farmers and also a commercial cash crop farmer growing under irrigated conditions. Groundnut production technology has evolved to the fullest by many research organisations across the globe and Acharya N.G. Ranga Agricultural University, Andhra Pradesh have developed a complete seed to seed groundnut production technology. Groundnut cultivation is input intense and technology driven cultivation. Groundnut crop responses well for all the scientifically developed technological practices and inputs. Such research-based groundnut production technology availability to the farmers is a boon for scientific cultivation of the crop on day-to-day basis.

Many technology transfers programmes, activities and methods were in vogue for disseminating the crop production package of technologies to the farmers. Mobile devices are commonly used by the farmer and countryside people [1] With the advent of smart phones to the rural areas, an always in hand friend to the farmer, a smart mobile phone, can be potential transfer of technology route when the right kind of applications are developed and made available in the farmers format.

Mobile phones are most used devices and carried all the time with the users. Hence a mobile application with entire package of practices of a crop will help the farmer or any user to have the information always carried with them and can be adopted in their fields. Mobile application can be used as ready reference for management of crops. Mobile phones are potentially useful tools in agriculture due to its mobility, cost of devices and variety of information providing [2].

By 2022, over 700 million people are expected to have a smartphone in India, and over a billion devices will be sold over the next four-five years [3]. Mobile app is a software application developed specifically for using in smart phone. Mobile applications provide complete and timely to the farmers which are helpful for management, controlling and monitoring entire crop cultivation [4,5]. Mobile phones helped to bridge the digital divide and catalyse the social mobilisation through improved communication [6]. Further, Mobile phones-based advisories when provided through right kind of information by developing suitable apps has positive impact on technology transfer [7]. Mobile phone-based interventions enhanced the quality and speed of extension service delivery [8].

The farmer needs two-way-communication and dynamic information for day-to-day farming [9]. Dynamic apps will be more useful than static apps [10]. Keeping this in view the groundnut mobile app was made dynamic with two-way communication facility by keeping the options like call the expert scientists, call the toll-free numbers of the University, send queries by e-mail or SMS and giving feed back to the developers.

To make available the groundnut production technology to the farmers, an Android based mobile application called "Mana Verusanaga" which means "Our Groundnut" was developed with complete package of practices in Telugu language readily useful for farmers and extension functionaries.

To assess the utilization and impact of "Mana Verusanaga" groundnut, a study was conducted with the objectives of (1) to study the utilization of the groundnut mobile app; (2) to study the useful of the groundnut mobile app; (3) to know the extent of groundnut production technology adoption by using groundnut mobile app; (4) to study the content analysis groundnut mobile app; and (5) to get the suggestions from the groundnut mobile app users.

Table-1 Distribution of respondents based on utilization of the app, (n=100)

SN	Utilization aspect	Response Categories	Percentage
1	How you came to know about "Mana Verusanaga" app?	Information sources	34.00
		News papers	09.00
		Agricultural Department Officers	07.00
		ANGRAU scientists	08.00
		Searching Google play store /internet	42.00
2	Have you faced any difficulty in downloading the "Mana Verusanaga" app?	Yes	97.00
		No	03.00
3	Is the one-time registration of app being easy?	Yes	100.00
		No	0.00
4	Regularity of reading of information in the app	Regular	55.00
		Occasional	43.00
		Irregular	02.00
5	When you read -the information in the app?	When ever get time	12.00
		Whenever required	34.00
		For telling others	10.00
		Whenever any crop problem arises	44.00
6	Understanding of the information in the app	Can understand completely	89.00
		Understand partially	11.00
		Do not understand	0.00
7	Number of the times you visit information in the app?	Daily	07.00
		Weekly once	65.00
		Once in a month	16.00
		Occasional	12.00
8	Information sharing with the friends	Regularly sharing	44.00
		Whenever anyone ask	53.00
		Not at all shared	03.00
9	Is the information and photos available in the app useful?	More useful	94.00
		Sometimes useful	06.00
		Not useful	0.00

Table-2 Distribution of app users based on the usefulness of the information in the app, (n=100)

SN	Aspect	Usefulness of the information		
		More Useful (f)	Useful (f)	Less useful (f)
1	Selection of right variety	56.00	39.00	5.00
2	Varieties characters	89.00	11.00	0
3	Land preparation aspects	76.00	12.00	12.00
4	Recommended seed rate	45.00	54.00	1.00
5	Seed treatment for pest and diseases control	72.00	24.00	4.00
6	Right sowing time	64.00	22.00	14.00
7	Fertilizer application practices	86.00	13.00	1.00
8	Weed management	45.00	31.00	24.00
9	Cropping pattern	36.00	38.00	26.00
10	Pest and disease Management	91.00	9.00	0
11	Harvesting and Seed storage	61.00	34.00	5.00
12	Seed production practices	32.00	46.00	22.00
13	Farm Mechanisation	75.00	24.00	1.00
14	Value addition	36.00	45.00	19.00
15	Contacting scientist through phone numbers given on specific problems	81.00	19.00	0

