EFFECTIVENESS OF ONLINE AGRICULTURAL TECHNOLOGY TRANSFER DURING COVID-19 PANDEMIC

by

ARYA P. S.

(2020-11-082)

THESIS

Submitted in partial fulfilment of the

requirements for the degree of

MASTER OF SCIENCE IN AGRICULTURE

Faculty of Agriculture

Kerala Agricultural University

DEPARTMENT OF AGRICULTURAL EXTENSION

COLLEGE OF AGRICULTURE

VELLAYANI, THIRUVANANTHAPURAM 695 522

KERALA, INDIA

2023

DECLARATION

I, hereby declare that this thesis entitled "**EFFECTIVENESS OF ONLINE AGRICULTURAL TECHNOLOGY TRANSFER DURING COVID-19 PANDEMIC**" is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Place: Vellayani

Date: 29/05/2023

Arya P. S.

(2020-11-082)

CERTIFICATE

Certified that this thesis entitled "**EFFECTIVENESS OF ONLINE AGRICULTURAL TECHNOLOGY TRANSFER DURING COVID-19 PANDEMIC**" is a record of research work done independently by Ms. Arya P. S. (2020-11-082) under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

Vellayani

Date: 29.05.2023

Dr. Sangeetha K. G.

(Major advisor, advisory committee)
Assistant Professor
Training Service Scheme,
College of Agriculture, Vellayani

CERTIFICATE

We, the undersigned members of the advisory committee of Ms. Arya P. S., a candidate for the degree of Master of Science in Agriculture with the major in Agricultural Extension, agree that the thesis entitled **"EFFECTIVENESS OF ONLINE AGRICULTURAL TECHNOLOGY TRANSFER DURING COVID-19 PANDEMIC"** may be submitted by Ms. Arya P. S. (2020-11-082), in partial fulfilment of the requirement for the degree.

Dr. Sangeetha K. G.
(Major Advisor, Advisory committee)
Assistant Professor
Training Service Scheme
College of Agriculture, Vellayani
Thiruvananthapuram – 695522

Dr. A. Anil Kumar
(Member, Advisory Committee)
Professor and Head
Department of Agricultural Extension
College of Agriculture, Vellayani
Thiruvananthapuram- 695522

Dr. Archana R. Sathyan
(Member, Advisory Committee)
Assistant Professor
Department of Agricultural Extension
College of Agriculture, Vellayani
Thiruvananthapuram- 695522

Dr. Pratheesh P. Gopinath
(Member, Advisory Committee)
Assistant Professor and Head
Department of Agricultural Statistics
College of Agriculture, Vellayani
Thiruvananthapuram- 695522

ACKNOWLEDGEMENT

I feel privileged to express my deep sense of gratitude, appreciation and heartfelt thanks to my major advisor ***Dr. Sangeetha K. G.*** *Assistant Professor, Training Service Scheme, College of Agriculture, Vellayani, for her expert guidance, constructive criticism, constant encouragement, affectionate advices, enduring patience and above all, the understanding and wholehearted cooperation rendered throughout the course of my study. This work would not have been possible without her valuable help and support.*

I am indebted to ***Dr. A. Anil Kumar****, Professor and Head, Department of Agricultural Extension, College of Agriculture, Vellayani, and member of Advisory Committee, for his valuable advices, encouragement and whole hearted approach for the successful completion of the thesis.*

I am particularly thankful to ***Dr. Archana R.Sathyan,*** *Assistant professor, Department of Agricultural Extension, College of Agriculture, Vellayani, for the valuable advices, moral support, constant motivation and encouragement during the course of the study.*

I extend my sincere gratefulness to ***Dr. Pratheesh P. Gopinath****, Assistant professor and Head, Department of Agricultural Statistics, College of Agriculture, Vellayani, and member of Advisory Committee for his willingness to render help at any time and the valuable suggestions and moral support he has extended during this work.*

I extend my thankfulness and respect to all the faculty members and non-teaching staff of Department of Agricultural extension for their constant encouragement and support throughout my course work.

I express my sincere gratitude to all the ***farmers*** *who corporated and willingly participated during my survey.*

I convey my heartfelt thanks to ***Alaka chechi, Pooja chechi, Chippy chechi, Reshma chechi, Sreelakshmi chechi, Jeena chechi, Niranjan chettan, Safnatha,***

Sreekanth chettan, Riza chechi, Varna chechi *and all other seniors for their suggestions and encouragement throughout my coursework.*

From the bottom of my heart, I acknowledge the infinite affection and constant encouragement and support by my dearest friends ***Hiba, Achu, Koulu, Gibi, Ashitha, Dhyana, Kiran, Ajay, Rejith, Koshy and Cool.***

I express my thanks and wholehearted cheers to my batchmates, ***Divina, Rajesh, and Prathiksha*** *for their constant support.*

I am deeply indebted to my ***amma, acha and aisu*** *for their unconditional love, affection, sacrifices, moral support and faith. I am grateful to all my relatives and near and dear ones for their support, love and care.*

I am thankful to the ***Kerala Agricultural University*** *for technical and financial assistance for persuasion of my study and research programme.*

A word of apology to those whom I forgot to mention here. I once again express my sincere gratitude to all those who helped me in one way or another in the successful completion of this venture.

Arya P. S.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

Abbreviation/Symbol	Expansion
A	Agree
Agrl.	Agricultural
AICC	Agricultural Information and Communication Center
ARS	Agricultural Research Station
ATMA	Agricultural Technology Management Agency
BDO	Block Development Officer
COVID	Coronavirus Disease
DA	Dis Agree
e.g.	For example
EI	Effectiveness Index
et al.	And co-workers or co-authors
F	Frequency
FAO	Food and Agricultural Organization
FFS	Farmers Field School
Fig.	Figure
i.e.,	That is
ICT	Information and communication technology
KAU	Kerala Agriculture University
KVK	Krishi Vigyan Kendra
Max	Maximum
Min	Minimum
MOOC	Massive Open Online Classes
N	Total number of respondents

NABARD	National Bank for Agriculture and Rural Development
NGO	Non-Governmental Organization
NS	Non-Significant
SA	Strongly agree
SD	Standard Deviation
SDA	Strongly disagree
Sl. No.	Serial Number
TV	Television
UD	Undecided
Via	By means of
viz.,	Namely

INTRODUCTION

1. INTRODUCTION

Agriculture is a key source of food over the world. It is expected that over two billion more people will be part of the world in 2050. Such an increase in population demands a boost of almost 70 percent in the food production rate (Gupta *et al*., 2020). The need for an evolutionary agricultural paradigm to keep up with the growing demand of food and crop production is necessary to guarantee a sustainable development (Gollin *et al*., 2002). A remarkable shift in agricultural practices has occurred over the past century in response to new technologies.

We are passing through an era where technology is extensively utilised for meeting our daily requirements. As reported by Mgendi *et al*. (2019) agricultural technology transfer plays a chief role in transforming agricultural productivity in rural areas especially in the current setting where food demand surpasses the production capacity. The development in agriculture can be accelerated through advanced technologies. Agricultural technology transfer methods refer to the techniques used by an extension system for imparting agricultural information to farming community. Information exchange links improved cognition and knowledge for all of the technologies and increased adoption of innovative technologies (Shikuku, 2019).

The choice of method depends on various factors such as the tenure system in the area, community organization and availability of resources (Anandajayasekeram *et al*., 2008). Various stakeholders such as extension agencies, research organizations and development partners continue to play innovative roles in transferring new technology to agricultural producers but the change is very slow, limited and incomplete (Badiane, 2014). Effective use of electronic media seems essential to keep farmers abreast of latest agricultural information and technologies for meeting the emerging challenges in the new era (Muhammad *et al*., 2012).

Times of crisis is a great teacher as along with the inherent challenges it can throw open many new opportunities (NABARD, 2020). Due to extensive COVID-19 mitigating actions nationally, economic activities related not only to Indian farming systems but to farmers all over South Asia have faced several severe hits due to the unusual circumstances that have arguably outweighed the direct impacts of COVID-19 (Mahendra Dev, 2020; Pothan *et al*., 2020).

From the onset of COVID-19 pandemic digital agriculture tools have enabled smallholder farmers to continue receiving advisory, acquire much-needed financing, receive inputs for their farms and identify new markets for their product (Arathoon *et al*., 2021). The digital agriculture sector has expanded at an impressive rate over the past few years, with a reported 44 per cent per annum increase in the number of registered farmers as users of digital tools (Tsan *et al.,* 2019). Technology has almost taken every part of our life and is considered as path breaker. Even user from remotest part of the world can access and learn updated learning material through e-learning portals (Joshi and Dewangan, 2021).

Digital extension services promise to contribute to e.g. increased crop production, reduced pest and disease pressure, better insight into soil health conditions and, ultimately, improved livelihoods through better and more inclusively accessible information (Agyekumhene *et al*., 2020). They are also seen as potentially disruptive as their potential to increase connectivity and transparency among those who have relevant applied knowledge may radically change the way in which agricultural extension is organised (McCampbell *et al.*, 2021).

To have an in-depth analysis on effectiveness of online agricultural technology transfer among farmers, and to understand the methods adopted by farmers and extension personnel and also to understand the constraints faced by both while online learning and teaching, the present study entitled "Effectiveness of online agricultural technology transfer during COVID-19 pandemic" with the following objectives becomes very relevant:

1. Assessment of the effectiveness of online agricultural technology transfer for the farmers during COVID-19 pandemic.

2. Appraisal of the methods adopted by extension personnel for online agricultural technology transfer.
3. Exploration of constraints in availability, accessibility and utilization of online platforms for agricultural technology transfer.
4. Delineation of blended learning package for effective online agricultural technology transfer for farmers.

1.1 SCOPE AND IMPORTANCE OF THE STUDY

Technological changes and adoption of improved agricultural techniques are important components in the development of any agrarian community. Usage of online media is the key option for the extension personnel as well as farmers for effective agricultural technology transfer during this pandemic situation. At the same time a lot of constraints are facing by both for effective online technology transfer.

Therefore, the present study investigating the effectiveness of online agricultural technology transfer and its relationship with socio-economic characteristics of farmers will be of high relevance especially in this pandemic situation. Moreover, exploration of constraints in effective agricultural technology transfer and the delineation of a blended learning package based on the results of the study will also be a great contribution to the farming community as well as the extension system for refining the transfer of technology means and measures leading to a better agricultural production.

1.2 LIMITATIONS OF THE STUDY

The researcher faced all the limitations, being a single researcher. One of the major limitation was the resources and time available at the disposal of student researcher. Since the study was completely based on the expressed opinions of respondents, it may not be free from personal bias and prejudices. However, maximum effort was made to avoid the bias and carry out research in

an effective manner. Despite these limitations, research was conducted very carefully to make study as objective and systematic as possible.

1.3 ORGANIZATION OF THESIS

The thesis has been presented in five chapters. The first chapter is an introductory one that highlights the objectives, scope, importance and limitations of the study. The second chapter deals with the literature reviewed in line with the objectives. The third chapter describes the methodology followed out in carrying the research work. The fourth chapter deals with results and discussion of the study. The fifth chapter includes summary, implications, conclusions of the study and suggestions for future research. References, appendices and abstract are given at the end.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

Review of literature covers the theoretical orientation of the study. A comprehensive literature review is mandatory for any scientific research. It helps in analyzing the past studies related to present research objectives and also help to form a better framework for interpretation of result. Also an exhaustive review of literature enables us to come up with a well-structured thesis.

The main focus of this chapter is to present a resume of conceptual formulations pertaining to effectiveness of online agricultural technology transfer. Keeping in view the major objectives of the study, related literatures reviewed are presented under the following headings.

2.1. Profile characteristics of the respondents

2.2. Effectiveness of online agricultural technology transfer

2.3. Methods of online agricultural technology transfer

2.4. Constraints in online agricultural technology transfer

2.5. Blended learning

2.1. PROFILE CHARACTERISTICS OF THE RESPONDENTS

2.1.1. Age

Riyajjudin (2005) in his study revealed that 43 per cent online service users belonged to middle age category.

Parida (2010) in his study Utilization of Information and Communication Technology (ICT) tools by staff and students in Universities reported that most of the respondents belonged to young age group (39.17%).

Dhakal and Chayal (2010) in their study Farmers' experience with ICTs on transfer of

technology in changing agri-rural environment reported that majority (46.67 %) of the respondents belonged to the middle aged group followed by 38.67 per cent were within young age and 14.67 per cent were under old age.

Patidar (2015) observed in his study "study on role of online communication in transfer of agricultural technology" that majority of the users (48.33%) belonged to middle age group.

Swaroop (2016) reported in his study about accessibility and extent of utilization of ICT for the adoption of enhanced agricultural practices that most of the respondents were middle aged (54.17%).

Singh and Kameswari (2019) found that majority of the respondents (48.57%) were middle aged, followed by young aged (37.50%) and old aged (13.93%).

Hashem *et al.* (2021) reported that 54.8% were of young age, 27.7% were middle aged and 16.5 % were of old age.

2.1.2. Education

Kadian and Kumar (2001) in their study found that maximum number of respondents (45 per cent) studied up to high school level, followed by the respondents having education in the category of intermediate and above (28.34 per cent), 18.33 per cent of the respondents had educational level up to primary and 8.33 per cent of the respondents in the category of illiterates.

Singh *et al.* (2009) in their study training need of farm related crop production in Madhya Pradesh revealed that 39.16 per cent of the respondents were educated up to primary school, while 9.58 per cent possessed college level of education.

Parida (2010) revealed that majority of the users were literates and maximum number of them (26.66%) were educated up to higher secondary level.

Patel (2015) observed that the primary and middle education groups, followed by higher education and formal education groups, would be more concerned about the use of communication channels within the farming population.

Thomas *et al.* (2017) reported that technology transfer methods were influenced by the education status of the respondents.

Patel *et al*. (2018) reported that majority (94%) of the respondents were educated up to primary or above levels.

Hashem *et al.* (2021) reported that most respondents belonged to highly educated category (86.6%).

2.1.3. Innovativeness

Gopinath (2005) found that most of the respondents (51.33%) had medium level of innovativeness, while 31.33 percent had low and 17.34 percent had high level of innovativeness.

Parida (2010) reported that most of the online communication service users (40.83%) were found to have high level of innovativeness.

Kalyan (2011) in the study on effect of technology utilization by Chittoor farmers reported that most of the respondents (59.17%) had medium level of innovativeness followed by high (20.83%) and low (12.50%) level of innovativeness.

Arathy (2011) found that more than half (59.17%) of the respondents had medium level of innovativeness followed by high (28.33%) and low (12.50%) level of innovativeness.

Patidar (2015) concluded that majority of the respondents (42.50%) were found to have medium level of innovativeness.

Pudke (2018) reported that 75.84 per cent of respondents were having medium innovativeness, followed by low (15.83%) and high (8.33%).

Roy *et al*. (2018) revealed that farmer with higher degree of innovativeness used to experience more number of ICT tools than other members of farming community.

Geethu (2019) noticed that 62.67 per cent of the trainees had medium level of innovativeness. 21.33 per cent had high innovativeness and 16 per cent had low innovativeness.

2.1.4. Social participation

Riyajuddin (2005) revealed that majority of the respondents (51%) never participated in any organization while 41.50 per cent had participated in one organization.

Shivhare (2008) revealed that most of the banana growers had medium social participation.

Thakre (2017) reported that majority of the respondents (55.83%) belonged to medium category of social participation.

Patil (2017) concluded that 43.70 per cent of the respondents had medium social participation, while 38.52 per cent had low and 17.77 per cent had high social participation.

Balu (2019) reported that majority of the respondents (65.83%) had medium level of social participation, followed by 17.50 per cent with low and 11.67 per cent with high level of social participation.

2.1.5. Information source utilization

Duram and Larson (2001) concluded that various information sources used by farmers were books, journals, newspapers, internet sources, farm consultants, group activities, on-farm research, NGO and other public sources.

Gunawardana (2005) reported that effective communication from different sources are the essence of extension which provides knowledge and information for rural people.

Palaniswamy (2011) found that majority of the respondents (43.23%) had higher level of information source utilization.

Sujitha (2015) reported that 84 per cent of the respondents had high level of information source utilization followed by low.

Chowhan and Ghosh (2020) revealed that only 21.8 per cent respondents had high use of information sources.

2.1.6. Information seeking behaviour

Nandakumar *et al*. (2014) concluded that majority of the technology transfer takes place through the personal contacts with research stations /KVK, followed by farm TV programs, radio, newspaper, books/magazines and journals.

Kavithaa *et al*. (2014) reported that 52.86 per cent of the respondents had medium level of information seeking behaviour.

Patidar (2015) revealed that 42.50 per cent of online communication service users were having medium level of information seeking behaviour.

Kailash (2016) reported that majority of the respondents received information through mobile phones.

Pujar (2018) stated that 52.50 per cent of the respondents belonged to medium level of information seeking behaviour, followed by low (33.33%) and high (14.17%).

Shukla *et al*. (2022) observed that 71.11 per cent of framers had medium level of information seeking behaviour.

2.1.7. Extension agency contact

Aphunu and Otoikhian (2007) revealed that about 62 per cent of the respondents had contact with extension agents on a monthly basis.

Chauhan (2009) reported that 42.50 per cent of the respondents had regular contact with extension personnel.

Shankaraiah (2011) found that majority of the farmers (37.50%) had high extension participation, followed by medium (35%) and low (27.50%).

Adesoji and Tunde (2012) observed that 76 per cent of farmers had contact with extension agents and 87 per cent of researchers had contact with extension agents.

Khan *et al*. (2017) revealed that 24 per cent of the respondents had medium level of extension agency contact.

Patel *et al*. (2018) observed that majority (64%) of the respondent farmers had medium to very high level of extension agency contact.

Bhongle (2018) revealed that 66.66 per cent of the respondents had medium level extension agency contact.

Balu (2019) concluded that majority of the respondents (61.67%) had medium extension agency contact followed by low (20%) and high (15%).

2.1.8. Mass media exposure

Chavan *et al*. (2010) reported that mass media exposure had significant correlation with perceived effectiveness of agricultural programmes.

Sobha (2013) found that 67.78 percent of farmers were having medium level of mass media exposure.

Sharma *et al*. (2014) stated that television (80.71%) was the most used mass medium by the farmers for getting information regarding modern agricultural technologies.

Beevi (2014) reported that 58.34 per cent of the respondents had medium level of mass media exposure.

Patidar (2015) reported that majority of the respondents (49.17%) had medium exposure on mass media sources.

Bhatia *et al.* (2016) revealed that 48.67 per cent, 36.67 per cent and 14.67 per cent of the respondents had medium, low and high mass media exposure respectively.

Shivaraj and Philip (2016) reported that 41 per cent of the respondents had medium level of mass media exposure, followed by high (37%) and low (22%).

Patel *et al*. (2018) reported that majority (67.00 per cent) of the respondents had medium to very high level of mass media exposure.

Pujar (2018) concluded that majority of the respondents (37.50%) had medium exposure to mass media.

2.1.9. Social Media Participation

Morris and James (2017) found that social media provides opportunities to engage with stakeholders and develop more entrepreneurial activity.

Kanjina (2021) revealed that majority of the respondents (81.92%) of the respondents did not adopt social media.

Philips *et al*. (2021) concluded that farmers use social media for knowledge exchange to address and support on-farm activities.

Mishra *et al*. (2022) reported that majority of farmers were in medium category of social media use.

Riley and Robertson (2022) suggested that social media helps the farmers to identify the shifting boundaries and scripts of good farming.

2.1.10. Trainings undergone

Reddy *et al*. (2005) from their study on effectiveness of trainings found that the trainings were effective.

Dixit *et al*. (2014) stated that trainings helped the farmers to increase their efficiency and educated them to use resources in efficient and balanced way.

Kabir *et al*. (2014) reported that 73.78 per cent of the respondents had medium exposure to training programs and 26.25 per cent of them had low exposure.

Singh and Singh (2014) concluded that trainings conducted under ATMA had an effectiveness of 54.6 per cent.

Islam (2015) reported that 48.67 per cent of the respondents had medium training experience.

Gautam *et al*. (2017) concluded that short term trainings of farmers in vegetable IPM methods improved knowledge and attitude of farmers in pest management.

2.2. EFFECTIVENESS OF ONLINE AGRICULTURAL TECHNOLOGY TRANSFER

Xu and Ebojoh (2007) found that effectiveness of online learning programs were influenced by the factors like assessment, benefits, constraints and the design delivery method.

Roy (2013) found that 91 per cent of farmers perceived FFS for soil and crop management as medium to highly effective.

Rahman (2015) reported that training program was highly effective among 68 per cent of the farmers and medium effective for 32 per cent.

Khan *et al*. (2017) reported that 62.7 per cent of farmers perceived that effectiveness of mass media in technology transfer was low, while 31.8 per cent perceived as moderately effective and 5.5 per cent as highly effective.

Khan *et al*. (2017) revealed that the perceived effectiveness of AICC in technology transfer was high for 37 per cent of the respondents and moderately effective (38%), less effective (25%).

Bahasoan *et al*. (2020) concluded that online learning during COVID-19 pandemic were effective and inefficient.

Raza *et al*. (2020) defines effectiveness as the outcome of use of different ICT tools by the farmers to meet their information needs.

Mendhe *et al*. (2020) concluded that availability of information through internet assists the process of agricultural extension and makes it more effective.

2.2.1. Dimensions of effectiveness

2.2.1.1. Information Credibility

Meena (2010) concluded that ARS/KVK scientists were perceived as most credible followed by the extension officials.

Hassan *et al*. (2012) revealed that television was considered as a credible source for disseminating clear and understandable agricultural information.

Kakade (2013) reported that farm radio programmes were the second credible information source, next to agriculture extension workers.

Khan *et al*. (2017) concluded that 52 per cent of the respondents opined that the credibility of messages received from AICCs were high.

2.2.1.2. Information Adequateness

Kaur and Kaira (2003) reported that majority of the respondents (90%) opined the information were useful and timely.

Khan *et al*. (2017) reported that majority of the respondents thought adequateness of information from the AICC were low.

Aldosari *et al*. (2019) concluded that electronic media have been found very effective in timely disseminating information needed by the farmers.