Materials and Methods

The mobile application on entire research-based production technology of groundnut developed by Acharya N.G. Ranga Agricultural University (ANGRAU), Andhra Pradesh and named as "Mana Verusanaga" was developed and made available for the farmers during the year 2017 [11, 12]. The application was kept in Google play store during the period 2017-2019. As on 14-05-2018 a total of 7967 farmers were downloaded from Google Play store. Apart from play store the app .apk file was also shared through social media platforms and also directly installed by connecting to mobile phone and laptop computer. During the installation of the mobile app in the mobile, all the users have to furnish their details like their name, mobile number, email, category (farmers/student/extension officer etc). The filled in details will get to the developer mobile phone in the form of SMS or by e mail.

All the farmers who had downloaded and registered used the mobile app for two consecutive seasons viz, *Kharif* and *Rabi*. A total of 100 farmers were selected randomly among the list of users who continuously used the mobile app during their groundnut crop cultivation from the state of Andhra Pradesh for two cropping seasons. An interview schedule with profile characteristics, app utilization pattern, usefulness of the information and adoption of package of practices through mobile app and content analysis of app was developed for collecting the responses from

the mobile app used farmers. All the selected responders were interviewed and their responses were collected. The results were analysed using appropriate descriptive statistical tools.

Results and Discussion

Utilization of the app

[Table-1] results indicate that regarding information about the app availability, majority of the farmers were aware about the app through searching Google Play store /internet (42%), followed by information sources like daily newspapers (34%), social media information sources (34%), newspapers (9%), ANGRAU scientists (8%) and Department of Agriculture Officers (7%). Mobile app availability for users was broadly publicised through mass media and in various meetings hosted by the University institutions. Still easy of searching, the majority of the mobile phone users searched in the Google Play store for the groundnut crop app and then downloaded. With regard to downloading the mobile app, farmers responded that they users found no difficulty in downloading (97%) and only few farmers felt difficulty (3%). All the app users responded that one-time registration of the app was easy. As the mobile app was hosted in most popular app store i.e., Google Play Store with right kind of search words, the users were able to download with-out any difficulty.

Table-3 Distribution of app users based on the adoption of recommended practices in the app, (n=100)

SN	Recommended practices available in mobile app	Response categories	
		Adopted (f)	Not adopted (f)
1	Selection of right and suitable variety based on season, location and other special characters	58.00	42.00
2	Right time of sowing (<i>Kharif</i> (upto July 15) and <i>Rabi</i> (upto December 15 th).	62.00	38.00
3	Seed treatment with fungicide, insecticide, rhizobium, Trichoderma	71.00	29.00
4	Recommended dose of Nitrogen: Phosphorus: Potassium (8N:16P:20K) based on soil test recommendations	54.00	46.00
5	Application of gypsum (200 kg /acre) at 30-45 days after sowing	89.00	11.00
6	Correcting Micro nutrient deficiencies (zinc, iron and boron)	42.00	58.00
7	Pre-emergence application of weedicide and Hand weeding at 20-25 Days after sowing	27.00	73.00
8	Irrigation at 20-25 Days after sowing and from pegging to pod formation	23.00	77.00
9	Drought mitigating using urea spray or lime application	4.00	96.00
10	Insect control and Integrated Pest Management practices	67.00	33.00
11	Disease control and Integrated Disease Management practices	71.00	29.00
12	Right time of harvesting and storage	57.00	43.00
13	Farm mechanisation practices like sowing in ferti-cum seed drill, etc	43.00	57.00
14	Value addition to groundnut	9.00	91.00

For registration of the app, one-time screen for providing the users information was given in the app which can be done by SMS (without internet connectivity) and by email (if internet connectivity available). Regarding regularity of reading of information in the app, majority of the users were regular (55%), followed by occasional (43%) and irregular (2%). Mobile application was offline, once installed the app can be open up and can see the content as many times as the user wishes.