2.2.1.3. Information Understandability

Kaur and Kaira (2003) concluded that technical words used in the dairy farming information was understandable up to some extent by 75 per cent of the respondents

followed by completely understandable (12.50%) and not understandable at all (12.50 %).

Parganiha *et al*. (2012) reported that understandability of messages were medium for majority (44%) of the members of farmers category.

Hadiya (2019) reported that information delivered were highly understandable for 80 per cent of extension personnel, 60 per cent of input dealers and 42.22 per cent of farmers.

Nantongo *et al*. (2021) stated that understandability and usability of the weather and climate information received were low.

2.2.1.4. Information Accessibility

Nnenna (2013) reported that the level of access and utilization of ICT tools and facilities were found to be generally low among the respondents.

Benard *et al*. (2014) revealed that the barriers to accessing agricultural information were lack of information services, inadequate number of extension agents, inadequate funds and lack of awareness of information sources.

Nantongo (2021) observed that smallholder farmers accessed weather information through traditional and modern media sources like radio, television, and telephone.

2.2.1.5. Information Applicability

Parganiha *et al*. (2012) concluded that information were fully applicable for about 40 percent of respondents of farmers category, whereas medium and partially applicable to 16 per cent and 24 percent of members respectively. It was also found that message was fully applicable for In-service Personnel (60%) and Input Dealers (53.33%)

Khan *et al*. (2017) stated that a remarkable number of respondents opined that the applicability of information from the AICC were less.

Hadiya (2019) revealed that messages were fully applicable for majority of the extension personnel (68%) and 46.66 per cent for input dealers.

2.3. METHODS OF ONLINE AGRICULTURAL TECHNOLOGY TRANSFER

Patidar (2010) revealed that majority of respondents used mobile phones for receiving information.

FAO (2014) reported that mobile phones have been proven as the most effective modern information and communication technology that are accessible to rural farm families.

Thakur and Chander (2018) reported that popular social media tools i.e. Facebook, WhatsApp and YouTube are being used for information delivery and sharing across different agriculture subsectors in India, the potential of these tools are not fully exploited by agricultural extension and development departments to reach out to farmers.

Madushanki *et al*. (2019) indicated that Wi-Fi and mobile technology are the most frequently used technologies by applicants involved in the agriculture and farming industries.

Balogun (2020) opined that to mitigate the constraints to the agricultural activities during COVID-19, especially in the farmers' access to information about how to obtain inputs and innovative agricultural technologies, digital tools such as mobile phone and internet enabled applications and services are preferred.

Mahapatra (2020) states that smartphones act as a most important tool for farmers in providing information related to crop growth states, weather forecast and advisory, farm advice, market price and post- harvest management in this COVID-19 pandemic condition.

Singh (2020) opined that during the pandemic period, digital technologies have emerged as essential tools to disseminate and share information through various digital platforms and social media as solutions for social distancing measures.

Hashem *et al.* (2021) found that the respondents who use agricultural ICTs revealed that the most common types of used ICTs were social media (27.1%), online platforms and internet services (25.4%) and mobile applications (22.4%).

Gurung (2021) found that teachers used Zoom, Google meet, Whatsapp, Google classroom for online teaching.

Pokhrel and Chhetri (2021) reported that virtual classroom platforms like videoconferencing (Google Hangouts Meet, Zoom, Slack, Cisco, WebEx) and customizable cloud-based learning management platforms such as Elias, Moodle, Big Blue Button and Skype were increasingly being used.

Roy and Ghosh (2022) opined that about 70 per cent of respondents were aware about imparting education through online platform and 45 per cent had adapted it.

2.4. CONSTRAINTS IN ONLINE AGRICULTURAL TECHNOLOGY TRANSFER

Anand *et al*. (2020) reported that erratic power supply, poor internet connectivity and lack of knowledge in using and handling various ICT tools were the barriers faced by farmers.

Mishra *et al*. (2020) found that lack of knowledge about ICT tools, poor condition of equipment, relevant information not received in time and awareness of new ICT service among farmers about the use of ICTs for the educational and agricultural purpose were the major constraints in ICT use.

Yaseen *et al*. (2020) opined that lack of awareness, poor ICT infrastructure, internet coverage, authenticity of information and lack of skill were the major constraints.

Hashem *et al.* (2021) found that major obstacles preventing the use of agricultural ICTs were the lack of awareness (34.1%), the high cost of agricultural ICTs (29.1%), and

unavailability (27.3%). The other obstacles preventing the use of agricultural ICTs were the difficulty of use (6.4%).

Gurung (2021) opined that high internet connectivity, Wi-Fi and broadband connections that facilitate high-speed internet is not installed as it is not required daily basis by the people in rural area, while some people can't afford it due to its high cost.

Ramu and Karthikeyan (2022) reported that paddy farmers face problems with high internet charges, high cost of mobile and television.

2.5. BLENDED LEARNING

Kolowich (2009) opined that blended learning can produce better teaching and learning outcomes than E-learning or face-to-face mode.

Means *et al*. (2013) reported that increased capabilities of web-based applications and collaboration technologies and the rise of blended learning models combining web-based and face-to face classroom instruction have raised expectations for the effectiveness of online learning.

Du Plessis *et al.* (2015) indicated that introducing blended learning will boost student engagement, therefore improving retention.

Deegan *et al*. (2016) concluded that blended learning can be used effectively for the instruction of a diverse range of practical skills in agricultural college.

Gambari *et al.* (2018) reported that the undergraduates taught using blended learning mode of instruction performed better than their counterparts taught using e-learning and traditional teaching method.

METHODOLOGY

3. METHODOLOGY

The research methodology in accordance with the objectives of the study is presented under the following section heads.

3.1 Research design

3.2 Locale of the study

3.3 Sampling methodology

3.4 Selection, operationalization and measurement of independent variables

3.5 Effectiveness of online agricultural technology transfer for the farmers during COVID-19 pandemic

3.6 Methods adopted by extension personnel for online agricultural technology transfer

3.7 Constraints in availability, accessibility and utilization of online platforms

3.8 Blended learning package for effective online agricultural technology transfer for farmers

3.9 Suggestions to improve the effectiveness of online agricultural technology transfer

3.10 Techniques employed in data collection

3.11 Statistical tool used for data analysis

3.12 Hypothesis

3.1. RESEARCH DESIGN

Research design is the entire process of planning and carrying out research. Kerlinger (2014) defined ex-post-facto research as empirical inquiry done systematically in which the scientist does not have direct influence of independent variables as their manifestations have already occurred or because they are inherently not manipulatable.

In the study ex post facto research design was used. Inferences about associations among variables are identified, without direct investigation, from concomitant variation of independent variables and dependent variables.

3.2. LOCALE OF THE STUDY AREA

The study was conducted in Kerala among the farmers who received online training and extension personnel who conducted training.

3.3 SAMPLING METHODOLOGY

Two categories of respondents have been identified for the study, namely farmers and extension personnel.

i) Farmers: For the selection of respondents, the farmers who had undergone online trainings organised by public extension agencies such as Kerala Agricultural University and State Department of Agriculture constituting a total of 100 farmers were selected randomly.

ii) Extension personnel: 50 extension officials: 25 each from KAU and Department of Agriculture, who had conducted online trainings for farmers were selected randomly.

Thus, a total of 150 respondents comprising of 100 farmers and 50 extension personnel, constitute the total sample size.

3.4. SELECTION, OPERATIONALIZATION AND MEASUREMENT OF VARIABLES

3.4.1 Selection of variables

The variables suited for the study were selected through judges rating method after an explorative analysis of available literature and consultation with experts of Kerala Agricultural University (KAU). Twenty seven independent variables were selected based on various literatures which were then given for judges rating. For judges

rating, Google form was created in the form of a questionnaire to collect responses on a five point continuum with options “most relevant”, “more relevant”, “relevant”, “less relevant”, and “least relevant” with scores 5,4,3,2 and 1 respectively. Option was also given for providing their additional opinions. The questionnaire is furnished in the Appendix 1.

The form were sent to each thirty five judges through email. The scores assigned by these judges were added up for each variable. Finally, 10 independent variables with highest scores were selected according to the rating of 25 judges. The selected independent variables with their corresponding measurement procedure are presented in Table 1.

Table 1: Independent variables and measurement procedures

Sl.No.	**Variables**	**Measurement**
1	Age	Chronological age of respondent
2	Education	Majjusha (2000)
3	Innovativeness	Gurubalan (2007)
4	Social participation	Fayas (2003)
5	Information source utilization	Thasneem (2016)
6	Information seeking behaviour	Geethu (2019)
7	Extension agency contact	Greeshma (2017)
8	Mass media exposure	Jaganathan (2004)
9	Social media participation	Arbitrary scale
10	Trainings undergone	Geethu (2019)

3.4.1.1 Age

Age was operationalized as the number of years completed by the respondent at the time of investigation. It was measured by asking the actual age of respondents. With quartiles as check, respondents were categorized as in the table below with respect to their age.

Sl. No	Category	Criteria

1.	Young age	≤ Q1
2.	Middle age	>Q1 to ≤ Q3
3.	Old age	> Q3

The respondents were categorized into different groups and expressed as frequency and percentage.

3.4.1.2 Education

It is operationally defined as the number of years of formal education completed by the farmer. Education status of the respondent was measured with scoring procedures followed by Majjusha (2000).

Sl. No	**Category**	**Score**
1.	Illiterate	1
2.	Primary school	2
3.	Secondary school	3
4.	Collegiate	4

The responses were classified into different groups based on their level of education and expressed as frequency and percentage.

3.4.1.3 Innovativeness

It is operationally defined as the degree to which an individual is prompt in adopting a new practice and introducing changes into their operations if found practical and feasible. Innovativeness was measured using scale developed by Gurubalan (2007). The scale consist of five statements. The response for each of the statement was noted over a five-point continuum, which ranges between strongly agree and strongly disagree. The score 5, 4, 3, 2 and 1 was assigned for positive statements and 1, 2, 3, 4 and 5 for negative statements. The scoring procedure followed is given below.

Sl. No	Statements	SA	A	UD	DA	SDA
1	You would feel restless unless, you tryout an innovative method which you have come across					
2	You are cautious about trying new practices.					
3	You like to keep up to date information about the subjects of your interest.					
4	You would prefer to wait for others to try out new practices first.					
5	You opt for the traditional way of doing things than go in for newer methods.					

Based on the scores obtained by the respondent, they were classified as low, medium and high level of innovativeness and expressed as frequency and percentage.

3.4.1.4 Social participation

Operationally defined as the degree of involvement of farmers in various activities and programmes of social organizations. Social participation were measured on the basis of nature and frequency of participation. Nature of participation refers to the membership position of members in social organizations. Frequency of participation refers to the nature of participation of members in social organizations. Scale used by Fayas (2003) with slight modification were used for the study.

In case of nature of participation score of 1 was assigned for ‘No membership', 2 for having a 'Membership' and 3 if the respondent is an 'Office bearer'. In the case of frequency of participation, 1, 2 and 3 were assigned for 'Never attending', 'Sometimes' attending and 'Regularly' attending respectively.

Organization	**Nature of participation**			**Frequency of participation**		
	Not a member (1)	Member (2)	Office bearer (3)	Never (1)	Occasionally (2)	Regularly (3)
Panchayat						
Co-op society						
Farmers club						
Youth club						
Socio-cultural organizations						

The scores obtained by a respondent on the above two dimensions were summed up across each items for all the organizations which gave his social participation score. Based on the total score obtained, the respondents were classified into three categories with quartiles as check. The score ranges from six to eighteen.

3.4.1.5 Information source utilization

Operationally defined as the sources from which respondent receives relevant information on farming during COVID-19. Each respondent were asked to indicate how often he received information on farming practices from each of mass media, personal cosmopolite and personal localite sources of information. The information source utilization was measured in terms of frequency of use of information source the respondents rely on. Scale developed by Thasneem (2014) with suitable modification were used. The measurement was done as given below.

Sources	Frequency			
	Most often (4)	Often (3)	Sometimes (2)	Rarely (1)
1. Mass media sources				
Farm publications				
Television				
Films				
Newspaper				
Agricultural exhibitions				
2. Personal cosmopolite sources				
Research scientists				
Agrl.officers				
Agrl. assistants				
3. Personal localite sources				
Progressive farmers				
Neighbour				
Friends				
Family members				
Relatives				

Based on the total score obtained, the respondents were classified into three categories with quartiles as check and expressed as frequency and percentage. Score ranges from fifty two to thirteen.

3.4.1.6 Information seeking behaviour

Operationally defined as the view of farmers on search and use of data sources based on frequency of participation, extent of usefulness of various sources of information. Scale used by Geethu (2019) with suitable modification were used.

In this scale the responses were collected on a four point continuum, with score ranges from 4 to 1 for ‘regularly’ to ‘never’. The possible score ranges from ‘forty’ to ‘ten’.

	Sources	**Regularly (4)**	**Once in fortnight (3)**	**Whenever problem arise (2)**	**Never (1)**
Media sources	Television				
	Radio				
	Newspapers				
	Agricultural publications				
Formal sources	Scientists of KVK/KAU				
	Agricultural officers				
	BDO				
Informal sources	Family members				
	Neighbours				
	Friends and relatives				

Based on the total score obtained, the respondents were classified into three categories with quartiles as check and expressed as frequency and percentage.

3.4.1.7 Extension agency contact

It is operationalized as the degree of contact of farmers with various agricultural officials for acquiring information on farming and other activities. Scoring procedure used by Greeshma (2017) were followed after modifications. Scores were in the order of 1, 2 and 3 for the responses 'Never', 'Occasionally' and 'Regularly'.

Sl. No.	**Extension personnel**	**Frequency of contact**		
		Regularly (3)	Occasionally (2)	Never (1)
1.	Agricultural scientist			
2.	Agricultural officer			
3.	Agricultural assistant			
4.	KVK			
5.	ATMA			

Based on the total score obtained, the respondents were as low, medium and high level of extension agency contact based on quartiles and expressed as frequency and percentage. The possible score ranges from fifteen to five.

3.4.1.8 Mass media exposure

Operationalized as the extent to which farmer is exposed to different mass media channels such as radio, television, newspaper, information material and farm magazines *etc*. Scale used by Jaganathan (2004) were followed. The scale consisted of 8 statements which were measured on a three-point continuum ranging from 'Regularly', 'Occasionally' and 'Never' with weightage of 3, 2 and 1 respectively. The minimum and maximum score likely for each respondent was 8 and 24 respectively. The respondents were categorized into low, medium and high mass media exposure based on quartiles.

Sl.No	**Mass media**	**Frequency of exposure**		
		Regularly (3)	Occasionally (2)	Never (1)

1	Radio			
2	Newspaper			
3	Television			
4	Farm magazines			
5	Bulletins			
6	Books			
7	Films			
8	Social media			

3.4.1.9 Social Media Participation

Social media participation is operationally defined as the extent to which the farmers take part or become involved in the social media. It was measured in terms of frequency of use of social media channels and duration of time spent on social media by the farmer.

Frequency of use of social media

Social media channels	**Very often (3)**	**Somewhat often (2)**	**Rarely (1)**
Facebook			
Instagram			
Twitter			
Telegram			
Whatsapp			

Duration of time spent on social media

Time	**Score**

1hour	1
2-3hours	2
3-5hours	3
More than 5hours	4

The scores obtained by a respondent on the frequency of use of social media channels and duration of time spent on social media by the farmer were summed up which gave his social media participation score. The respondents were categorized into low, medium and high level of social media participation based on quartiles and expressed as frequency and percentage.

3.4.1.10 Trainings undergone

Operationally defined as the number of days of online training received during COVID-19 period. Scoring procedure followed by Geethu (2019) with suitable modification were used. The respondents had been categorized into three, based on the average of number of trainings attended.

Sl.No	Trainings undergone	Scores
1	1	1
2	2-4	2
3	>5	3

3.5 Operationalization and measurement of dependent variable

3.5.1 Effectiveness of online agricultural technology transfer

Based on the objectives of the study, effectiveness of online agricultural technology transfer was selected as the dependent variable.

In this study, effectiveness of online agricultural technology transfer was operationally defined as the degree to which the agricultural information obtained

through online methods are useful in producing a desired result in farm related activities.

Effectiveness of online agricultural technology was measured using effectiveness index. Scale used by Khan *et al.* (2017) with suitable modification were used for the study. The effectiveness index consists of five dimensions, information credibility, information adequateness, information understandability, information accessibility and information applicability which have a positive influence on the effectiveness of online agricultural technology transfer. Each of the dimensions were measured and standardized.

Values of the dimensions were standardized with the formula;

$$Z_i = \frac{X_i - X_{min}}{X_{max} - X_{min}}$$

Which ranges from 0 to 1.

- Zi = standardized score of i^{th} individual of i^{th} dimension
- Xi = score of i^{th} individual of i^{th} dimension
- $Xmin$ = minimum score of obtained
- $Xmax$ = maximum score obtained

Effectiveness Index (EI) was used to measure the effectiveness of online agricultural technology transfer of the respondents. The total score was calculated by adding the standardized values obtained for the five dimensions. The total score ranges from 0 to 5. This score was used to calculate the effectiveness index score.

Effectiveness Index (EI) is given by the formula;

$$\text{EI} = \frac{\sum_{i=1}^{5} zi}{\text{n}} \times 100$$

EI = (sum of obtained standardized scores for the five dimensions / 5) × 100

The index score of effectiveness ranges from 0 to 100. Based on the EI, the respondents were grouped into three categories namely low, medium and high, considering the quartile values and expressed as frequency and percentage.

Sl. No.	Category	Criteria
1.	Low	≤Q1
2.	Medium	>Q1 to ≤Q3
3.	High	>Q3

The five dimensions and their respective items of measurement were provided in the interview schedule and respondents were asked to respond to the statements.

3.5.2. Dimensions of effectiveness

The five dimensions of effectiveness of online agricultural technology transfer were operationalized as follows;

3.5.2.1 Information Credibility

Defined as the degree to which the farmers can trust and believe the information provided by the authority. By summing up the scores for different statements, the total score was obtained. The score ranges from 5-20.

3.5.2.2 Information Adequateness

Operationally defined as the extent to which the information received are sufficient and adequate for the farmers. By summing up the scores for different statements, the total score was obtained. The score ranges from 5-20.

3.5.2.3 Information Understandability

Refers to the extent the information conveyed has been clear and comprehensible to the receiver. By summing up the scores for different statements, the total score was obtained. The score ranges from 5-20.

3.5.2.4 Information Accessibility

Operationally defined as the extent to which the information is accessible to the farmers on time. By summing up the scores for different statements, the total score was obtained. The score ranges from 5-20.

3.5.2.5 Information Applicability

Defined as the extent to which the information is applicable to the real time situation for the farmers. By summing up the scores for different statements, the total score was obtained. The score ranges from 5-20.

3.6 METHODS ADOPTED BY FARMERS AND EXTENSION PERSONNEL

Different digital devices, digital platforms and web application used by the farmers as well as extension personnel were identified based on the interaction and discussion with the respondents during the data collection using the questionnaire. The responses obtained were recorded on a five point continuum scale *viz*., most often, often, sometimes, rarely and never were assigned score of 5, 4, 3, 2 and 1 respectively.

3.7 CONSTRAINTS

Constraints in availability, accessibility and utilization of online platforms for agricultural technology transfer for farmers and constraints in organizing and implementing online training programs by extension personnel were measured using the schedule developed by the researcher for the study. The responses obtained were recorded on a five point continuum scale *viz*., extremely important, important, moderately important, slightly important and not at all important were assigned score of 5, 4, 3, 2 and 1 respectively. The total scores of constraints were summed up and then divided by the total number of respondents to obtain mean score. The constraints were then ranked in descending order on the basis of these mean scores.

3.8 BLENDED LEARNING PACKAGE

Blended learning is a combination of both online learning and traditional physical classroom interactions. An online pre-class event can be used to know the level of

knowledge and skill of learner before the face to face class begins. A core classroom event followed by online independent experiences, including interaction with online resources or e-mentoring services could be used to develop communities of learners or to engage in further discussions on advanced topics of individual interest (FAO, 2021).

The respondents were asked to mark their preference on a five point continuum ranging from ‘most preferred’, ‘more preferred’, ‘preferred’, less preferred and ‘least preferred’ with weightage of 5, 4, 3, 2 and 1 respectively for different modes learning namely, e-learning, traditional class room learning and blended learning. Based on frequency and percentage analysis, preference on different modes of learning were calculated.

3.9 SUGGESTIONS

Suggestions to improve the effectiveness of online agricultural technology transfer were collected from the respondents and experts based on interactions and discussions.

3.10 DATA COLLECTION TECHNIQUES

A well-structured interview schedule and online-questionnaire were administered to the respondent group. The questionnaire was directly administered to the respondents by the investigator and responses were recorded.

3.11 STATISTICAL TOOLS USED FOR DATA ANALYSIS

Statistical methods used to analyse the data and draw conclusions are detailed below;

3.11.1 Quartiles

The respondents were grouped based on the quartile values of independent and dependent variables. After grouping of the respondents, their frequencies and percentage were worked out.

3.11.2 Frequency and percentage analysis

After grouping the respondents into various categories, percentage analysis was used for simple and meaningful interpretation of the data. It is calculated by multiplying the frequency with hundred and further dividing it with total number of respondents.

3.11.3 Mean

The mean is the average of a data set. The mean values were used to compare the two categories of respondents for their independent and dependent variables.

3.11.4 Standard deviation

Standard deviation was used to quantify the amount of dispersion in a data set. It is the positive square of the squared deviations taken from the arithmetic mean.

3.11.5 Karl Pearson Correlation

Karl Pearson Correlation was used to determine the relationship between the dependent variable and independent variables.

3.11.6 Chi square analysis

Chi square analysis was used to find the relationship between categorical variables and the dependent variables.

3.11.7 Regression analysis

The regression analysis was used to find the functional relationship between two variables.

3.12. HYPOTHESIS

A research hypothesis is a conjectural statement of the relation between two or more variables (Kerlinger, 1973). A hypothesis must be testable to allow a verification or falsification. The null hypothesis set for the study were there exists no significant relationship between independent variables and effectiveness of online agricultural technology transfer.