[Table-1] results regarding when the app users read the information in app, majority were reading the app information whenever any crop problem occurred (44%), followed by whenever required (34%), when ever get time (12%) and for telling others (10%). With regard to number of times visit the information in the app, majority of the farmers visiting the information in the app weekly once (65%), followed by once in a month (16%), occasional (12%) and daily (7%). After installing the app for the first time, farmers checked entire information available in the mobile app by visiting many times initially. Later on, whenever they take up any groundnut cultivation activity or need information, mostly on weekly basis, they visited the mobile app and got the required information.

The results of app information sharing with the fellow farmer indicate that, majority of farmers were regularly sharing (44%), followed by whenever anyone ask (53%) and not at all shared (3%). Sharing of the information by the app users to the fellow farmers will promotes farmer to farmer extension.

When the usefulness of the information and photographs kept in the mobile app sought from the app users, majority of the farmers revealed that the information was more useful (94%) and sometimes useful (6%). The photographs of the all the groundnut varieties, pest and diseases, machinery, value added products etc where more useful to get better understanding for the content provided in the mobile app.

Usefulness of the information kept in the mobile app

Results of the [Table-2], reveals that majority of app users perceived that selection of right variety information was more useful (56%), followed by useful (39%) and less useful (5%). Always the selection of variety for the right season for better yields was always a challenge to the farmer and hence, the information on various varieties selection was perceived important by many app used farmers. Regarding varieties characters information, majority of the app user felt more useful (89%) and remaining users felt useful (11%). The mobile app contains all the cultivating and seed available varietal characteristics along with their photos was perceived useful by majority of app users. The land preparation information was felt more useful (76%) and remaining equal percentage of users felt useful (12%) and less useful (12%). Regarding recommended seed rate, majority of farmers felt the information was more useful (45%), followed by useful (54%) and less useful (1%). Seed rate for groundnut cultivation varies according to season, sowing method, type of irrigation etc, hence the detailed information given in the mobile app was perceived important by the farmers.

Information on seed treatment for pest and disease control, which was felt more useful (72%) by the app users, followed by useful (24%) and less useful (4%). Seed treatment is one of the important operations which protect the crop from soil

born disease and root grubs. This will also important to inoculate the rhizobium culture in the field for fixing the nitrogen. Similarly, right sowing time information was perceived by the app users as more useful (64%), useful (22%) and less useful (14%). Farmers always consult the extension staff or fellow farmers for right time of showing and as the information in detail was available in the mobile app, the farmers felt that information was more useful to them. Majority of the app users felt that, fertilizer application practices information was more useful (86%), followed by useful (13%) and less useful (1%). Groundnut is legume crop; the fertilizers doses varies with reduced nitrogenous fertilizers. As the entire doses of recommended fertilizers were given in the app, the farmers felt that information was very useful.

With regard to weed management information, majority of the app users perceived the information in the app as more useful (45%), useful (31%) and less useful (24%). Information on cropping patterns kept in the mobile app were perceived by the majority of the farmers as useful (38%), more useful (36%) and less useful (26%). Even though, the cropping patters information was given in the mobile app, the farmers accustomed to the regular cropping based on their local suitability. The intercropping choices with various crops information given in the app was felt more useful and useful by the farmers.

The results on the information in the app usefulness, regarding pest and disease management majority of the farmers opined the information as more useful (91%) and others as useful (9%). As the complete pest complex information for groundnut was given in detail like type of pest, nature of damage, economic threshold level, various cultural, mechanical, biological and chemical control methods were given in the app with good supporting photographs, the farmers felt that information was complete. Harvesting and seed storage information was perceived as more useful (61%), followed by useful (34%) and less useful (5%). Harvesting, threshing, decortication and stripping of pods were always requiring scientific method to follow and hence, the information given in the app was felt useful by the app using famers.

The information on seed production practices were perceived as useful (46%), followed by more useful (32%) and leas useful (22%). As seed production was an important activity with different set of practices to be followed. The complete information on seed production was felt useful by the farmers, those who wish to produce seeds. Farm mechanisation information was also felt more useful (75%), useful (24%) and less useful (1%) by the app users. Post-harvest information related to value additions information was felt useful (45%), more useful (36%) and less useful (19%) by the app users.

Apart from the groundnut crop production package information, the contact details of the University toll free number and district wise expert scientists' mobile numbers were given in the mobile app, from which the users can directly connect a call was felt more useful (81%), followed by useful (19%) by the app users.

Adoption of recommended practices available in the mobile app

The mobile app which contains a set of 14 most scientifically proven critical practices at different stages of the groundnut crop cultivation which will improve the quality and yield.