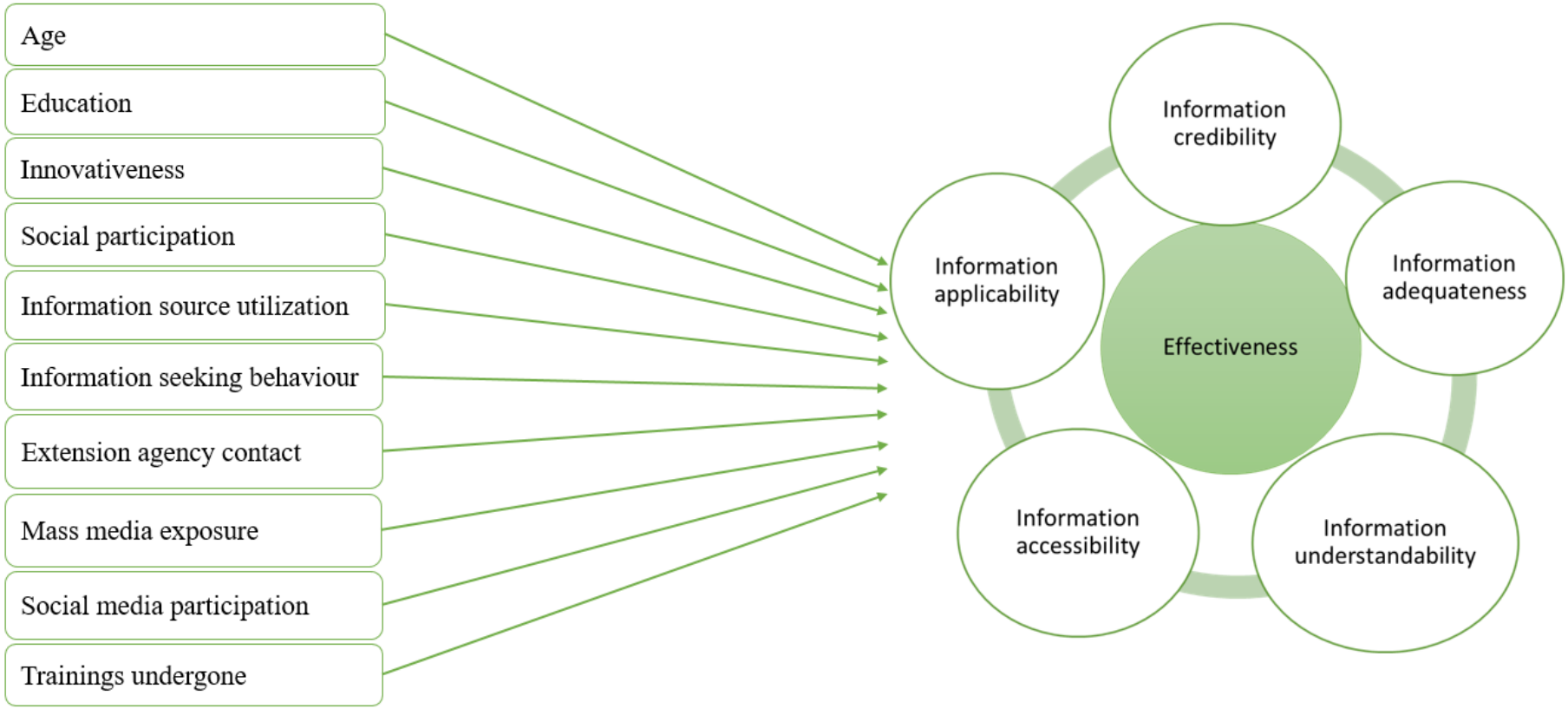

Fig.1. Conceptual model of the study

RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

This chapter highlights the findings of the study in line with the objectives. They are categorized under the following subheadings.

4.1. Distribution of respondents based on socio economic characteristics

4.2. Effectiveness of online agricultural technology transfer

4.3. Correlation analysis between profile characteristics of farmers and dependent variable

4.4. Methods adopted for online technology transfer

4.5. Constraints faced during online agricultural technology transfer

4.6. Blended learning package for online agricultural technology transfer

4.7. Suggestions for improving the effectiveness of online agricultural technology transfer

4.8. Empirical model of the study

4.9. Future lines of research

4.10. Validation of hypothesis

4.1. DISTRIBUTION OF RESPONDENTS BASED ON SOCIO ECONOMIC CHARACTERISTICS

Results based on the respondents' personal and social characteristics that were selected through judges rating are presented below.

4.1.1. Age

Age was operationalized as the number of years completed by the respondent at the time of investigation. Table 2 presents the distribution of respondents based on their age.

Table 2. Distribution of respondents based on their age

N=100

Sl. No	Category (years)	Frequency	Percentage
1	Young age	26	26
2	Middle age	51	51
3	Old age	23	23
	Q1= 42 Min= 25 Q3= 55 Max= 68		Mean= 47.99 SD= 9.31

From the analysis of Table 2 it is evident that majority of the respondents (51%) surveyed belonged to the middle age category, followed by respondents in young age (26%) and old age (23%). Mean age of respondents was found to be 47.99 years with minimum age being 25 and maximum being 68. Similar findings were revealed by Hashem *et al*. (2021).

4.1.2. Education

Education was operationally defined as the number of years of formal education completed by the farmer. The respondents were grouped into different categories based

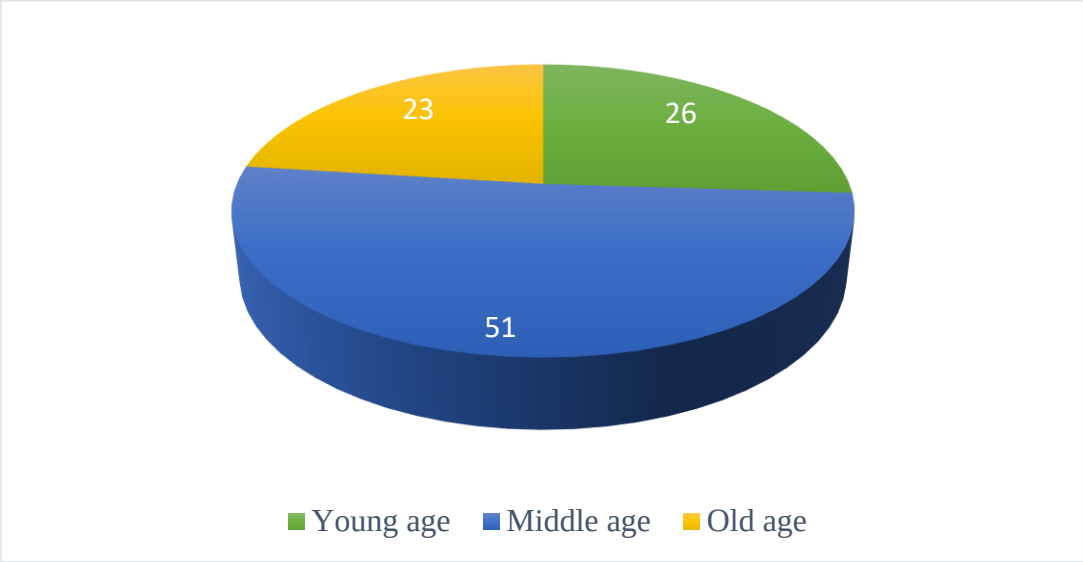

Fig. 2. Distribution of respondents based on their age

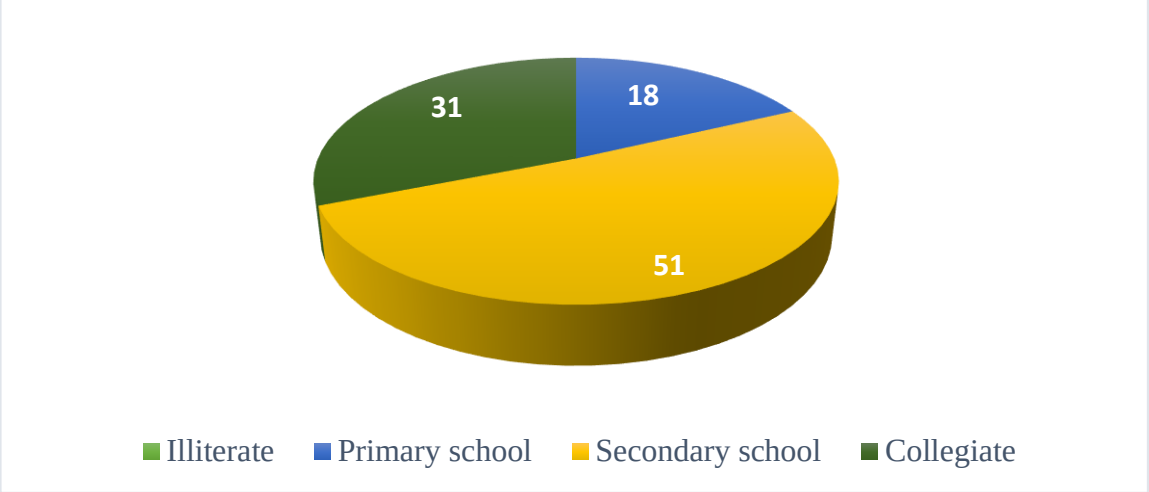

Fig. 3. Distribution of respondents based on their education

on their level of education as illiterate, primary school, secondary school and collegiate. Table 3 presents the distribution based on their education.

Table 3. Distribution of respondents based on their education

N=100

Sl. No	Category	Frequency	Percentage
1	Illiterate	0	0
2	Primary school	18	18
3	Secondary school	51	51
4	Collegiate	31	31

From the analysis of Table 3 it was inferred that all the respondents were literate with educational qualification ranging from primary school to collegiate. Among the respondents surveyed, 51 per cent were with educational qualification of secondary school, followed by collegiate (31%) and primary school (18%). Famers with higher educational qualifications would be having better exposure to online methods of agricultural technology transfer. The results obtained are in par with Paul (2022) in her study on effectiveness of e-marketing of cardamom.

4.1.3. Innovativeness

Innovativeness was defined as the degree to which an individual is prompt in adopting a new practice and introducing changes into their operations if found practical and feasible. Categorization according to the innovativeness is presented in Table 4.

Table 4. Distribution of respondents based on innovativeness

N=100

Sl. No	Category	Frequency	Percentage
1	Low	22	22
2	Medium	49	49
3	High	29	29
	Q1= 18 Min= 13 Q3=22 Max= 25		Mean= 19.84 SD=3.04

From the table 4 it can be inferred that majority of farmers were having medium level of innovativeness (49%), followed by high (29%) and low (22%). Educated people with mass media exposure, social media participation and high extension agency contact tend to adopt innovations earlier than others. The findings of the study are in accordance with results of Rahman (2015).

4.1.4. Social participation

Social participation is defined as the degree of involvement of farmers in various activities and programmes of social organizations. Table 5 presents the distribution of respondents based on their social participation.

Table 5. Distribution of respondents based on social participation

N=100

Sl. No	Category		Frequency	Percentage
1	Low		22	22
2	Medium		50	50
3	High		28	28
	Q1= 15 Q3=21	Min= 10 Max= 17	Mean= 17.88 SD=3.98	

From table 5 it can be inferred that majority of the respondents (50%) had medium social participation, followed by high (28%) and low (22%).

Table 6 & 7 shows the distribution of respondents based on nature of participation and frequency of participation.

Table 6. Distribution of respondents based on nature of participation

Category	Percentage

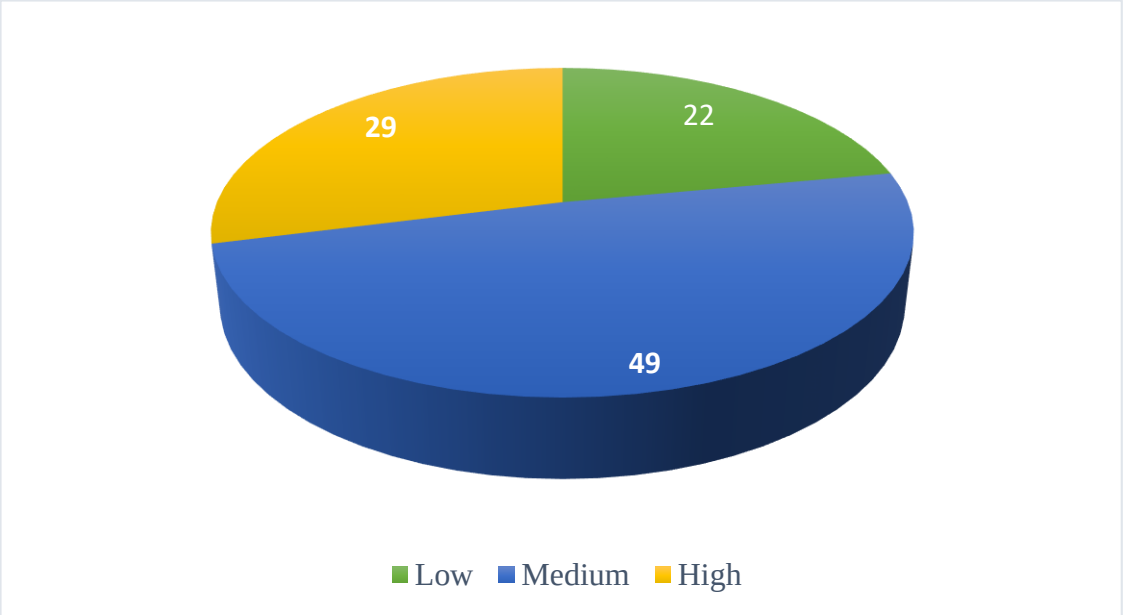

Fig. 4. Distribution of respondents based on their innovativeness

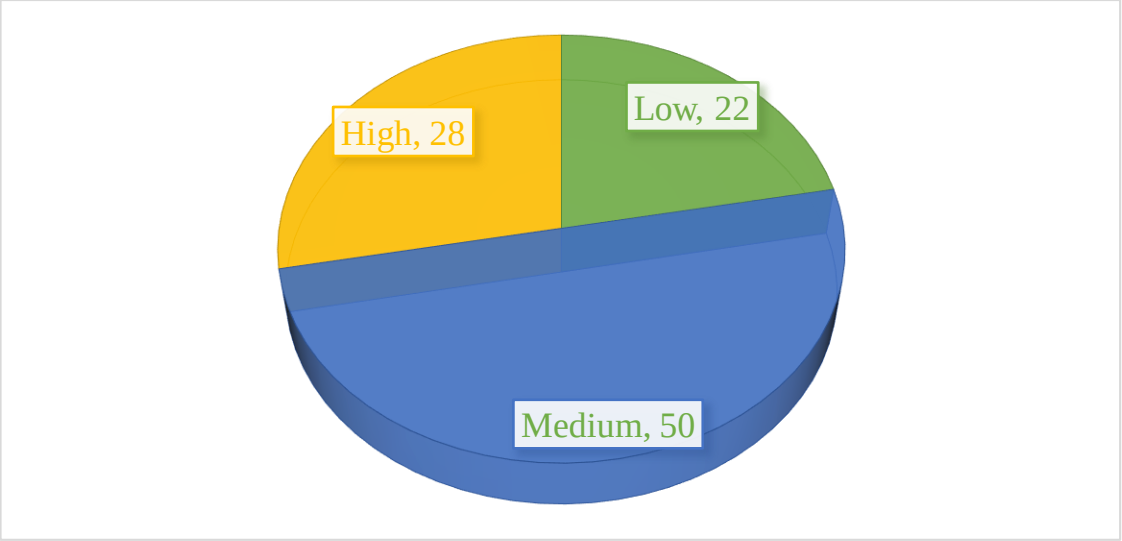

Fig. 5. Distribution of respondents based on their social participation

Not a member	54.4
Member	39.6
Office bearer	6

Table 7. Distribution of respondents based on frequency of participation

Category	**Percentage**
Never	23.6
Occasionally	46.8
Regularly	29.6

39.6 per cent of the respondents were members of the different organizations and 54.4 percent were not a member in any organization. Only 6 per cent were office bearers. In case of participation 46.8 per cent occasionally participated in meetings and 29.6 percent regularly attended the meetings. Percentage of respondents never attended meetings was low (23.6%).

It can be inferred that for the respondents who were having membership either in one or more than one organizations, these organization might act as ample source of latest information and technologies. Low social participation might deprive the farmers to exchange their views about latest information and technologies. Ultimately the effectiveness of online agricultural technology transfer may depend upon the social participation. Similar findings were observed by Islam (2015).

4.1.5. Information source utilization

Information source utilization is operationally defined as the sources from which respondent receives relevant information on farming during COVID-19. Distribution of respondents based on information source utilization was identified and are presented in Table 8.

Table 8. Distribution of respondents based on their information source utilization

N=100

Sl. No	Category	Frequency	Percentage
1	Low	24	24
2	Medium	49	49
3	High	27	27
	Q1= 37 Min= 19 Q3= 46 Max= 52	Mean= 40.8 SD=7.13	

A critical analysis of Table 8 reveals that 49 per cent of the respondents exhibited medium level of information source utilization pattern followed by 27 per cent of respondents with high utilization of information sources. Among the farmers, 24 per cent fall in the category of low utilization of information sources. It can be inferred that higher percentage of the respondents (49%) had medium level of information source utilization.

Table 9. Distribution of respondents according to sources utilized and their frequency

Sources	Most often		Often		Sometimes		Rarely	
	F	%	F	%	F	%	F	%
Farm publications	39	39	31	31	27	27	3	3
Television	60	60	31	31	7	7	2	2
Films	39	39	38	38	14	14	9	9
News paper	94	94	3	3	2	2	1	1
Agricultural exhibitions	20	20	27	27	42	42	11	11
Research scientists	10	10	43	43	33	33	14	14
Agricultural officers	54	54	31	31	9	9	6	6
Agricultural assistants	56	56	28	28	10	10	6	6
Progressive farmers	40	40	33	33	25	25	2	2
Neighbors	37	37	43	43	15	15	5	5
Friends	44	44	41	41	12	12	3	3
Family	38	38	43	43	16	16	3	3
Relatives	26	26	45	45	23	23	6	6

Majority of the respondents sought information from newspaper and television and considered it easily accessible source of information due to the COVID-19 scenario.

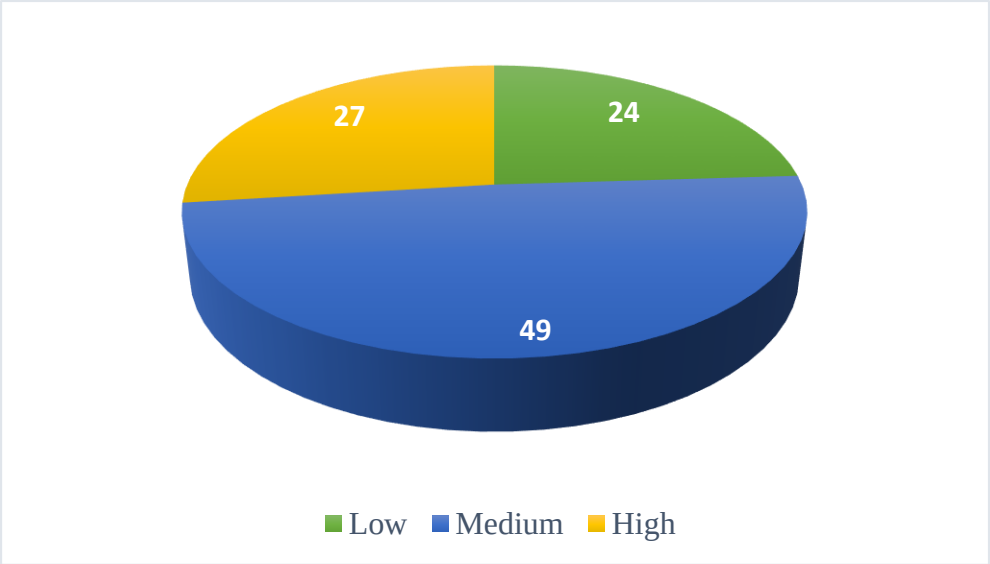

Fig. 6. Distribution of respondents based on their information source utilization

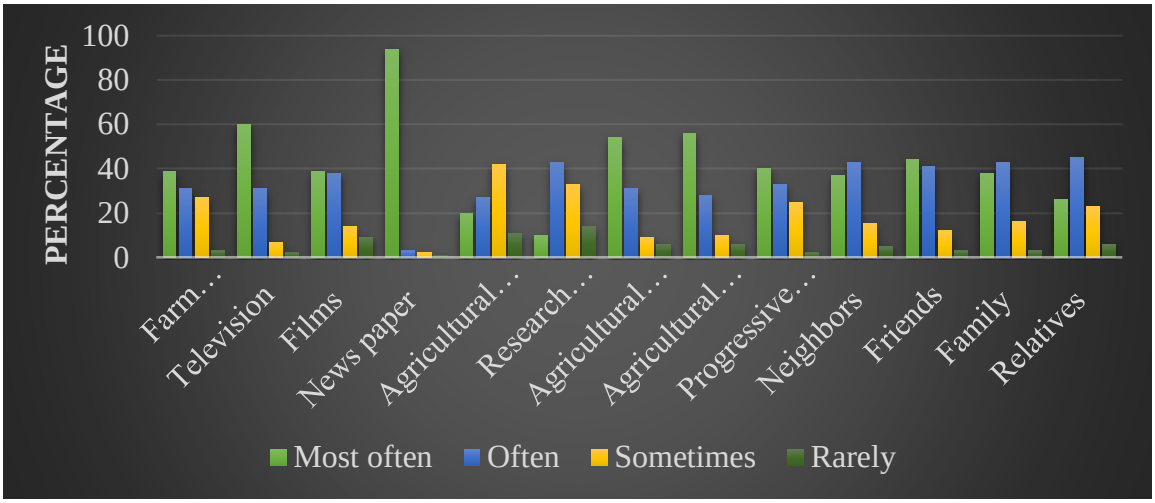

Fig. 7. Distribution of respondents according to sources utilized and their frequency

Other source consulted by the respondents in decreasing trend of information source utilization were agricultural assistants, agricultural officers, friends, progressive farmers, farm publications and films, family, neighbours, relatives, agricultural exhibitions and research scientists.

4.1.6. Information seeking behaviour

Information seeking behavior is defined as the view of farmers on search and use of data sources based on frequency of participation, extent of usefulness of various sources of information. Table 10 presents the distribution of respondents based on their information seeking behavior.

Table 10. Distribution of respondents based on information seeking behavior

N=100

Sl. No	Category		Frequency	Percentage
1	Low		24	24
2	Medium		45	45
3	High		31	31
	Q1= 27	Min= 18	Mean= 29.84	
	Q3= 33	Max= 40	SD= 4.75	

On perusal of Table 10 it is observed that 45 per cent of the respondents mainly fall into medium level of information seeking behaviour, followed by 31 per cent and 24 per cent in high and low level of information seeking respectively.

Table 11. Distribution of respondents based on frequency of information seeking

Sources	Regularly		Once in fortnight		Whenever problem arise		Never	
	F	%	F	%	F	%	F	%

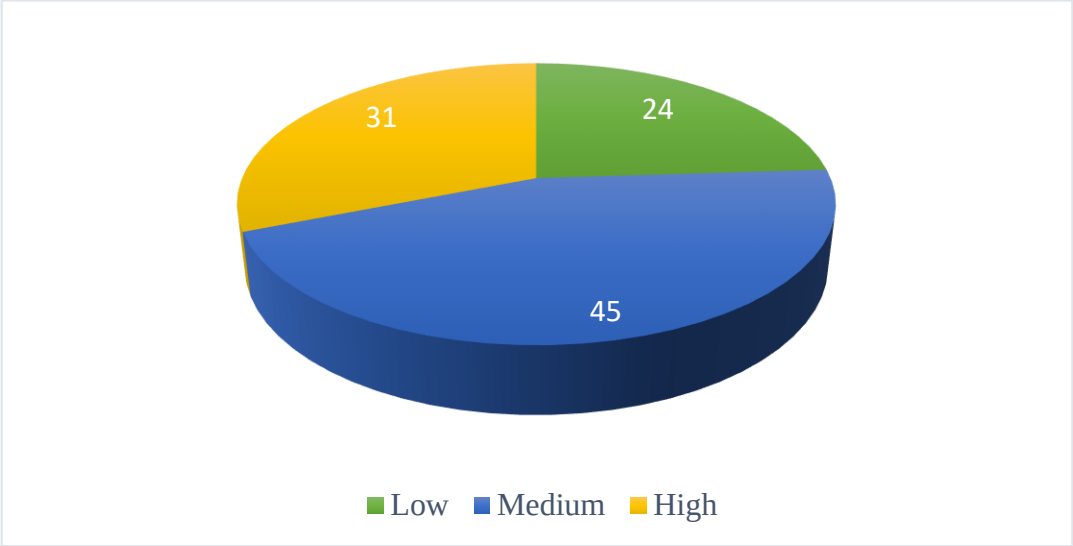

Fig. 8. Distribution of respondents based on their information seeking behaviour

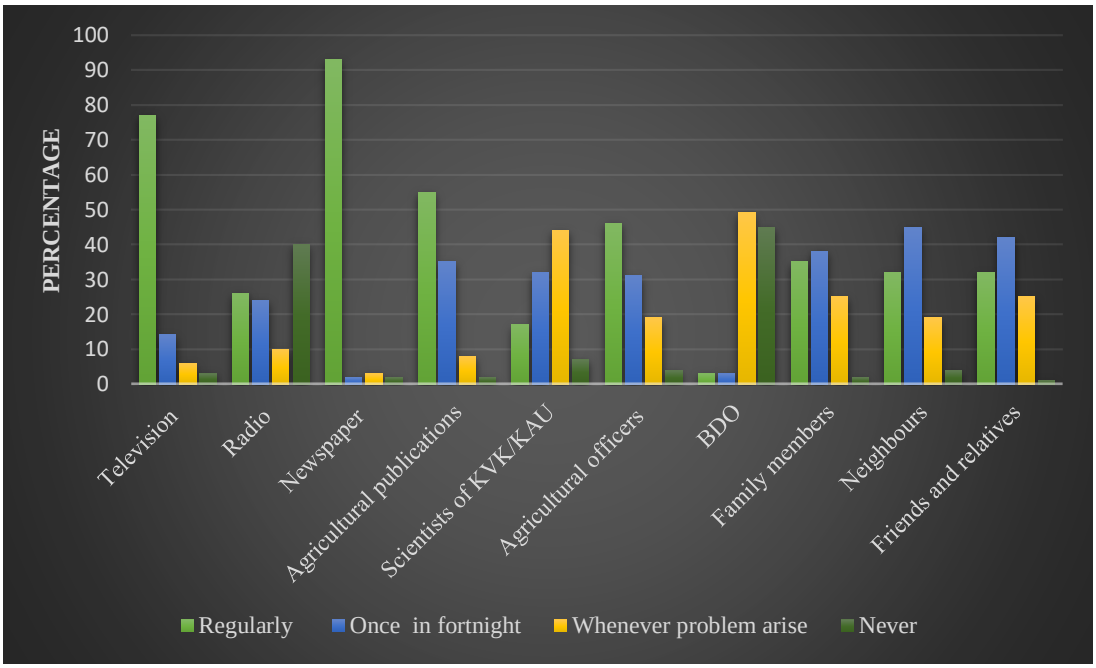

Fig. 9. Distribution of respondents based on frequency of information seeking

Television	77	77	14	14	6	6	3	3
Radio	26	26	24	24	10	10	40	40
Newspaper	93	93	2	2	3	3	2	2
Agricultural publications	55	55	35	35	8	8	2	2
Scientists of KVK/KAU	17	17	32	32	44	44	7	7
Agricultural officers	46	46	31	31	19	19	4	4
BDO	3	3	3	3	49	49	45	45
Family members	35	35	38	38	25	25	2	2
Neighbours	32	32	45	45	19	19	4	4
Friends and relatives	32	32	42	42	25	25	1	1

Table 11 indicates that major source of information for the respondents were newspaper followed by television and agricultural publications. 93 per cent of the respondents regularly used newspapers, may be due to the fact that it was cheap and easy to obtain. The results of the study showing medium information seeking behaviour are in line with the findings of Kavithaa (2014) and Kassem *et al*. (2021).

4.1.7. Extension agency contact

Extension agency contact is operationalized as the degree of contact of farmers with various agricultural officials for acquiring information on farming and other activities. The distribution of respondents based on their contact and frequency of contact with different extension agencies were recorded and are shown in Table 12 and 13 respectively.

Table 12. Distribution of respondents based on extension agency contact

N=100

Sl. No	Category	Frequency	Percentage
1	Low	15	15

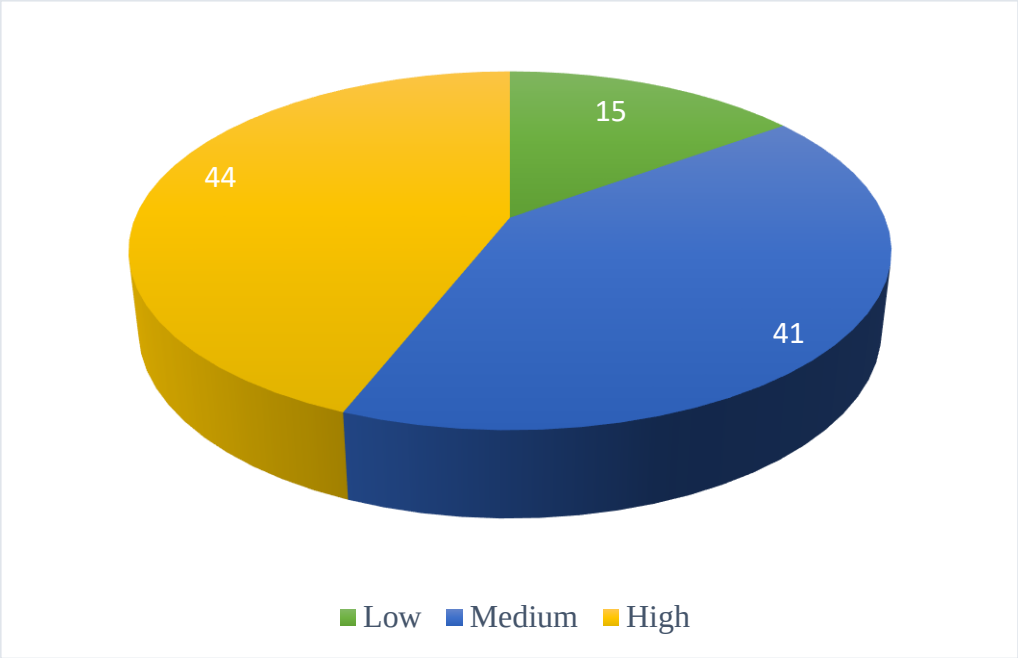

Fig. 10. Distribution of respondents based on their extension agency contact

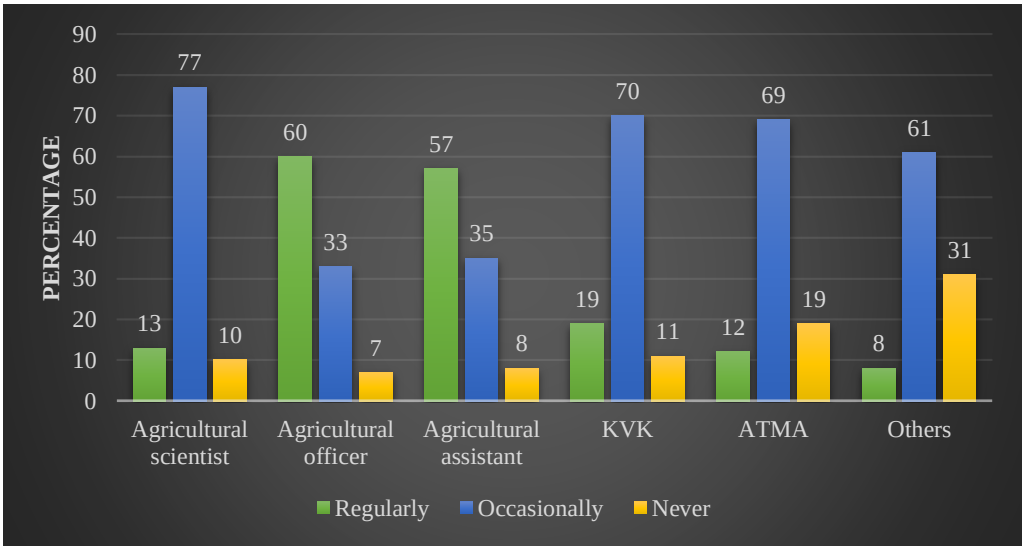

Fig. 11. Distribution of respondents according to the frequency of extension agency contact

2	Medium		41	41
3	High		44	44
	Q1= 11 Q3= 14	Min= 7 Max= 18		Mean= 12.83 SD= 2.53

It is evident from Table 12 that, majority of the respondents had high extension agency contact (44%) followed by medium (41%) and low (15%).

Table 13. Distribution of respondents based on frequency of extension agency contact

N=100

Category	**Regularly**		**Occasionally**		**Never**	
	F	**%**	**F**	**%**	**F**	**%**
Agricultural scientist	13	13	77	77	10	10
Agricultural officer	60	60	33	33	7	7
Agricultural assistant	57	57	35	35	8	8
KVK	19	19	70	70	11	11
ATMA	12	12	69	69	19	19
Others	8	8	61	61	31	31

Table 13 revealed that majority of the respondents had regular contact with agricultural officer (60%) and agricultural assistant (57%). More than sixty percent of respondents occasionally contacted agricultural scientists (77%), KVK (70%) and ATMA (69%).

It can be concluded that majority of the respondents consider extension agencies as a source of updating knowledge and skills which ultimately leads to building self-confidence. The contact with various extension agencies may widen the versatility of an individual. Greater the extension contact, more will be the scope for developing the potential to make use of the available information and technologies to maximize the output from farming activities. The results of the study showing higher extension agency contact is on par with observation of Patel *et al*. (2018) in their study relationship between attitude of farmers towards FIG and their profile in Anand district of Gujarat, indicating medium to high extension contact.

4.1.8. Mass media exposure

Mass media exposure is defined as the extent to which farmer is exposed to different mass media channels such as radio, television, newspaper, information material and farm magazines *etc*. Table 14 presents the distribution of respondents based on their exposure to mass media.

Table 14. Distribution of respondents based on their mass media exposure

N=100

Sl. No	Category		Frequency	Percentage
1	Low		20	20
2	Medium		50	50
3	High		30	30
	Q1= 18 Q3=21	Min= 13 Max= 24	Mean= 19.16 SD=2.44	

It is evident from Table 14 that 50 per cent of the respondents had medium level of mass media exposure. While 30 per cent of the respondents had high mass media exposure and 20 per cent respondent had low level of mass media exposure.

Table 15. Distribution of respondents based on frequency of mass media used

Category	Regularly		Occasionally		Never	
	F	%	F	%	F	%
Radio	16	16	50	50	34	34
Newspaper	93	93	7	7	0	0
Television	67	67	30	30	3	3
Farm magazines	65	65	35	35	0	0
Bulletins	17	17	74	74	9	9
Books	33	33	61	61	6	6
Films	27	27	62	62	11	11
Social media	62	62	37	37	1	1

Table 15. Indicates that 93 percent of the respondents regularly used newspaper followed by television (67%), farm magazines (65%) and social media (62%).

The results indicates that most of the farmers were in medium category of mass media exposure. The reason might be that information reaches rapidly among the respondents through mass media which will make a large number of farmers aware about latest

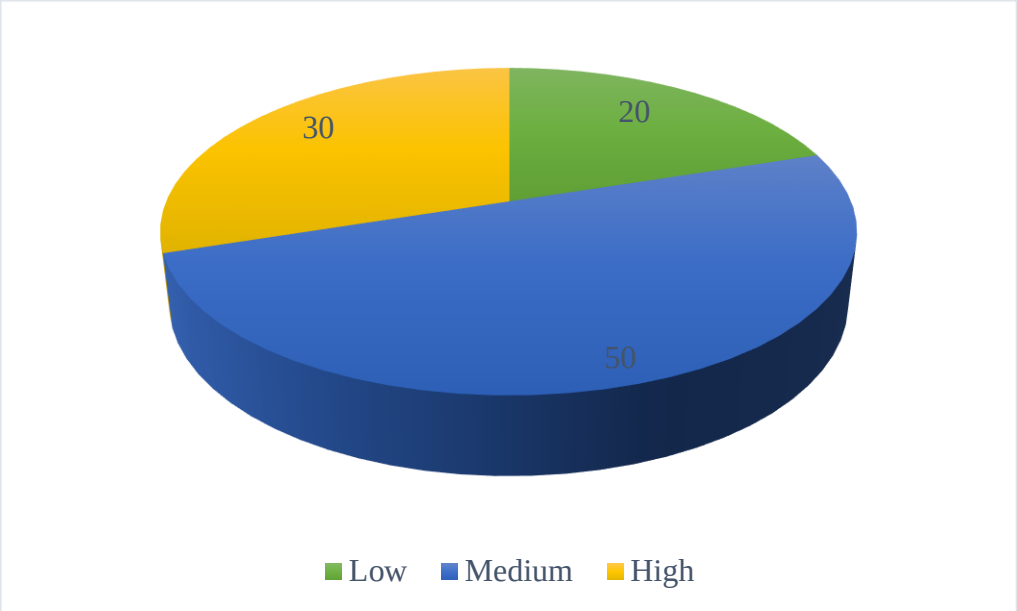

Fig. 12. Distribution of respondents based on their mass media exposure

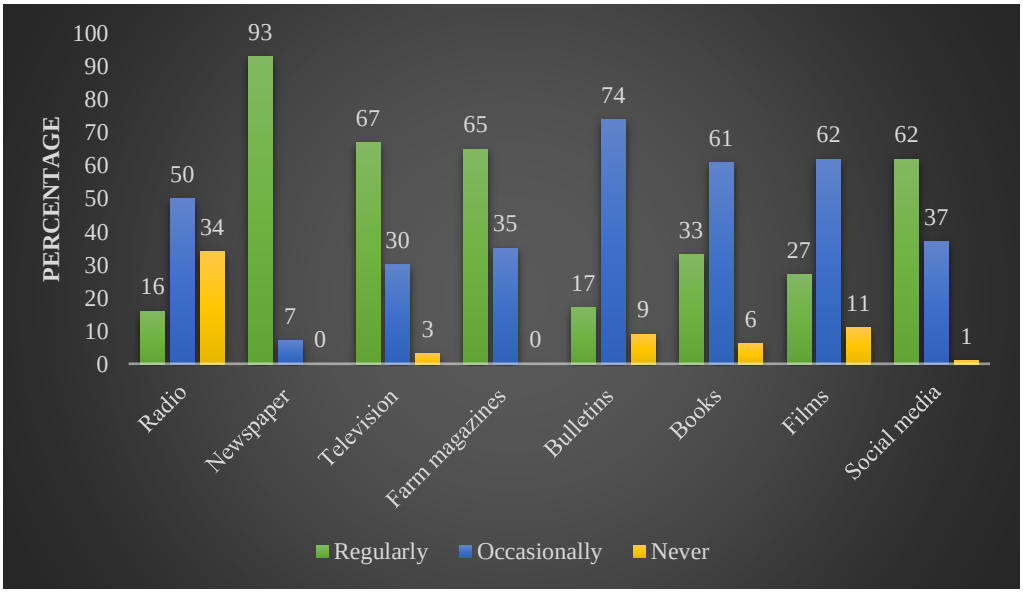

Fig. 13. Distribution of respondents based on their frequency of mass media exposure

information or technologies. It can be inferred that more than half of the respondents were utilizing various media of information, which indicated that the farmers exhibited enthusiasm in understanding various methods of agricultural technology transfer through online mode. The result of the study is on par with the findings of Roy *et al*. (2018).

4.1.9. Social media participation

Social media participation is defined as the extent to which the farmers take part or become involved in the social media. Table 16 presents the distribution of respondents according to their social media participation.

Table 16. Distribution of respondents based on their social media participation

N=100

Sl. No	Category	Frequency	Percentage
1	Low	18	18
2	Medium	49	49
3	High	33	33
	Q1= 9 Min= 6 Q3=12 Max= 18		Mean= 10.92 SD=2.56

From the Table 16 it can be inferred that majority of the farmers had medium level of social media participation (49%) followed by high (33%) and low (18%).

Table 17. Distribution of respondents based on the frequency of social media participation

Category	Regularly		Occasionally		Never	
	F	%	F	%	F	%
Facebook	30	30	44	44	26	26
Instagram	5	5	18	18	77	77
Twitter	5	5	11	11	84	84
Telegram	13	13	34	34	53	53
Whatsapp	80	80	19	19	1	1

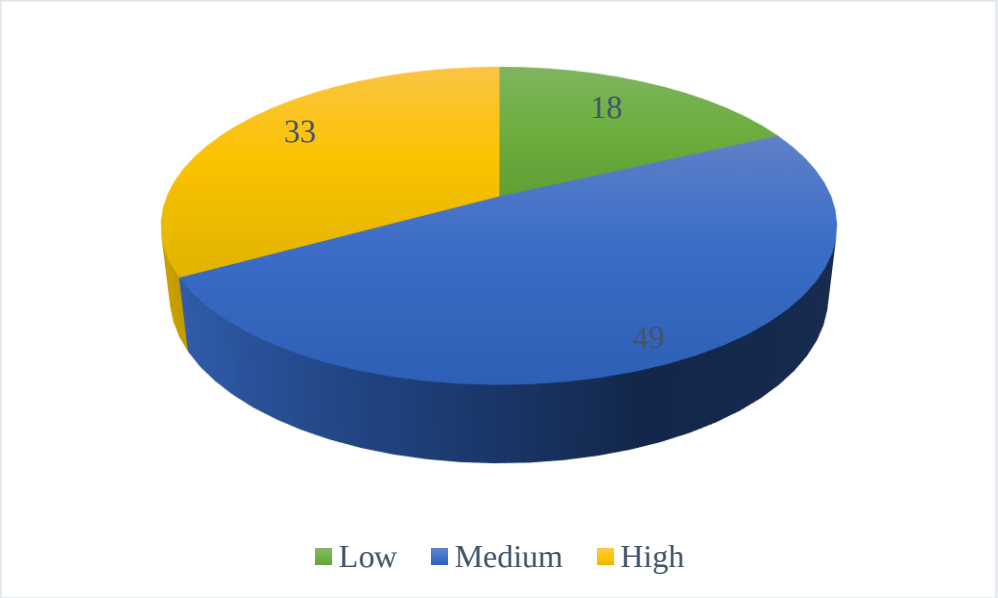

Fig. 14. Distribution of respondents based on their social media participation

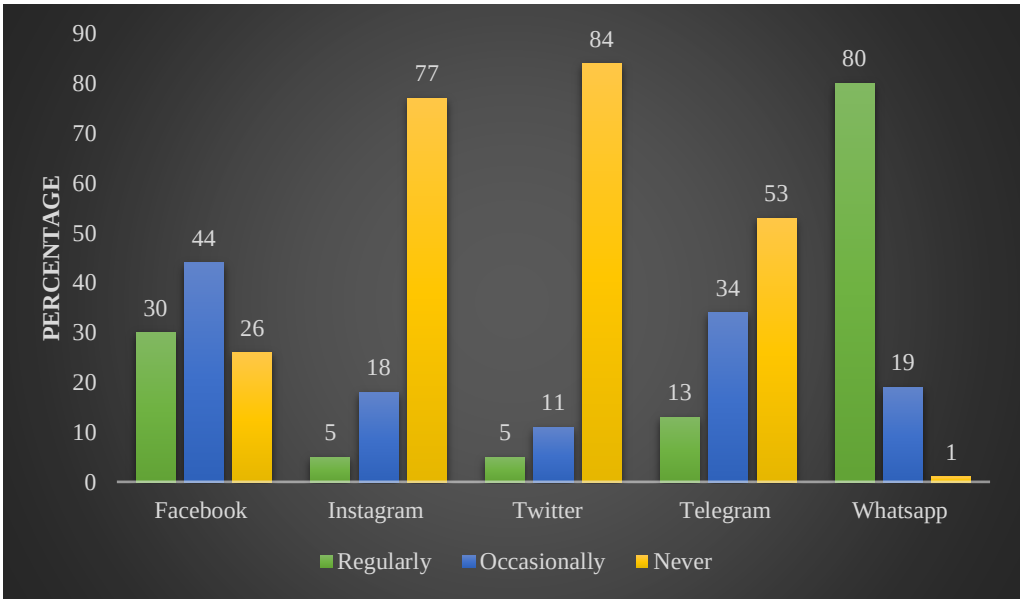

Fig. 15. Distribution of respondents based on their frequency of social media participation

It is clear from Table 17 that 80 per cent of respondents regularly used Whatsapp followed by facebook (30%). Instagram and twitter were the least used social media channels.