Results in the [Table-3], showed that the selection of right and suitable variety based on season, location and other special characters was adopted (58%) and remaining farmers not adopted (42%). The recommended tight time of sowing was adopted by majority (62%) and other farmers not adopted (38%). After sowing the most important practice, i.e., seed treatment with fungicides, insecticides, rhizobium and Trichoderma were adopted by 71.00 percent and not adopted by 29.00 percent of app users. The recommended dose of Nitrogen Phosphorus and Potassium fertilizers provided in the app were adopted by 54.00 percent and not adopted by 46 percent of the app users.

[Table-3] results regarding gypsum application indicated that, majority of the farmers adopted the practice (89%) and few farmers were not adopted (11%). Other important practices regarding correcting micro nutrient deficiencies practices given in the mobile app were not adopted by 58.00 percent of the farmers followed by 42.00 percent of the farmers adopted the management practices for micro nutrient deficiencies. Weed management practices given in the mobile app were adopted only by 27.00% of the users and remaining 73.00% of the farmers were not adopted. As hand weeding 25 days after sowing and 40 days after sowing was regular practice, the farmers not adopted the pre-emergence chemical weed control practice. Irrigation management practices at critical stages were adopted by only 23.00% farmers and remaining 77.00 percent farmers were not adopted the practices given in the mobile app. Regarding drought mitigation methods given in the mobile app farmers practiced by only 4.00 percent of the farmers and remaining 96.00% of the farmers were not adopted the methods given in the mobile app. As drought is an occasional phenomenon and during the study season, there was no drought period and hence, farmers not practiced the drought mitigation methods.

Regarding insect control measures and Integrated Pest Management practices, majority of the farmers were adopted (67%) followed by other non-adopted mobile users (33%). Similarly, diseases control and Integrated Disease Management Practices were adopted by majority of the app users (57%) and remaining users were not adopted (43%). Farm mechanisation practices along with the farm machinery were adopted by 43.00 percent and not adopted by 57.00 percent of the farmers. As part of the post-harvest aspects, value addition to groundnut in making various value added products were given in the app. The various value-added methods were not adopted (91%) by the app users and only few farmers adopted some of the value-added practices (9%).

Among the set of 14 critical management practices to be followed for the better-quality yield of groundnut, majority of the farmers well adopted the practices like application of gypsum which gives higher pod setting, pod filling and improve oil percentage. Other practices like diseases and Integrated Disease Management practices, insect control and Integrated Pest Management practices, time of sowing, selection of varieties, fertilizers application, correction of micro nutrients, right time of harvesting and farm mechanisation practices were well adopted though the information provided in the mobile app. The clearly given critical practices for better yield were best understood by the app users and that helped them to adopt that critical recommended practices to follow by themselves with the help of the mobile app.

Content analysis of the information given in the mobile app

[Table-4] reveals that regarding readability of the content, majority were responded as Standard (52%), followed by easy (45%) and hard (03%). Easy understating will always help for better dissemination of content provided in the app. Degree of adequacy of the information provided in the app, when studied, results in the [Table-4] reveals that the information was more adequate (72%) and followed adequate (28%). As the entire production technology developed by the Acharya N.G. Ranga Agricultural University was kept in the mobile app, the farmers also felt the information as adequate. As per the clear aspect of the content for the reader, the app users responded that the information was clear (98%) and only few responded as not clear (2%). All most all the farmers felt the information was clear which indicates that the content in local language with suitable photographs have given the clear understanding of the information provided in the mobile app. Regarding practical usage of the information, majority of the app users opined that the information was practical (88%) followed by

opinion of somewhat practical (12%). As all the practices were based on research outcome and later tested by field extension process, the information was more practice and readily adoptable.

Regarding adequacy of illustrations i.e., photographs, the app users responded adequate (81%) and not adequate (19%). As the language attracts more of the attentions of information seeker, the app users felt that the language was more Literic (83%) and only few felt the languages ad vernacular (17%). Even though various slangs of Telugu language are available, the standard literic form of the language was used in the entire mobile app.

Table-4 Distribution of mobile app users based on the content analysis aspects, (n=100)

SN	Aspect	Response categories	Percentage
1	Readability of the content	Easy	45.00
		Standard	52.00
		Hard	03.00
2	Degree of adequacy of the information	More adequate	72.00
		Adequate	28.00
		Inadequate	0
3	Clear	Clear	98.00
		Not clear	02.00
4	Practical usage of information	Practical	88.00
		Somewhat practical	12.00
		No practical	0
5	Adequacy of illustrations (photographs)	Adequate	81.00
		Not adequate	19.00
6	Language	Literic	83.00
		Vernacular	17.00