Table 18. Distribution of respondents based on time spent on social media

Time	Frequency	Percentage
1hour	20	20
2-3hours	60	60
3-5hours	20	20
More than 5hours	0	0

Table 18 revealed that majority of the farmers (60%) spent 2-3 hours in social media followed by 3-5 hours (20%) and lowest for 1 hour (20%).

Improved internet connectivity in rural areas, affordability of smartphones, cheaper data packages and increasing awareness about online methods might be the reason for the results. The results of the study are in line with the findings of Mishra *et al*. (2022).

4.1.10. Trainings undergone

Operationally defined as the number of days of online training received during COVID-19 period. Table 19 presents the distribution of respondents according to the numbers of trainings undergone.

Table 19. Distribution of respondents according to trainings undergone

N=100

Sl. No	Training received	Frequency	Percentage
1	1	5	5
2	2-4	62	62
3	>5	33	33

Data in Table 19 revealed that majority of respondents (62%) undergone 2-4 number of trainings. 33 per cent of the respondents attended more than five trainings, followed by

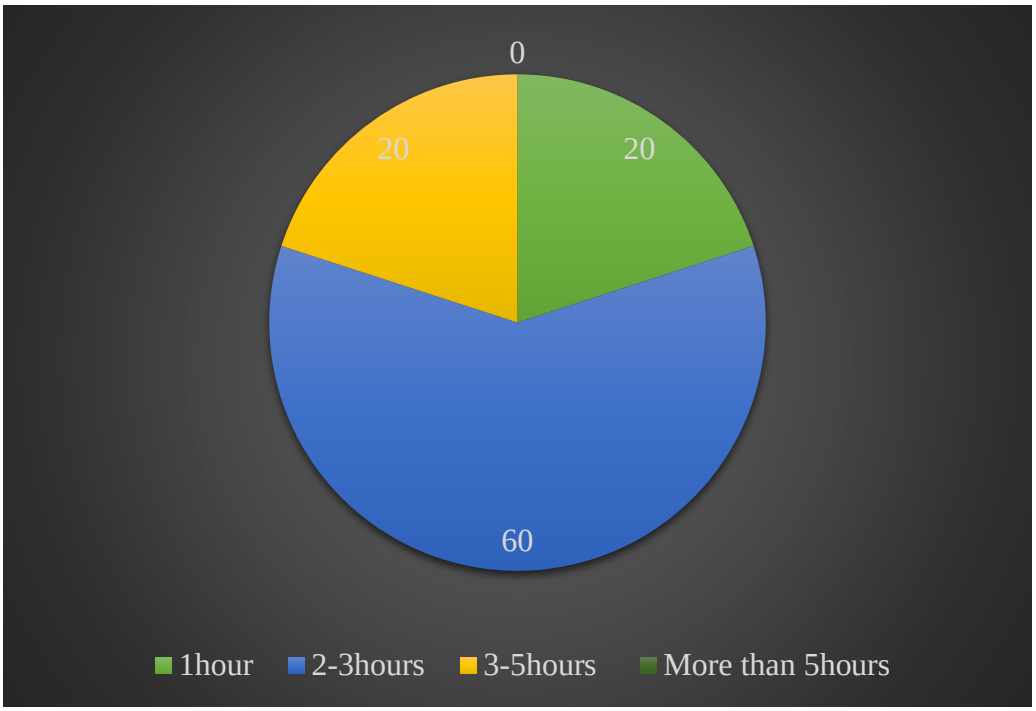

Fig. 16. Distribution of respondents based on time spent on social media

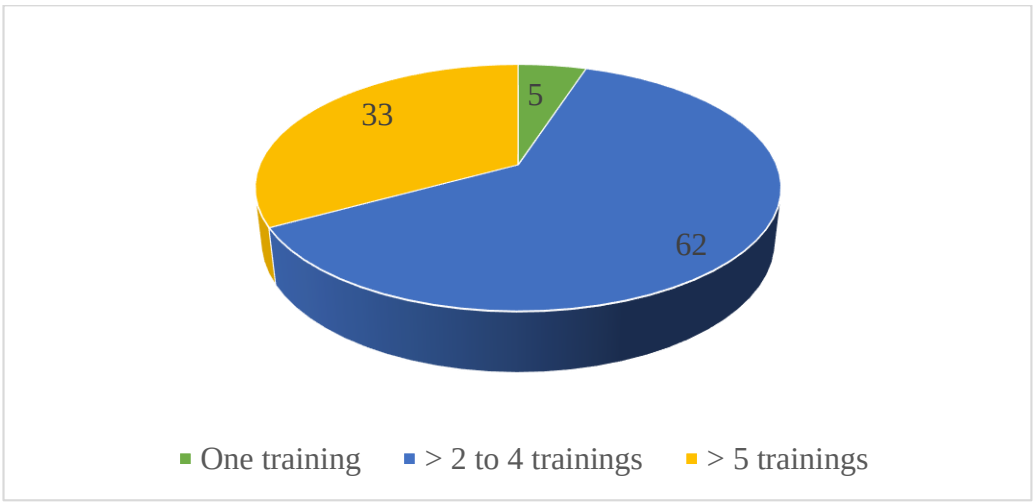

Fig. 17. Distribution of respondents based on trainings undergone

5 percent respondents had attended only one training. The result might be because of the medium level of information source utilization and majority of respondents were middle and old aged who were not much proficient in handling digital devices and online platforms. With increased familiarity and experience, farmers would develop a positive attitude towards the transfer of agricultural technology through online platforms, leading to improved effectiveness. Similar findings were observed by Islam (2015).

4.2. Effectiveness of online agricultural technology transfer

4.2.1. Analysis of dimensions of effectiveness of online agricultural technology transfer

Effectiveness of online agricultural technology transfer was operationally defined as the degree to which the agricultural information obtained through online methods are useful in producing a desired result in farm related activities. In this study five dimensions of effectiveness of online agricultural technology transfer includes information credibility, information adequateness, information understandability, information accessibility and information applicability. Quartiles were used for categorizing the respondents based on the dimensions of effectiveness of online agricultural technology transfer. The results are presented below.

Table 20 presents the distribution of respondents based on the dimensions of perceived effectiveness of online agricultural technology transfer

Table 20. Distribution of respondents based on dimensions of perceived effectiveness of online agricultural technology transfer

N=100

Sl. No.	Dimension	Categories	Frequency	Percentage
1	Information credibility	Low (≤ 15)	19	19
		Medium (>15 - ≤ 17.75)	56	56

		High (>17.75)	25	25
2	Information adequateness	Low (≤ 15)	22	22
		Medium (>15 - ≤ 18)	50	50
		High (>18)	28	28
3	Information understandability	Low (≤ 13)	21	21
		Medium (>13 - ≤ 18)	52	52
		High (>18)	27	27
4	Information accessibility	Low (≤ 11)	19	19
		Medium (>11 - ≤ 16)	55	55
		High (>16)	26	26
5	Information applicability	Low (≤ 15)	7	7
		Medium (>15 - ≤ 18)	66	66
		High (>18)	27	27

Table 20 indicates that majority of the respondents (56%) had a medium credibility on the information provided through online methods. Similarly 25 per cent and 19 per cent respondents had high and low level of information credibility. Credibility of the information provided may influence the adoption of latest agricultural technologies as farmers think them as worthy. For majority of the respondents (50%) adequateness of information provided through online methods were medium. Similarly 28 per cent had high level of information adequateness followed by low (22%).

Respondents were classified into three categories as low, medium, and high based on their comprehension of the information provided. The medium category had the highest percentage of respondents at 52 per cent, followed by high at 27 per cent, and low at 21 per cent. Similarly 55 per cent of respondents falls in medium category based on information accessibility. 26 per cent of respondents had high information accessibility and 19 per cent had low accessibility to the information provided through online methods. Based on the last dimension i.e. information applicability, 66 per cent of respondents rated ToT through online mode having only medium level of applicability, followed by high (27%) and low (7%).

Distribution of respondents based on the perceived effectiveness of online agricultural technology transfer are presented on table 21.

Table 21. Distribution of respondents based on perceived effectiveness of online agricultural technology transfer

N=100

Sl. No.	**Category**	**Frequency**	**Percentage**
1	Low ($\leq$ 38.96)	24	24
2	Medium(>38.96 - $\leq$ 73.31)	51	51
3	High (> 73.31)	25	25
Q1= 38.96	Min= 20.56	Mean= 54.95	
Q3= 73.31	Max= 100	SD= 20.68	

It is evident from the Table that the effectiveness of online agricultural technology transfer fall under medium category (51%) followed by high (25%) and remaining in the low category (24%). By the online agricultural technology transfer farmers were influenced moderately. To improve the effectiveness, training programs on ICT tools

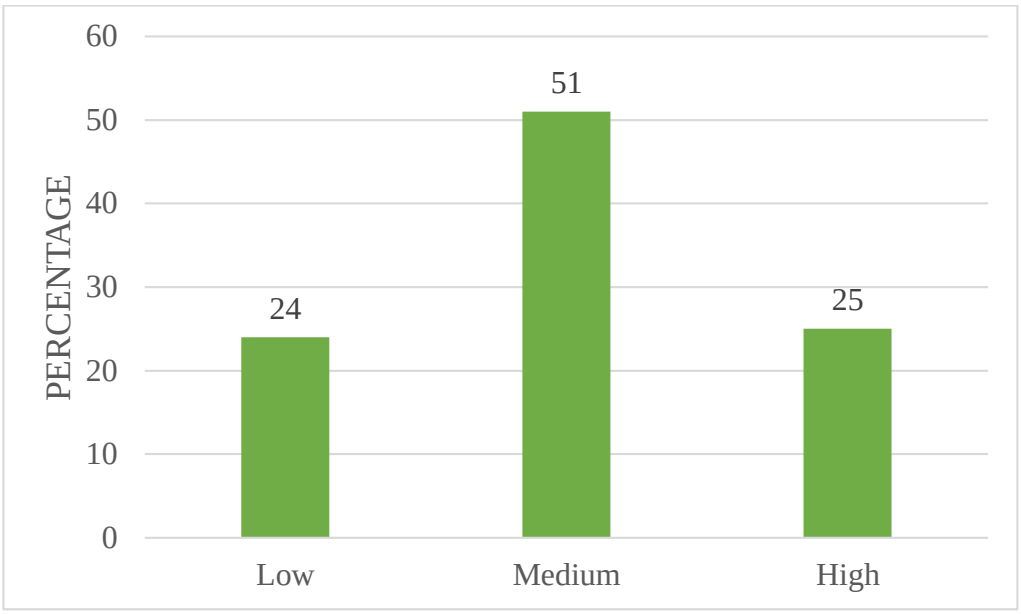

Fig. 18. Distribution of respondents based on effectiveness of online agricultural technology transfer

and online methods should be ensured and that will make online agricultural technology transfer highly effective. The findings of the study are in line with the results of Khan *et al.* (2017).

4.3. CORRELATION ANALYSIS BETWEEN PROFILE CHARACTERISTICS OF FARMERS AND DEPENDENT VARIABLE

4.3.1. Relationship between effectiveness of online agricultural technology transfer and independent variables

A correlation study was done to analyze the relationship of the profile characteristics of farmers with effectiveness of online agricultural technology transfer. The coefficient of correlation of the profile characteristics with effectiveness have been furnished in Table 22.

Table 22. Correlation between effectiveness of online agricultural technology transfer and independent variables

Sl. No.	Independent variables	Correlation coefficient (r)
1	Age	-0.569***
2	Innovativeness	0.125NS
3	Social participation	0.333***
4	Information source utilization	0.265**
5	Information seeking behaviour	0.376***
6	Extension agency contact	0.221*
7	Mass media exposure	0.299**
8	Social media participation	0.467***

[*** Correlation is significant at 0.001 level, ** Correlation is significant at 0.01 level and *Correlation is significant at 0.05 level, NS – Non Significant]

From the above table it is clear that variables like social participation, information seeking behavior and social media participation had positive and significant relationship with effectiveness of online agricultural technology transfer at 0.001 level. Whereas two variables namely information source utilization and mass media exposure were positively and significantly correlated at 0.01 level of significance. The variable extension agency contact had positive and significant relationship at 0.05 level. Increased contact with extension functionaries, social participation, exposure to mass media, and access to various information sources result in farmers utilizing online methods more frequently for agricultural technology transfer, networking with experts and peers. It was also inferred that age had negative and significant association with the perceived effectiveness of online agricultural technology transfer. Innovativeness had no significant relationship with effectiveness. This might be due to the fact that during COVID-19 pandemic farmers irrespective of their level of innovativeness had no other choices rather than adopting online classes and trainings. The analysis revealed that farmers with high social participation, information source utilization, information seeking behavior, extension agency contact, mass media exposure and social media participation had better effectiveness of online agricultural technology transfer.

A chi square analysis was done to find the relationship of the profile characteristics of farmers with effectiveness of online agricultural technology transfer. The factors that associated are presented in the table below.

Table 23. Association of education and trainings undergone with effectiveness of online agricultural technology transfer

Sl. No.	Categorical variables		Low	Medium	High	$\chi 2$ (calculated)	P
1	Education	Collegiate	3	14	14	20.727	0.00035

		Secondary school	11	29	11		
		Primary school	10	8	0		
		Illiterate	0	0	0		
2	Trainings undergone	1	2	20	2	12.8542	0.01201
		2-4	2	32	17		
		>5	1	10	14		

From the table 23 it is clear that variables education and trainings undergone had a positive and significant relationship at 0.05 per cent level of significance. Education is an important determinant of intensity of adoption of online methods for agricultural technology transfer by farmers. Education makes farmers more capable of understanding the benefits of online methods and make their better utilization. Number of trainings undergone may influence the farmers and helps them to incorporate latest technologies in their farming activities.

The regression analysis was carried out to find the relationship between the dependent and independent variables. The major findings are presented in the below.

Table 24. Association of age with effectiveness of online agricultural technology transfer

Variable	t value	P value

Age	-3.679	0.000

Review of the above table reveals that age had significant but negative relationship with effectiveness of online agricultural technology transfer. It is clear from the results that perceived effectiveness was higher among young and middle aged farmers. As the age of the respondents increases the perceived effectiveness tends to decrease. This might be due to the fact that young farmers uses a greater number of online methods as compared to old farmers.

4.4 METHODS ADOPTED FOR ONLINE TECHNOLOGY TRANSFER

4.4.1. Online methods used by farmers

Various online methods have been used to transmit the agricultural information to farmers. Different methods used by farmers for gaining agricultural information includes digital devices, digital platforms and digital applications.

4.4.1.1 Digital devices used by farmers

Digital devices are those devices that can receive, process and send digital information such as mobile phones, laptop, computers and tablets. Distribution of farmers based on the frequency of use of digital devices are presented in table 25.

Table 25. Distribution of farmers based on the frequency of use of digital devices for online agricultural technology transfer

N=100

Digital devices	**Frequency of use**									
	Never		**Rarely**		**Sometimes**		**Often**		**Most often**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Smartphone	2	2	1	1	2	2	33	33	62	62
Laptop	36	36	24	24	22	22	13	13	5	5

Desktop	68	68	16	16	7	7	4	4	5	5
Tablet	80	80	11	11	5	5	2	2	2	2
Smartphone+ laptop	48	48	28	28	16	16	7	7	1	1
Smartphone + desktop	73	73	13	13	4	4	7	7	1	1
Laptop + tablet	80	80	14	14	1	1	4	4	1	1
Desktop + tablet	85	85	8	8	2	2	4	4	1	1

The results presented in table 25 reveals the details of various digital devices used by farmers. The table shows that smartphone was the most common digital device used by all the respondents. Panda *et al*. (2019) found that 90 per cent of the farmers have access to mobile phones. That could be the reason why the respondents most often used smartphone for online agricultural technology transfer. Among the respondents 22 per cent indicated that sometimes they used a laptop to access information. Tablet and desktop were the least used digital devices by the farmers.

4.4.1.2. Digital platforms used by farmers

Digital platforms are the digital space that provides facilities for users to interact digitally. Distribution of farmers based on the frequency of use of different digital platforms are presented in the table 26.

Table 26. Distribution of farmers based on the frequency of use of digital platforms for online agricultural technology transfer

N=100

Digital platforms	**Frequency of use**									
	Never		**Rarely**		**Sometimes**		**Often**		**Most often**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Google meet	1	1	3	3	5	5	47	47	44	44

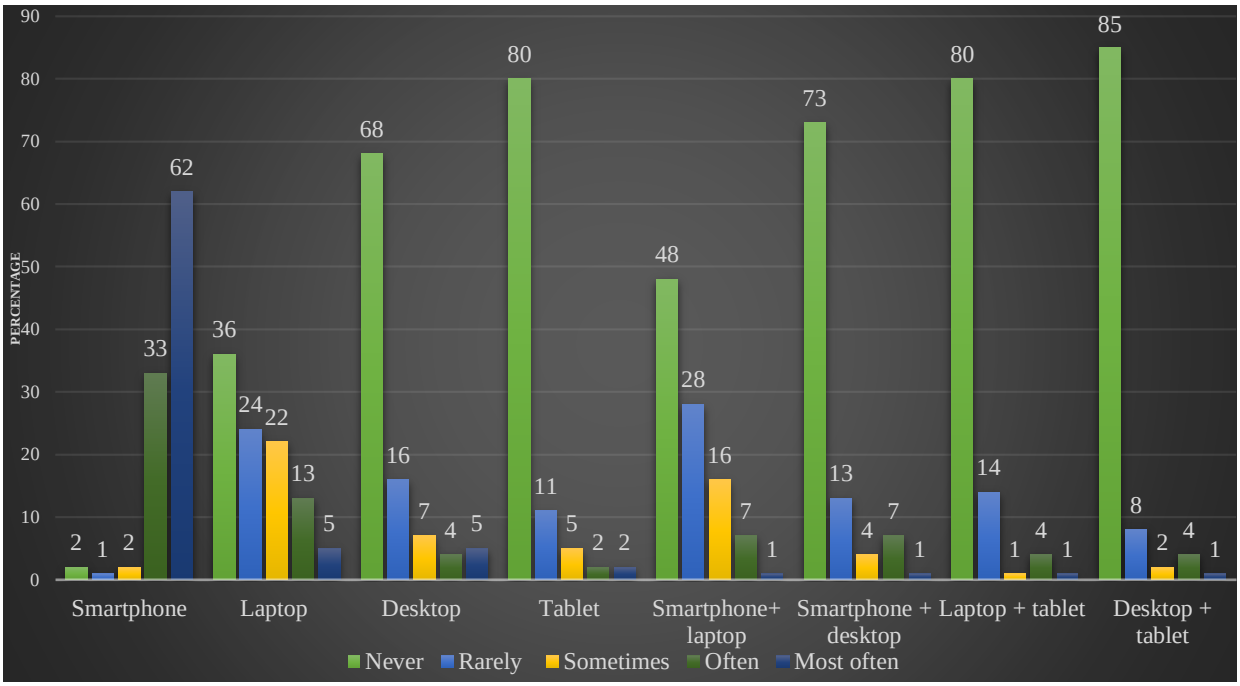

Fig. 19. Distribution of farmers based on frequency of use of Digital devices

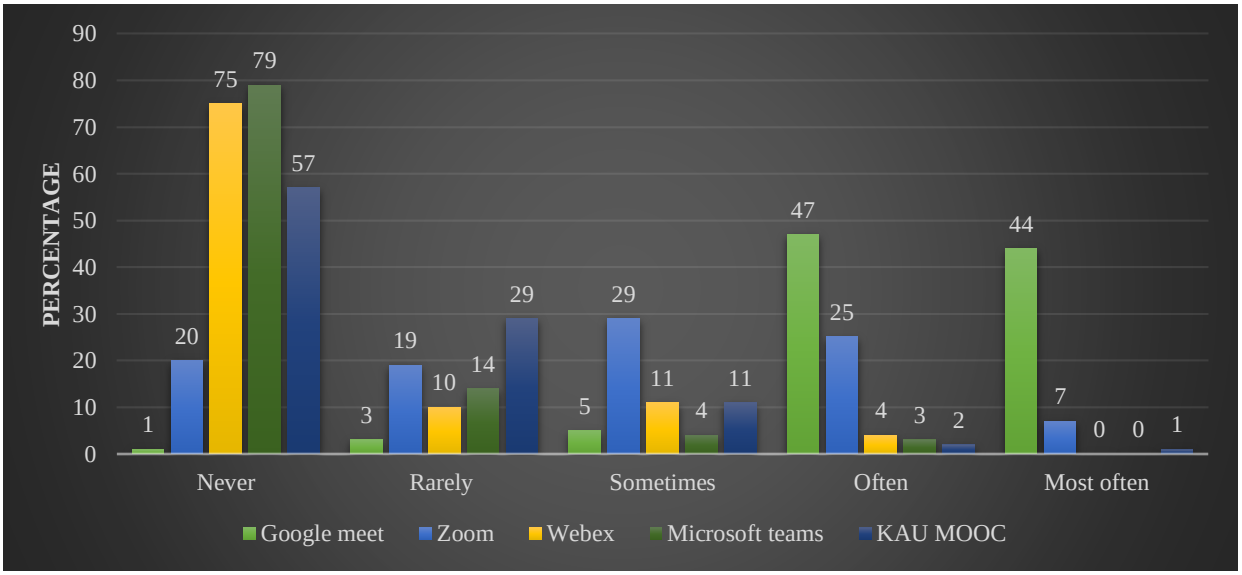

Fig. 20. Distribution of farmers based on frequency of use of Digital platforms

Zoom	20	20	19	19	29	29	25	25	7	7
Webex	75	75	10	10	11	11	4	4	0	0
Microsoft teams	79	79	14	14	4	4	3	3	0	0
KAU MOOC	57	57	29	29	11	11	2	2	1	1

Data from the table revealed that Google Meet was the digital platform which was used by the farmers most often, followed by Zoom. This might be because these applications can be applied easily by downloading in the smartphones. Majority of the respondents never used platforms like Webex, Microsoft teams and KAU MOOC.

Distribution according to frequency of use of Google meet and Zoom by farmers is given in table 27.

Table 27. Distribution based on frequency of use of Google meet and Zoom by farmers N=100

Frequency of digital platform used	F	%
Only Google meet were used	25	25
Only zoom were used	4	4
90% Google meet and 10% zoom were used	31	31
70% Google meet and 30% zoom were used	25	25
50% Google meet and 50% zoom were used	15	15
90% zoom and 10% Google meet were used	0	0
70% zoom and 30% Google meet were used	0	0

Table 27 indicates that 31 per cent of the farmers opined that 90 per cent Google meet and 10 per cent Zoom were used for attending online classes and trainings. For online sessions 25 per cent of the respondents used only Google meet. The reason for preferring Google meet might be that it offers a more user-friendly interface which makes the users comfortable while attending online classes and trainings.

4.4.1.3. Digital applications used by farmers

Digital applications are any application software that can be used in a mobile phone, computer, laptop or tablets. These can be accessed from any digital devices with internet connection. Distribution of farmers according to use of digital applications are detailed in the table 28.

Table 28. Distribution of farmers according to use of digital applications for online agricultural technology transfer

N=100

Digital applications	Frequency of use									
	Never		Rarely		Sometimes		Often		Most often	
	F	%	F	%	F	%	F	%	F	%
Whatsapp	0	0	1	1	1	1	41	41	57	57
Facebook	11	11	12	12	34	34	34	34	9	9
Instagram	65	65	17	17	13	13	2	2	3	3
Telegram	35	35	42	42	17	17	3	3	3	3
Twitter	72	72	20	20	5	5	2	2	1	1
YouTube	0	0	2	2	30	30	43	43	25	25
Agri related apps	11	11	20	20	45	45	23	23	1	1

Among the digital applications, 57 per cent of the respondents most often used Whatsapp followed by YouTube (25%) for agricultural technology transfer. The reason for selecting these applications for agricultural technology transfer might be the popularity and ease of use compared to other digital applications.

4.4.2. Online methods used by extension personnel

Various online methods have been used to transmit the agricultural information to farmers. Different methods used by extension personnel for agricultural technology transfer includes digital devices, digital platforms and digital applications.

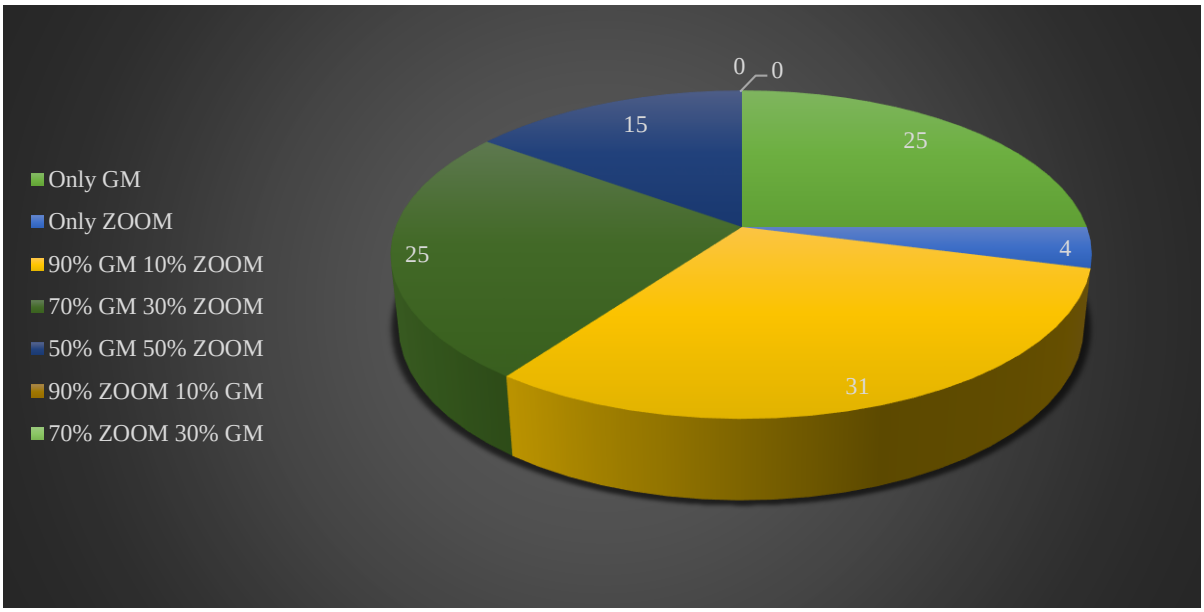

Fig. 21. Distribution of farmers based on frequency of use of Google Meet and Zoom

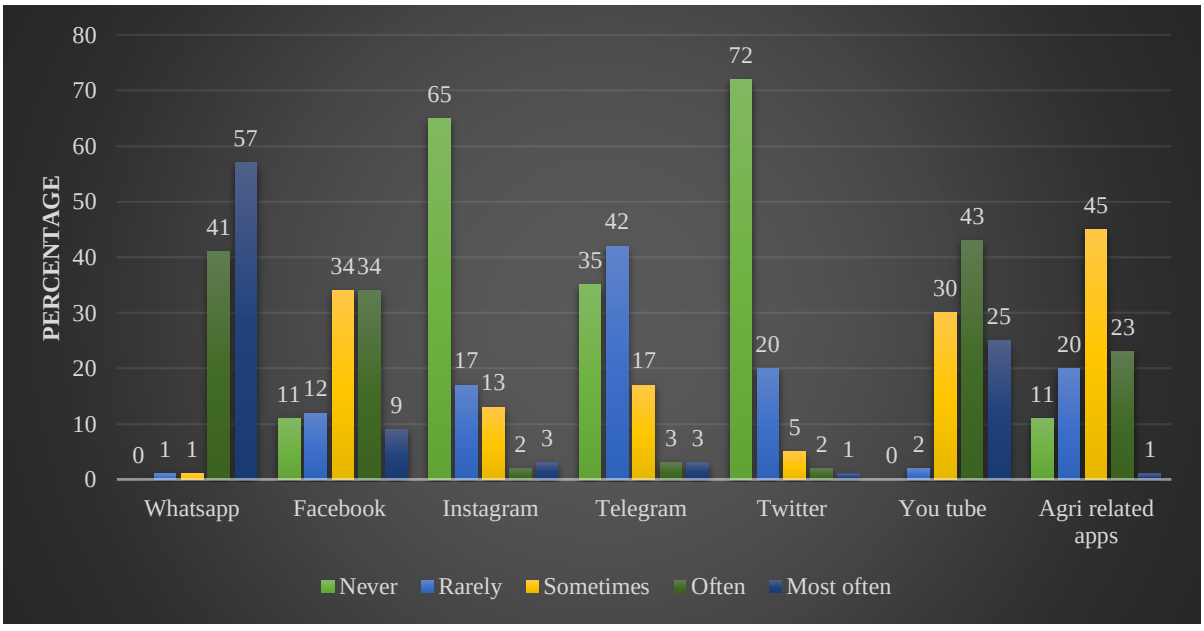

Fig. 22. Distribution of farmers based on frequency of use of Digital applications

4.4.2.1. Digital devices used by extension personnel

Distribution of extension personnel based on the frequency of use of digital devices are presented in table 29.

Table 29. Distribution of extension personnel based on the frequency of use of digital devices for online agricultural technology transfer

N=100

Digital devices	**Frequency of use**									
	Never		**Rarely**		**Sometimes**		**Often**		**Most often**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Smartphone	0	0	0	0	6	12	13	26	31	62
Laptop	0	0	0	0	6	12	21	42	23	46
Desktop	2	4	14	28	16	32	8	16	10	20
Tablet	33	66	8	16	4	8	5	10	0	0
Smartphone+ laptop	2	4	7	14	18	36	23	46	0	0
Smartphone + desktop	11	22	8	16	18	30	10	20	6	12
Laptop + tablet	39	78	4	8	4	8	3	6	0	0
Desktop + tablet	36	72	11	22	3	6	0	0	0	0

Analysis of table 29 reveals that smart phones were used most often by 62 per cent of the extension personnel. 46 per cent of the respondents indicated that they most often uses a laptop for taking online trainings and classes for farmers. A combination of both smartphone and laptop has also been used often by majority of the extension personnel for online agricultural technology transfer. Desktop and tablets were the least used digital devices among extension personnel also.

4.4.2.2. Digital platforms used by extension personnel

Distribution of extension personnel based on the frequency of use of digital platforms are presented in table 30.

Table 30. Distribution of extension personnel based on the frequency of use of digital platforms for online agricultural technology transfer

N=100

Digital platforms	Frequency of use									
	Never		Rarely		Sometimes		Often		Most often	
	F	%	F	%	F	%	F	%	F	%
Google meet	0	0	0	0	0	0	18	36	32	64
Zoom	0	0	1	2	17	34	24	48	8	16
Webex	9	18	20	40	15	30	6	12	0	0
Microsoft teams	19	38	25	50	6	12	0	0	0	0
KAU MOOC	12	24	15	30	20	40	1	2	2	4

Data from table 30 reveals that Google meet was used most often by majority of the respondent (64%), followed by Zoom (16%). Majority of the respondents rarely used Webex, Microsoft teams and KAU MOOC.

Distribution according to frequency of use of Google meet and Zoom by extension personnel is given in table 31.

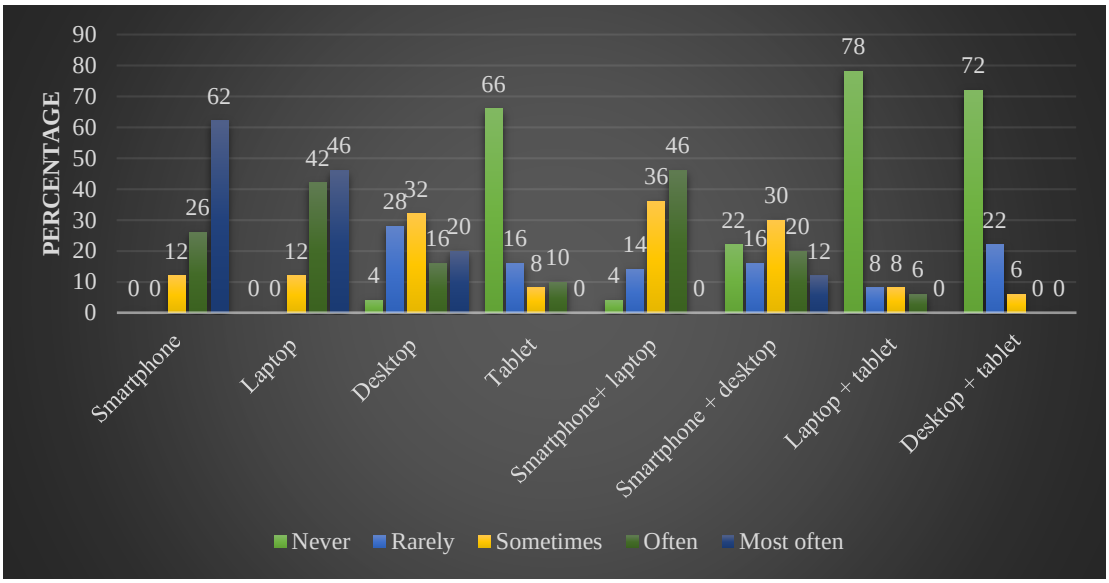

Fig. 23. Distribution of extension personnel based on frequency of use of Digital devices

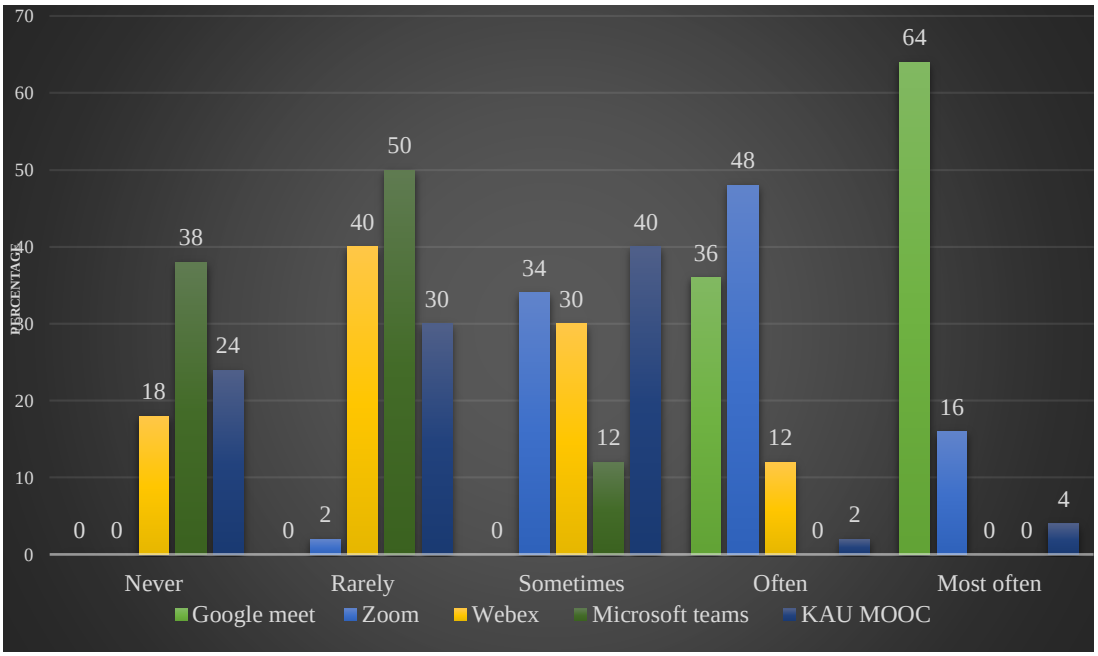

Fig. 24. Distribution of extension personnel based on frequency of use of Digital platforms

Table 31. Distribution according to the frequency of use of Google meet and Zoom by extension personnel

N=100

Frequency of digital platform used	F	%
Only Google meet were used	0	0
Only zoom were used	0	0
90% Google meet and 10% zoom were used	22	44
70% Google meet and 30% zoom were used	23	46
50% Google meet and 50% zoom were used	5	10
90% zoom and 10% Google meet were used	0	0
70% zoom and 30% Google meet were used	0	0

Table 31 indicates that 46 per cent of the extension personnel opined that 70 per cent Google meet and 30 percent Zoom were used for taking online classes and trainings for farmers. 44 per cent of the respondents used 90 per cent Google meet and 10 per cent Zoom. 10 per cent of the extension personnel used 50 per cent Google meet and 50 per cent Zoom for online agricultural technology transfer.

4.4.2.3. Digital applications used by extension personnel

Distribution of extension personnel according to use of digital applications are detailed in the table 32.

Table 32. Distribution of extension personnel according to use of digital applications for online agricultural technology transfer

N=100

Digital applications	Frequency of use									
	Never		Rarely		Sometimes		Often		Most often	
	F	%	F	%	F	%	F	%	F	%
Whatsapp	0	0	0	0	0	0	13	26	37	74
Facebook	4	8	10	20	8	16	21	42	7	14
Instagram	14	28	21	42	13	26	2	4	0	0
Telegram	15	30	5	10	22	44	6	12	2	4

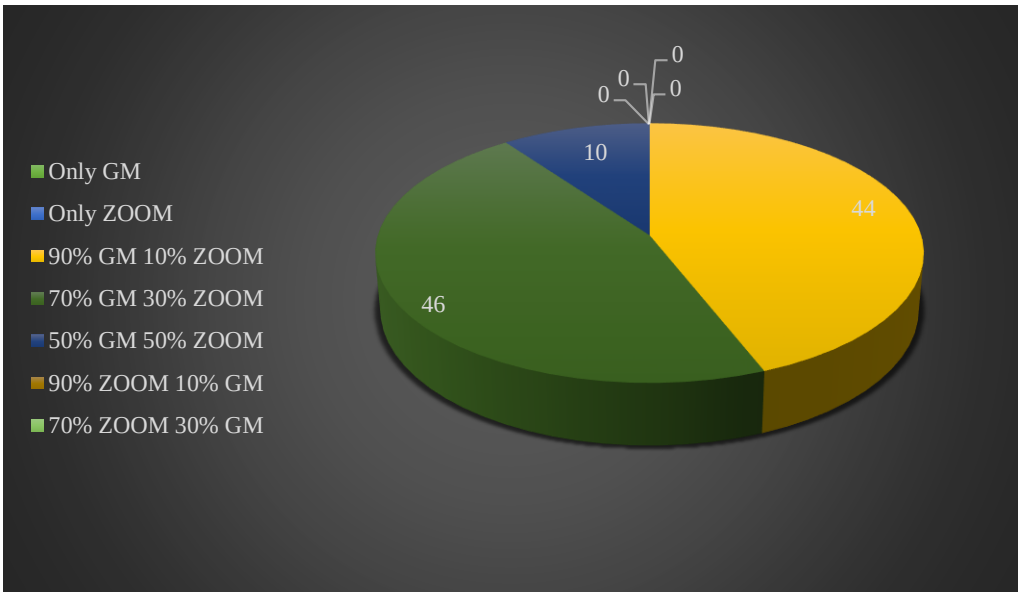

Fig. 25. Distribution of extension personnel based on frequency of use of Google Meet and Zoom

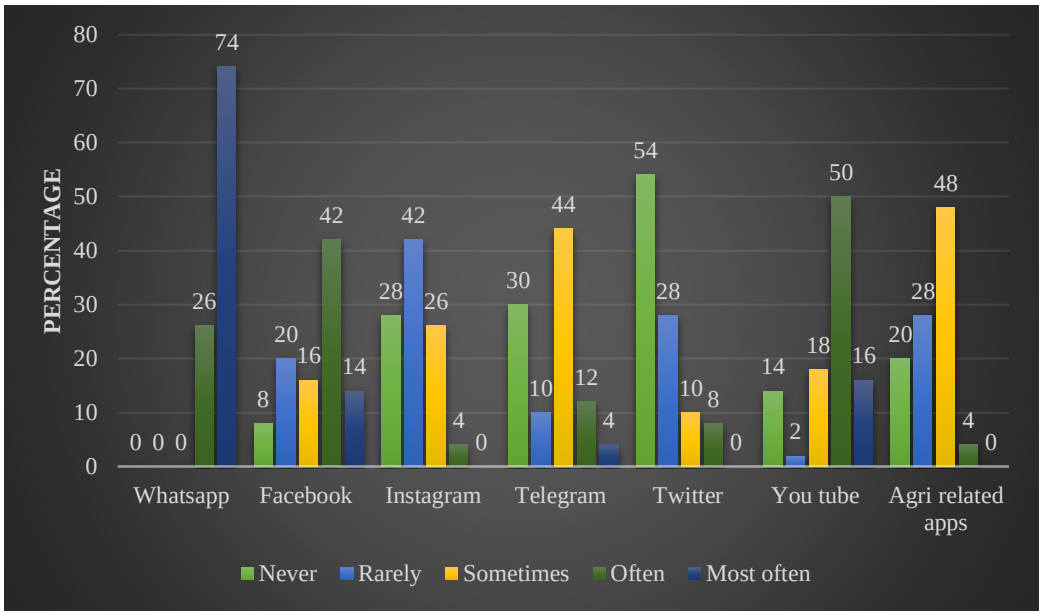

Fig. 26. Distribution of extension personnel based on frequency of use of Digital applications

Twitter	27	54	14	28	5	10	4	8	0	0
You tube	7	14	1	2	9	18	25	50	8	16
Agri related apps	10	20	14	28	24	48	2	4	0	0

Among the digital applications Whatsapp was the most popularly used digital application among the respondents compared to Facebook, Instagram, telegram and twitter. 74 per cent of the respondents most often used Whatsapp for agricultural technology transfer. Majority of the respondents never used twitter, instagram and telegram.

The findings regarding the different online methods used by extension personnel for agricultural technology transfer are in line with the results of Nyarko and Kozari (2021).

4.5 CONSTRAINTS FACED DURING ONLINE AGRICULTURAL TECHNOLOGY TRANSFER

Constraints experienced by the farmers and extension officials during online agricultural technology transfer were identified and were then ranked with mean score for each. The constraints experienced by famers and extension officials are presented in table 33 and table 34 respectively.

Table 33. Constraints faced by farmers during online agricultural technology transfer

Sl. No	Constraint	Total score	Mean score	Rank in class	Rank in total
a.	**Constraints in availability of online technology transferring methods**				
1	Poor internet connectivity	413	4.13	1	1
2	Poor quality of content provided	265	2.65	4	16
3	Information were not received in time	258	2.58	5	17

4	Lack of satisfactory solution for individual problems	370	3.70	2	5
5	Limited availability of devices	352	3.52	3	6
b.	**Constraints in accessibility of online technology transferring methods**				
1	High cost of digital devices	405	4.05	2	3
2	Expensive internet packs	409	4.09	1	2
3	Unstable power connection	384	3.84	3	4
4	Poor conditions of equipment	332	3.32	4	10
5	Health problems	296	2.96	5	15
c.	**Constraints in utilization of online technology transferring methods**				
1	Lack of experience in handling digital devices	335	3.35	2	8
2	Poor knowledge in handling online platforms	333	3.33	3	9
3	Lack of two way interaction	316	3.16	5	12
4	Lack of understanding certain topics which requires practical knowledge	309	3.09	6	13
5	Noise and other physical disturbances	336	3.36	1	7
6	More usage of technical language	323	3.23	4	11
7	Difficulty in making use of given theoretical information	299	2.99	7	14

Table 33 indicates that the most important constraints faced by the farmer respondents were poor internet connectivity, expensive internet packs and high cost of digital devices. The other constraints perceived by respondents in the order of their importance are unstable power connection, lack of satisfactory solution for individual problems, limited availability of devices, noise and other physical disturbances, lack of experience

in handling digital devices, poor knowledge in handling online platforms, poor conditions of equipment, more usage of technical language, lack of two way interaction, lack of understanding certain topics which requires practical knowledge, difficulty in making use of given theoretical information, health problems, poor quality of content provided and information were not received in time.