Suggestions rendered by the mobile app users

[Table-5] reveals that, similar app for other crops need to be developed (Rank I), videos on practices need to be added in the app (Rank II), develop apps on other agricultural aspects like organic farming etc (Rank III), information on availability of farm machinery for purchasing (Rank IV), automatic pest and disease detection should be equipped in the app (Rank V) and finally government subsidy programmes information can be made available in the app (Rank VI). After seeing the entire groundnut crop cultivation information in one app, the farmers suggested to develop similar kind of mobile apps for other crops also and similarly, specific mobile apps on Soil Health Management, Organic Farming, Agricultural Weather management, Dryland Agriculture etc can be developed and provided for farmers. Farmers rightly suggested that the various schemes related to groundnut crop like subsidy seed, farm machinery, gypsum distribution programmes and micro nutrients supply schemes information can be made available in the mobile app by which the farmers will get benefited.

Table-5 Suggestions given by the mobile app users, (n=100)

Suggestion given	Frequency	Rank
Similar app for other crops needs to be developed	82	I
Videos on practices need to added in the app	46	II
Develop apps on other agricultural aspects like organic farming etc	18	III
Information on availability of farm machinery for purchasing	14	IV
Automatic pest and disease detection should be equipped in the app	12	V
Government subsidy programmes information can be made available	11	VI

Conclusion

The study was conducted to assess the utilization, usage of information, adoption of groundnut production technology through mobile phone app. The crop specific mobile application on groundnut cultivation was effective for technology transfer to the farmers. The study revealed that the android app in local language and which is offline can be better utilized by the farmers. Further, advanced research-based production recommendations were also helped the farmers as decision support system for undertaking timely and right kind of management practices. The suggestions given by the app users will help to improve the mobile application and also provide more mobile app based agricultural technology transfer services to the farmers. The potential of the information dissemination through mobile phone can be best tapped by developing appropriate crop based mobile application for the farmers. The two-way communication provided in the mobile app helped the farmers to get more technical consultation with the expert scientists. More such of crop specific interactive mobile app can help the farmers for improving their crop cultivation competencies.

Application of research: The study helps to develop crop specific interactive mobile apps for better crop technology transfer to farmers and extension functionaries. The study method helps to study the impact of the various mobile apps with suitable methodological additions.

Research Category: Agricultural Extension

Abbreviations: SMS: Short Message Service

FAO: Food and Agricultural Organization,

Acknowledgement / Funding: Authors are thankful to Regional Agricultural Research Station, Tirupati, 517502, Acharya N.G. Ranga Agricultural University, Lam, 522034, Guntur, Andhra Pradesh, India

****Principal Investigator or Chairperson of research: Dr K. Mohan**

University: Acharya N.G. Ranga Agricultural University, Lam, 522034, Guntur, Andhra Pradesh, India

Research project name or number: Research station study

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Andhra Pradesh, India

Cultivar / Variety / Breed name: Groundnut (*Arachis hypogaea* L.)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

References

- [1] Mane S.G. and Kulkarni R.V. (2019) *International Journal of Trend in Scientific Research and Development. Conference Issue*, 179-182.
- [2] Suporn Pongnumkul, Pimwadee Chaovalit, and Navaporn Surasvadi (2015) *Journal of Sensors*, 1-18.
- [3] The Economic Times (2019) *The Economic Times* December 30 2019.
- [4] Belakeri P., Kotresh Prasad C., Bajantri S., Mahantesh M.T., Maruthi S.T. and Rudresh G.N. (2017) *International Journal of Current Microbiology and Applied Sciences*, 6(7), 2499 -2512.
- [5] Sharma S., Patodkar V., Simant S., Shah C., Godse S. (2015) *International Journal of Engineering Research and General Science*, 3(1).
- [6] Barah A. and Balakrishnan M., (2017) *Agricultural Reviews*, 29 (1), 82-85.
- [7] Saravanan R. and Suchiradipta B., (2015) *mExtension-Mobile Phones for Agricultural Advisory Services. Note 17. GFRAS Good Practice Notes for Extension and Advisory Services. GFRAS: Lindau, Switzerland.*
- [8] Xiaolan Fu and Shaheen Akter (2016) *The Journal of Development Studies*, 52(11), 1561-1576.
- [9] MANAGE (2017) *Mobile Apps Empowering Farmers. Extension Digest. National Institute of Agricultural Extension Management, Hyderabad*, 1(2),1-35.
- [10] Patel H.P. and Patel D. (2016) *International Journal of Information Sciences and Techniques*, 6 (1/2), 61-67.
- [11] Mohan K. (2020) *Indian Research Journal of Extension Education*, 20 (1), 15-20.
- [12] FAOSTAT (2010) Available at: <http://faostat.fao.org/>.