Out of the five constraints in availability of online technology transferring methods, the first rank was given for poor internet connectivity. The other constraints in availability in order of their importance are lack of satisfactory solution for individual problems, limited availability of devices, poor quality of content provided and information were not received in time.

Out of the constraints in accessibility of online agricultural technology transfer methods, the first rank was given for expensive internet packs. The other constraints in the order of their importance are high cost of digital devices, unstable power connection, and poor conditions of equipment and health problems.

From the constraints in utilization of online agricultural technology transfer methods, noise and other physical disturbances stood first and others were lack of experience in handling digital devices, poor knowledge in handling online platforms, more usage of technical language, lack of two way interaction, lack of understanding certain topics which requires practical knowledge and difficulty in making use of given theoretical information.

Table 34. Constraints faced by extension officials during online agricultural technology transfer

Sl. No	Constraint	Total score	Mean score	Rank
1	Poor infrastructure facilities	192	3.84	2
2	Inadequate staff strength	176	3.52	5
3	Poor internet connectivity	221	4.42	1
4	Lack of training to improve technical knowledge	170	3.4	6
5	Lack of support from authorities	131	2.62	11

6	Poor co-ordination and co-operation among different agencies under same department	145	2.9	9
7	Lack of active participation of farmers	165	3.3	7.5
8	Poor communication skills	139	2.78	10
9	Poor technical skills	165	3.3	7.5
10	Limited availability of devices	181	3.62	3
11	Maintenance problems	179	3.58	4
12	Health problems	113	2.26	12

Table 34 indicates that the major constraints faced by extension official during organizing and implementing online training programs were poor internet connectivity, poor infrastructure facilities and limited availability of devices. The other constraints in the order of their importance are maintenance problems, inadequate staff strength, lack of training to improve technical knowledge, lack of active participation of farmers and poor technical skills, poor co-ordination and co-operation among different agencies under same department, poor communication skills, lack of support from authorities and health problems. The findings of the study are in conformity with the results of Anand *et al*. (2020), Mishra *et al*. (2020) and Yaseen *et al*. (2020).

4.6 BLENDED LEARNING PACKAGE FOR ONLINE AGRICULTURAL TECHNOLOGY TRANSFER

Blended learning is a combination of both online learning and traditional physical class room interactions. Table 35 and table 36 represents the distribution of farmers and extension personnel based on their preference on different modes of learning respectively.

Table 35. Distribution of farmers based on the Preference on mode of learning

Mode of learning	**Most preferred**		**More preferred**		**Preferred**		**Less preferred**		**Least preferred**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**

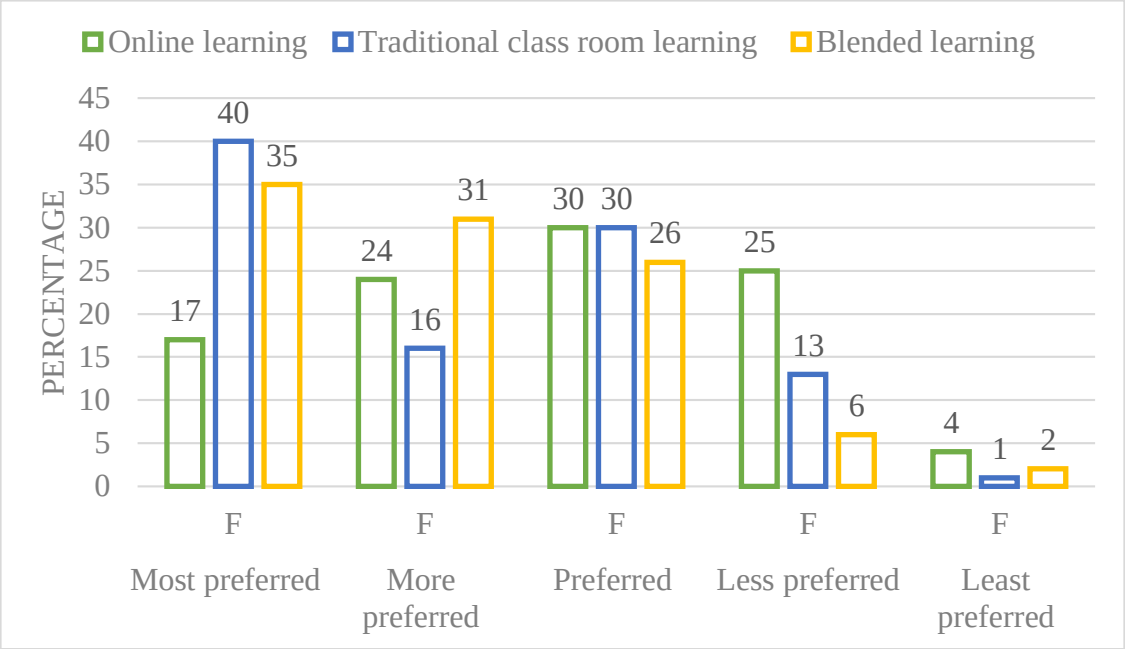

Fig. 27. Distribution of farmers based on their preference on mode of learning

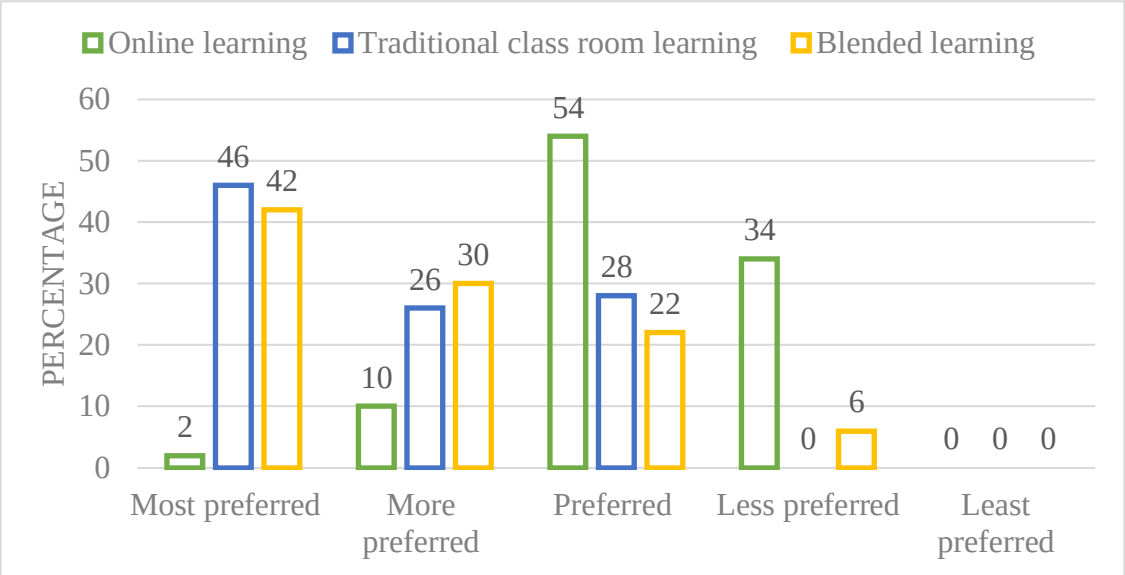

Fig. 28. Distribution of extension personnel based on their preference on mode of learning

Online learning	17	17	24	24	30	30	25	25	4	4
Traditional class room learning	40	40	16	16	30	30	13	13	1	1
Blended learning	35	35	31	31	26	26	6	6	2	2

Table 35 indicates that majority of the farmers mostly prefers traditional class room learning (40%) than the other two modes of learning; followed by blended learning (35%) and online learning (17%).

Table 36. Distribution of extension personnel based on the preference on mode of learning

Mode of learning	**Most preferred**		**More preferred**		**Preferred**		**Less preferred**		**Least preferred**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Online learning	1	2	5	10	27	54	17	34	0	0
Traditional class room learning	23	46	13	26	14	28	0	0	0	0
Blended learning	21	42	15	30	11	22	3	6	0	0

Table 36 indicates that majority of the extension personnel prefers traditional class room learning (46%), followed by blended learning (42%) and online learning (2%).

With the results obtained from the study, discussion with experts and review from similar studies, a blended learning package were delineated. The blended learning package consists of five phases namely; orientation, theory or practical sessions, assistance, assessment and follow-up. Different models of blended learning like supplemental blended learning, flipped class room blended learning, inside-out blended learning and online driver model blended learning can be incorporated with different phases of technology transfer.

Orientation consists of pre-class interaction with tutors in which learning objectives will be dealt with the support of power-point in face to face classroom set up and also through sharing the documents via online. Supplemental blended learning model provides the learners additional information outside their fixed learning environment.

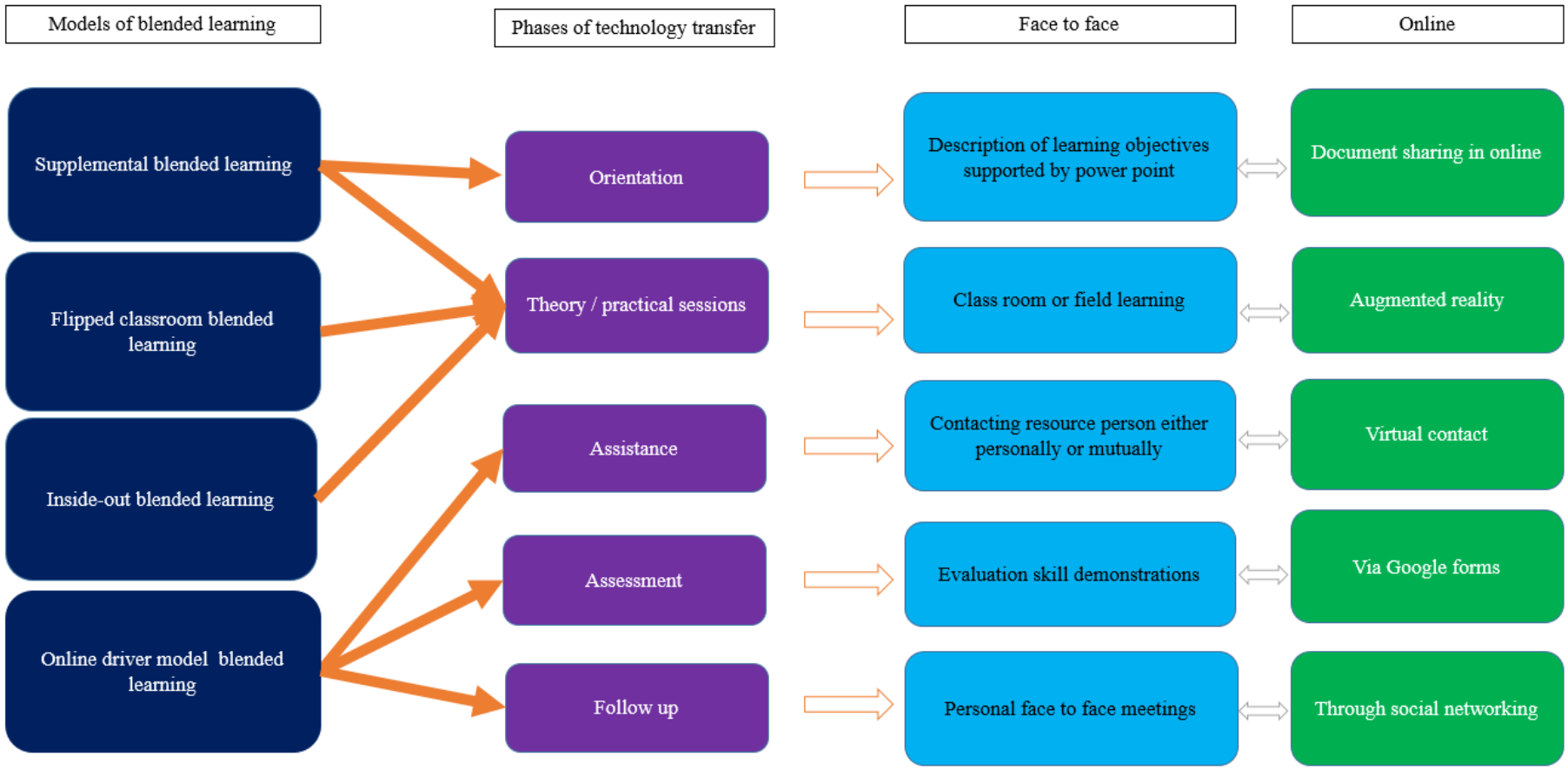

Fig. 29. Blended learning package for improving the effectiveness of online agricultural technology transfer

This model could be incorporated with initial phase of technology transfer. Flipped blended learning model is the one where learners are introduced to content at their home and practice working through it at physical classroom supported by the instructor. This model could be used during theory or practical session which could be held in classroom/field or through augmented reality. Inside-out blended learning model is the one where experiences are expected to end-up beyond the physical classroom. This model also could be used in theory/practical sessions.

During assessment phase, in offline mode the trainees can contact the resource person either personally or mutually. Whereas in online mode virtual contact can be done. For assessment, skill demonstration could be conducted and evaluation through Google forms can be offered. Next phase is follow-up which can be carried out through personal face to face meetings and also through social networking.

4.7 SUGGESTIONS FOR IMPROVING THE EFFECTIVENESS OF ONLINE AGRICULTURAL TECHNOLOGY TRANSFER

The major suggestions put forward by the farmers and extension personnel, consolidated and supplemented with the observations of the researcher has been listed below.

1. An e-studio consisting of all the necessary accessories, devices and other facilities with stable internet connectivity can be set up in all training institutes, research stations and colleges.
2. Trainings should be imparted on the use of ICT tools and online platforms related to agriculture which will help the farmers to make use of agricultural technologies through online mode.
3. Current infrastructure facilities available in the training institutes, research stations, krishi bhavans and colleges need to be improved.
4. Trainings should be imparted to the participant farmers for the smooth interaction through online platforms.
5. As smartphones are having more accessibility, more smartphone based applications related to agriculture can be developed and made popular.

6. Periodic advisories can be conducted through social networking.
7. More publicity to MOOC's can be given to attract the farmers to take part in the online courses offered.
8. Recordings of all the online classes could be bought to online library so that the farmers can utilise the same in future also.
9. During visualization of technologies, more pictures and videos could be incorporated.
10. A time limit of maximum 30-45 minutes should be kept for online classes and a weekly follow up of the same should be done.
11. After the online session, time should be given for interaction and discussion.
12. Conducting online classes for theory portions followed by offline sessions for practical part will be more effective.
13. Providing a time table of the online trainings and classes in advance will be helpful for farmers in arranging and managing the farm activities and other engagements accordingly.
14. Updated information regarding latest agricultural technologies and research activities could be provided through web portals.
15. Augmented reality techniques could be incorporated while providing online interactive sessions for demonstration of technologies.

4.8. EMPIRICAL MODEL OF THE STUDY

An empirical model of the study was developed to generate a brief idea about the entire research work (Fig.30). Effectiveness of online agricultural technology transfer, the dependent variable is placed in the centre. The five dimensions viz. information credibility, information adequateness, information understandability, information accessibility and information applicability are depicted as circles. The arrows indicates correlation between independent and dependent variable. It is evident that education, social participation, information source utilization, information seeking behaviour, extension agency contact, mass media exposure, social media participation and trainings undergone have positive as well as significant association with effectiveness of online agricultural technology transfer. Whereas age was negatively and significantly

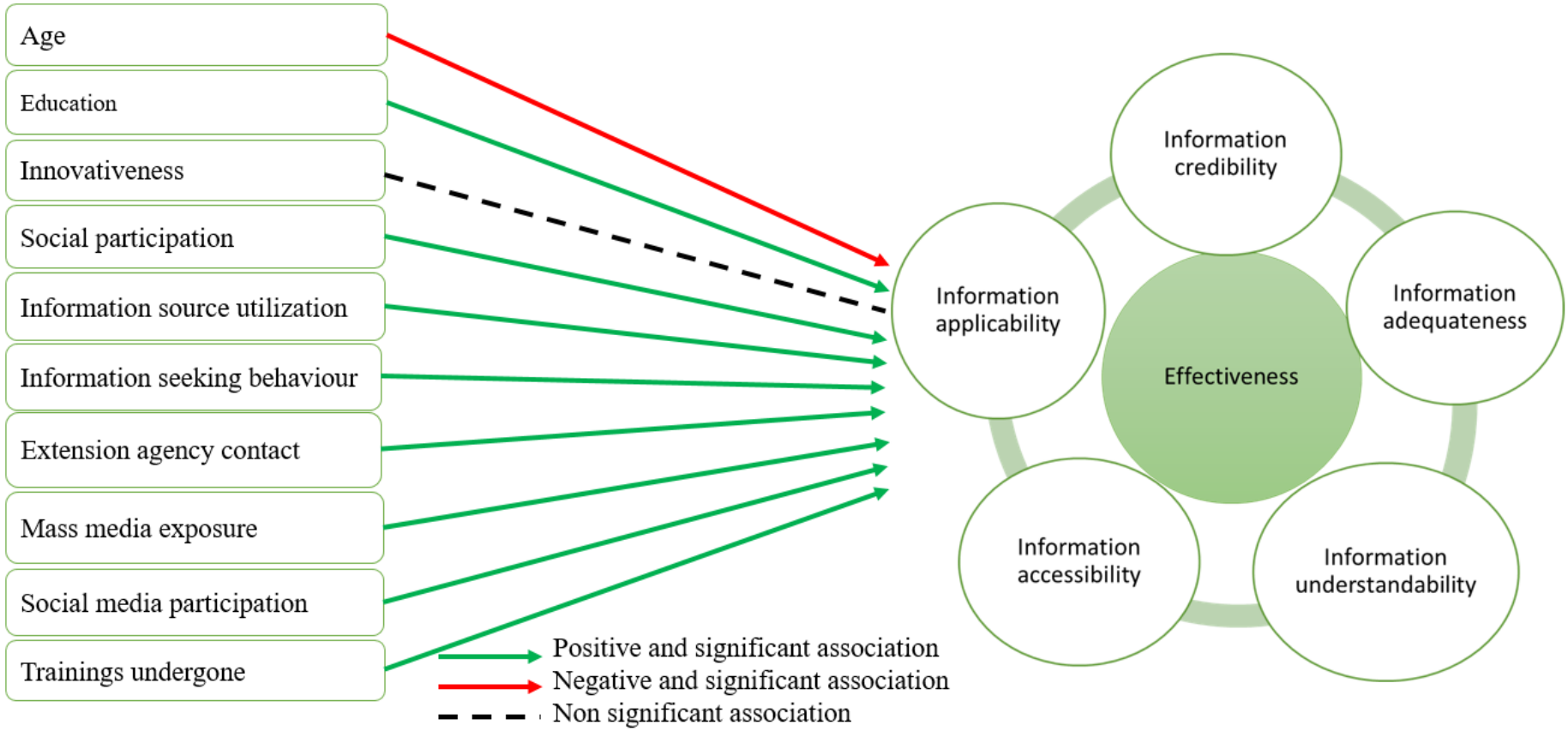

Fig. 30. Empirical model of the study

associated. Conversely innovativeness was not significantly related to effectiveness of online agricultural technology transfer.

4.9. FUTURE LINES OF RESEARCH

1. The study was carried out on a small sample population who attended online trainings that was purposefully chosen. It is important to replicate the study among those farmers who were facing digital divide.
2. Comparative analysis can be carried out by analysing the attitude of farmers towards online agricultural technology transfer during pre and post COVID scenario.

4.10. VALIDATION OF HYPOTHESIS

A research hypothesis is a statement about the expected outcome of a scientific study. A hypothesis must be testable to allow a verification or falsification. In this study the hypothesis set and established was;

There exists no significant relationship between independent variables and effectiveness of online agricultural technology transfer.

The results from the table 22 revealed that independent variables namely social participation, information seeking behaviour and social media participation were positively and significantly correlated at 0.001 level of significance. Whereas information source utilization and mass media exposure were positively and significantly correlated at 1% level of significance. Variables like extension agency contact, education and trainings undergone were positively and significantly correlated at 5% level of significance. Thus the null hypothesis was rejected.

SUMMARY

5. SUMMARY

There has been a remarkable connect between technology and human beings in every era. With the advancement of technology and the internet, learning and teaching techniques are changing to meet the demands of the users. Technology transfer can be main source to uplift the farming techniques and living standards. Traditional extension systems are not effective enough to meet the meet the growing food demands of the growing population. Current technical era need to make efficient use of latest online technologies and ICT tools in the field of agriculture. The farmers should receive agricultural information as fast as possible so that they understand, accept and use the information to produce a desired result. Effective use of electronic media seems essential to keep farmers with latest agricultural information and technologies. Usage of online media is the key option for the extension personnel as well as farmers for effective agricultural technology transfer during COVID scenario. At the same time a lot of constraints are facing by both for effective online technology transfer. Hence an in-depth analysis on effectiveness of online agricultural technology transfer among farmers, and to understand the methods adopted by farmers and extension personnel and also to understand the constraints faced by both while online learning and teaching, the present study entitled “Effectiveness of online agricultural technology transfer during COVID-19 pandemic” becomes very relevant.

The present study was conducted with the following objectives:

1. Assessment of the effectiveness of online agricultural technology transfer for the farmers during COVID-19 pandemic.
2. Appraisal of the methods adopted by extension personnel for online agricultural technology transfer.
3. Exploration of constraints in availability, accessibility and utilization of online platforms for agricultural technology transfer.

4. Delineation of a blended learning package for effective online agricultural technology transfer for farmers.

The study was conducted in Kerala among the farmers who received online training and extension personnel who conducted training. A total of 150 respondents comprising of 100 farmers and 50 extension personnel, constitute the total sample size. The study envisaged to assess the effectiveness of online agricultural technology transfer during COVID-19 pandemic. Ten independent variables selected through judges rating were age, education, innovativeness, social participation, and information source utilization, information seeking behaviour, extension agency contact, mass media exposure, social media participation and trainings undergone. Effectiveness of online agricultural technology transfer was the dependent variable.

The data were collected from the respondents through personal interview using a well-structured and pre-tested interview schedule. Appropriate statistical analyses were used for interpretation of the data and generation of results.

The salient findings of the study were:

1. Majority of the respondents (51%) surveyed belonged to the middle age category, followed by respondents in young age (26%) and old age (23%).
2. Among the respondents surveyed 51 per cent were with educational qualification of secondary school, followed by collegiate (31%) and primary school (18%).
3. Majority of farmers were having medium level of innovativeness (49%), followed by high (29%) and low (22%).
4. Majority of the respondents (50%) had medium social participation, followed by high (28%) and low (22%). 39.6 per cent of the respondents were members of the different organizations and 54.4 percent were not a member in any organization. Only 6 per cent were office bearers. In case of participation 46.8 per cent occasionally participated in meetings and 29.6 percent regularly attended the meetings. Percentage of respondents never attended meetings was low (23.6%).

5. It was found that 49 per cent of the respondents exhibited medium level of information source utilization pattern followed by 27 per cent of respondents with high utilization of information sources. While 24 per cent of the respondents fall in the category of low utilization of information sources.
6. It is observed that 45 per cent of the respondents mainly fall into medium level of information seeking behaviour, followed by 31 per cent and 24 per cent in high and low level of information seeking respectively.
7. It was evident that majority of the respondents had high extension agency contact (44%) followed by medium (41%) and low (15%).
8. It was observed that 50 per cent of the respondents had medium level of mass media exposure. While 30 per cent of the respondents had high mass media exposure and 20 per cent respondent had low level of mass media exposure.
9. It was revealed that majority of the farmers had medium level of social media participation (49%) followed by high (33%) and low (18%). 80 per cent of respondents regularly used Whatsapp followed by facebook (30%). Instagram and twitter were the least used social media channels. Majority of the farmers (60%) spent 2-3 hours in social media followed by 3-5 hours (20%) and lowest for 1 hour (20%).
10. It was found that majority of respondents (62%) undergone 2-4 number of trainings. While 33 per cent of the respondents attended more than five trainings, followed by 5 percent respondents had attended only one training.
11. Majority of the respondents (56%) had a medium credibility on the information provided through online methods. Similarly 25 per cent and 19 per cent respondents had high and low level of information credibility.
12. For majority of the respondents (50%) adequateness of information provided through online methods were medium. Similarly 28 per cent had high level of information adequateness followed by low (22%).

13. It was concluded that, based on the understandability of information provided respondents were categorized into low, medium and high. 52 per cent of the respondents fall in the medium category, followed by high (27%) and low (21%).
14. Based on information accessibility, 55 per cent of respondents fall in medium category. Similarly 26 per cent of respondents had high information accessibility and 19 per cent had low accessibility to the information provided through online methods.
15. Majority of respondents (66%) had medium information applicability, followed by high (27%) and low (7%).
16. It was found that the perceived effectiveness of online agricultural technology transfer fall under medium category (51%) followed by high (25%) and remaining in the low category (24%).
17. It was observed that independent variables like social participation, information seeking behavior and social media participation had positive and significant relationship with effectiveness of online agricultural technology transfer at 0.001 level. Information source utilization and mass media exposure were positively and significantly correlated at 0.01 level of significance.
18. It was concluded from the chi square analysis that education and trainings undergone had a positive and significant relationship at 0.05 per cent level of significance.
19. From the regression analysis carried out it was found that age had significant but negative relationship with effectiveness of online agricultural technology transfer.
20. It was observed that smartphone was the most common digital device used by all the respondents for online agricultural technology transfer. Google Meet was the digital platform which was used by the farmers most often, followed by Zoom. 31 per cent of the farmers opined that 90 per cent Google meet and 10 per cent Zoom were used for attending online classes and trainings. Among the digital applications, 57 per cent

of the respondents most often used Whatsapp followed by YouTube (25%) for agricultural technology transfer.

21. It was revealed that smart phones were used most often by 62 per cent of the extension personnel. While 46 per cent of the respondents indicated that they most often uses a laptop for taking online trainings and classes for farmers. Google meet was used most often by majority of the respondent (64%), followed by Zoom (16%). Similarly 46 per cent of the extension personnel opined that 70 per cent Google meet and 30 percent Zoom were used for taking online classes and trainings for farmers. Whereas 44 per cent of the respondents used 90 per cent Google meet and 10 per cent Zoom. Similarly, 10 per cent of the extension personnel used 50 per cent Google meet and 50 per cent Zoom for online agricultural technology transfer. While 74 per cent of the respondents most often used Whatsapp for agricultural technology transfer. Majority of the respondents never used twitter, instagram and telegram.
22. The most important constraints faced by the farmer respondents were poor internet connectivity, expensive internet packs and high cost of digital devices. The other constraints perceived by respondents in the order of their importance are unstable power connection, lack of satisfactory solution for individual problems, limited availability of devices, noise and other physical disturbances, lack of experience in handling digital devices, poor knowledge in handling online platforms, poor conditions of equipment, more usage of technical language, lack of two way interaction, lack of understanding certain topics which requires practical knowledge, difficulty in making use of given theoretical information, health problems, poor quality of content provided and information were not received in time.
23. The major constraints faced by extension official during organizing and implementing online training programs were poor internet connectivity, poor infrastructure facilities and limited availability of devices. The other constraints in the order of their importance are maintenance problems, inadequate staff strength, lack of training to improve technical

knowledge, lack of active participation of farmers and poor technical skills, poor co-ordination and co-operation among different agencies under same department, poor communication skills, lack of support from authorities and health problems.

24. With the results obtained from the study, discussion with experts and review from similar studies, a blended learning package were delineated.
25. The major suggestions to improve the effectiveness of online agricultural technology transfer include setting up of an e-studio consisting of all the necessary accessories, devices and other facilities with stable internet connectivity in all training institutes, research stations and colleges, trainings on the use of ICT tools and online platforms related to agriculture, Periodic advisories through social networking, More publicity to MOOC's, conducting online classes for theory portions followed by offline sessions for practical part, updated information regarding latest agricultural technologies and research activities through web portals and incorporating augmented reality techniques while providing online interactive sessions for demonstration of technologies.

Suggestions for future research work

1. Comparative studies of attitude of farmers towards online agricultural technology transfer during pre and post COVID scenario.
2. Analysis of blended learning for farmers after COVID-19 pandemic.
3. Study on formulation of strategies to improve the effectiveness of online agricultural technology transfer.

REFERENCES

6. REFERENCES

Adesoji, S.A. and Tunde, A., 2012. Evaluation of the linkage system of research-extension-farmers in Oyo State, Nigeria: Lesson for agricultural extension administrators. *J. Agric. Ext. Rural Dev. 4*(20): 561-568.

Agyekumhene, C., de Vries, J.R., van Paassen, A., Schut, M., and MacNaghten. P. 2020. Making Smallholder Value Chain Partnerships Inclusive: Exploring Digital Farm Monitoring through Farmer Friendly Smartphone Platforms. *Sustainability*. 12 (11): 4580.

Aldosari, F., Al Shunaifi, M.S., Ullah, M.A., Muddassir, M., and Noor, M.A., 2019. Farmers' perceptions regarding the use of information and communication technology (ICT) in Khyber Pakhtunkhwa, Northern Pakistan. *J. Saudi Society of Agric. Sci. 18*(2): 211-217.

Anand, S., Prakash, S., Yedida, S., and Singh, A.K., 2020. Constraints faced by farmers in access and use of information and communication technologies (ICTs) in Bihar. *J. Pharmacognosy and Phytochemistry*. *9*(2S): 80-85.

Anandajayasekeram, P., Puskur, R., Sindu, W., and Hoekstra, D. 2008. Concepts and Practices in Agricultural Extension in Developing Countries: A Source Book. IFPRI (International Food Policy Research Institute), Washington, DC, USA, and ILRI (International Livestock Research Institute), Nairobi, Kenya, 275 p.

Aphunu, A. and Otoikhian, C.S., 2021. Farmers' perception of the effectiveness of extension agents of Delta State Agricultural Development Programme (DADP). *Afr. J. Gen.Agri. 4*(3): 35-41.

Arathoon, L., Raithatha, R., and Tricarico, D. 2021. COVID-19: Accelerating the use of digital agriculture. [On-line]. Available: https://gsma.com [12 November 2022].

Arathy, B. 2011. Constraint analysis of rice farmers of Thrissur district of Kerala. M.Sc. (Ag) thesis, Acharya N.G. Ranga Agricultural University, Hyderabad. 125p.

Badiane, O. 2014. Agriculture and structural transformation in Africa. In: Falcon, P. and Naylor, R. L. (eds). Frontiers in Food Policy: Perspectives on Sub-Saharan Africa. Stanford Center on Food Security and the Environment, USA, pp. 1- 43. [On-line]. Available:http://fsi.stanford.edu/publications/frontiers_in_food_policy_perspectives_on_subsah aran_africa [13 December 2022].

Bahasoan, A.N., Ayuandiani, W., Mukhram, M., and Rahmat, A. 2020. Effectiveness of online learning in pandemic COVID-19. *Int. J. sci. technol. Manag. 1*(2): 100-106.

Balogun, C. E. 2020. Mitigating the impact of COVID-19 on rural farm families in Nigeria through innovative information transfer. *Int. J. Humanit. Arts Soc. Sci*. 10(2): 40-51.

Balu, G. M. 2019. Opinion and utilization of mobile based agro-advisory services by farmers. M. Sc (Agri) Thesis. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.130p.

Beevi, H. A. 2014. Radio listening behavior of families in the digital age. M.Sc. (Ag.) thesis. Kerala Agricultural University, Thrissur. 110p.

Benard, R., Frankwell, D., and Ngalapa, H. 2014. Assessment of information needs of rice farmers in Tanzania; A case study of Kilombero District, Morogoro. [On-line]. Available:https://www.researchgate.net/publication/280048695_Assessment_of_information_needs_of_rice_farmers_in_Tanzania_A_case_study_of_Kilombero_District_Morogoro. [17 December 2022].

Bhatia, R., Mehta, S.K., Mehta, V.P. and Malik, J. 2016. Mass Media Exposure of Organic Paddy Farmers of Haryana. *Indian J. Econ. Dev. 12*(1a): 435-440.

Bhongle, S. D. 2018. Opinion and utilization of mobile based agro advisory services by farmers in Nagpur district. M. Sc. (Ag.) thesis, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. 145p.

Chauhan, R. 2009. A study on perception of viewers' Krishi Darshan Programme of Doordarshan in Sehore district of Madhya Pradesh. M. Sc. (Ag.) Thesis. R.A.K. COA Sehore, JNKVV, Jabalpur.136p.

Chavan, C. R., Gohad, V. V., and Mai, R. A. 2010. Effectiveness of agriculture programme perceived by televiewing farmers. *Agric. update*. 5(2): 59-60.

Chowhan, S. and Ghosh, S.R. 2020. Role of ICT on agriculture and its future scope in Bangladesh. *J. Sci. Res. Rep. 26*(5): 20-35.

Deegan, D., Wims, P., and Pettit, T. 2016. Practical skills training in agricultural education—A comparison between traditional and blended approaches. *J. agric. Educ. Ext. 22*(2): 145-161.

Dhaka, B.L. and Chayal, K. 2010. Farmers' experience with ICTs on transfer of technology in changing agri-rural environment. *Indian Res. J. Ext. Educ. 10*(3): 114-118.

Dixit, A. K., Mohan, B., Singh, K., and Kumar, V. 2014. Impact of Training Programme on Goat Farmers and Stakeholders; A Study of CIRG Training Programmes. *Indian Res. J. Ext. Edu*. 14 (3): 101-105.

Du Plessis, A., Young, C., and Nel, P., 2015. Using eLearning, blended learning and digital literacy to improve student engagement and retention. [On-line]. Available: https://www.anzam.org/wp-content/uploads/pdf-manager/2604_124.PDF. [12 December 2022]

Duram, L.A. and Larson, K.L., 2001. Agricultural research and alternative farmers' information needs. *The Professional Geogr. 53*(1): 84-96.

Fayas, A .M. 2003. Viability of self-help groups in vegetable and fruit promotion council, Keralam - A multidimensional analysis, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 111 p.

Food and Agriculture Organization (FAO). (2014). Farming for the future: Communication efforts to advance family farming. [On-line]. Available: http://www.fao.org/3/a-i4223e.pd2 [5 November 2022].

Food and Agriculture Organization (FAO). 2021. E-learning methodologies and good practices. https://www.fao.org/3/i2516e/i2516e.pdf. Online [16 January 2023].

Gambari, A.I., Shittu, A.T., Ogunlade, O.O., and Osunlade, O.R., 2018. Effectiveness of blended learning and elearning modes of instruction on the performance of undergraduates in Kwara State, Nigeria. *MOJES: Malaysian Online J. Educational Sci. 5*(1): 25-36.

Gautam, S., Schreinemachers, P., Uddin, M.N. and Srinivasan, R., 2017. Impact of training vegetable farmers in Bangladesh in integrated pest management (IPM). *Crop Prot. 102*: 161-169.

Geethu, A. M. 2019. Comparative analysis of vocational training programmes of Krishi Vigyan Kendra. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 153 p.

Gollin, D., Parente, S., and Rogerson, R. 2002. The role of agriculture in development. *Am. Econ. Rev*. 92(2): 160-164.

Gopinath, M. 2005. Knowledge and adoption of Bengal gram farmers in Kurnool district of Andhra Pradesh. M.Sc. Thesis, Acharya N.G. Ranga Agricultural University, Hyderabad. 150p.

Greeshma, U. 2017. Techno - socio economic analysis of house terrace cultivation in Thiruvananthapuram Corporation. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 128 p.

Gunawardana. 2005. Communication behaviour of farmers on improved farm practices on Udaipur district of Rajasthan. M.Sc. thesis, MPUAT, Udaipur. 144p.

Gupta, M., Abdelsalam, M., Khorsandroo, S., and Mittal, S. 2020. Security and privacy in smart farming: challenges and opportunities. *IEEE Access.* 8: 34564-34584.

Gurubalan, M. 2007. Entrepreneurial behaviour of coconut oil based unit owners. M. Sc. (Ag) thesis, Kerala Agricultural University. 145p.

Gurung, S. 2021. Challenges faced by teachers in online teaching during Covid-19 pandemic. *The Online J. distance Educ. e-Learning*, *9*(1): 8-18.

Hadiya, B. 2019. Effectiveness of kisan mobile advisory service in dissemination of agricultural information in Gandhinagar District of Gujarat. *Indian J. Ext. Educ. 55*(2): 87-90.

Hashem, N.M., Hassanein, E.M., Hocquette, J.F., Gonzalez-Bulnes, A., Ahmed, F.A., Attia, Y.A., and Asiry, K.A. 2021. Agro-livestock farming system sustainability during the COVID-19 era: A cross-sectional study on the role of information and communication technologies. *Sustainability*. *13*(12): 6521.

Hassan, M.S., Shaffril, H.A.M., Samah, B.A., Ali, M.S., and Ramli, N.S.R.B. 2012. The credibility of television in disseminating agricultural information to Farmers in Malaysia. *Asian Social Sci. 8*(12): 133.

Islam, M. N. 2015. Effectiveness of electronic media for sustainable agricultural development: an investigation into TV Programmes. PhD thesis, Institute of Bangladesh Studies, University of Rajshahi, 277p.

Jaganathan, D. 2004. Analysis of organic farming practices in vegetable cultivation in Thiruvananthapuram district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 187 p.

Joshi, P. and Dewangan, D. 2021. Impact and development of online education (e-learning) in India. *J.Contemporary Issues in Business and Government.* 27(1): 3450-3458. [On-line]. Available: https://cibg.org.au [17 January 2023].

Kabir, K.H., Roy, D.E.B.A.S.H.I.S., Sarker, A. and Kuri, S.K. 2014. Information seeking behavior of the farmers to ensure sustainable agriculture. *Eur. Academic Res. 2*(3): 3723-3734.

Kadian, K. S. and Kumar, R. 2001. Sources of information and their extent of utilization by dairy farmers of Kangra Valley. *Himachal J. of Agril. Res*. 26 (1&2): 130-136.

Kailash. 2016. Study on use of mobile phone technology (smartphone) by the farmers of Nagpur district in Rajathan. M.Sc (Agri) Thesis. Institute of Agricultural Sciences, Banaras Hindu University, Varnasi. 156p.

Kakade, O. 2013. Credibility of radio programmes in the dissemination of agricultural information: a case study of Air Dharwad, Karnataka. *J. Humanities and Social Sci. 12*: 18-22.

Kalyan, N. V. 2011. Impact analysis of groundnut production technologies in Chittoor district of Andhra Pradesh. M.Sc. thesis, Acharya N.G. Ranga Agricultural University, Hyderabad. 120p.

Kanjina, S. 2021. Farmers' Use of social media and its Implications for Agricultural Extension: Evidence from Thailand. *Asian J. Agric. and Rural Dev. 11*(4): 302-310.

Kassem, H.S., Alotaibi, B.A., Aldosri, F.O. and Muddassir, M. 2021. Exploring the relationship between information-seeking behavior and adoption of biofertilizers among onion farmers. *Agron. 11*(6): 1258.

Kaur, A. and Kalra, R.K. 2003. Content analysis of dairy farming activities published in progressive farming. *Guj. J. Extn. Edu*. *XIV*. p.31.

Kavithaa, N.V., Rajkumar, N.V., and Lakshmi, C.S. 2014. Information seeking behaviour of dairy farmers. *Int. J. Sci. Environ. Technol. 3*(4): 1502-1506.

Kerlinger, F. N. 1973. *Foundations of Behavioural Research: Educational, Psychological and Sociological Enquiry*. Wadsworth publishing Company, United States, 468p.

Kerlinger, F. N. 1983. *Foundations of Behavioural Research*. Surjeeth publications, New Delhi, 741p.

Khan, M. S., Rahman, M.H., and Uddin, M.N. 2017. Effectiveness of selected mass media in agricultural technology transfer to the farmers of Bangladesh. *Res. Agric. Livest. Fish. 4*(1): 7-13.

Khan, M.S., Rahman, M.H., and Uddin, M.N. 2017. Effectiveness of agricultural information and communication center in technology transfer to the farmers in Bangladesh. *Asian J. Agirc. Ext. Econ. Soc*. *18*(4): 1-11.

Kolowich, S. 2009. Sustainable hybrid: Blended learning, preliminary data indicate hybrid courses produce better outcomes.

Madushanki, A.A.R., Halgamuge, M.N., Wirasagoda, W.A.H.S., Syed, A. Adoption of the Internet of Things (IoT) in agriculture and smart farming towards urban greening: A review. *Int. J. Adv. Comput. Sci. Appl. 10*: 11–28

Mahapatra, S. K. 2020. Smartphone Apps for Agri-information dissemination during COVID-19 lockdown. *Biotica Res. Today*. 2(5): 116-119.

Mahendra Dev, S. 2020. Addressing COVID-19 Impacts on Agriculture, Food Security, and Livelihoods in India. [Online] Available: https://www.ifpri.org/blog/addressing-covid-19-impacts-agriculture-food-security-and-livelihoods-india. [15 January 2023].

Majjusha, A. R. 2000. Techno-socio-economic assessment of farmers' practices in the cultivation of cowpea (*Vigna unguiculata L.*) in Thiruvananthapuram district. M. Sc. (Ag) Thesis, Kerala Agricultural University. 144p.

McCampbell, M., Adewopo, J., Klerkx, L. and Leeuwis, C., 2021. Are farmers ready to use phone-based digital tools for agronomic advice? Ex-ante user readiness assessment using the case of Rwandan banana farmers. *J. Agric. Educ. Ext.* 5(1): 1-23.

Means, B., Toyama, Y., Murphy, R., and Baki, M. 2013. The effectiveness of online and blended learning: A meta-analysis of the empirical literature. *Teachers college record*. 115(3): 1-47.

Meena, B.S. 2010. Communication sources credibility and utilization pattern among farmers. *Small*. 46: 23.

Mendhe, H., Sadaphal, S., and Fulsawange, S. 2020. Use Of ICT Tools For Effective Transfer Of Technology. *JETIR*. 7(11): 240–242. [Online]. Available: https://www.jetir.org/papers/JETIR2011038.pdf. [30 December 2022].

Mgendi, G., Mao, S. and Cheng, X. 2019. A review of agricultural technology transfer in Africa: lessons from Japan and China. Sustainability, 11(23): 6598. [On-line]. Available: https://doi.org/10.3390/su1123 6598 [25 December 2023].

Mishra, A., Singh, J., Malik, J.S., and Maurya, A.S. 2022. Social media use profile of farmers in Haryana. *Indian J. Ext. Educ. 58*(3): 51-54.

Mishra, A., Yadav, O.P., Yadav, V., and Pratap, S. 2020. Constraints faced by farmers and suggestions for effective utilization of ICT services in agriculture in central UP. *The Pharma Innovation J. 9*(2): 121-124.

Morris, W. and James, P. 2017. Social media, an entrepreneurial opportunity for agriculture-based enterprises. *J. Small Bus. Enterp. Dev.* 24(4): 1028-1045.

Muhammad, S., Lodhi, T. E., and Khan, G. A. 2012. In depth analysis of electronic media to enhance their role in agricultural technology transfer in the Punjab, Pakistan. *Pak. J. Agric. Sci.* 49(2): 221- 227.

NABARD [National Bank for Agriculture and Rural Development]. 2020. Impact assessment of COVID-19 on Indian agriculture and rural economy. [On-line]. Available:https://www.nabard.org/auth/writereaddata/tender/1211203145 ImpactAssessment of COVID.pdf. [30 July 2022].

Nandakumar, S., Ravichamy, P., and Balan, K. C. S. 2014. Mass media interventions and technology transfer among banana growers: Experiences from Tamil Nadu, India. *IJETCAS*. pp:14-28.

Nantongo, B., Ssekandi, J., Ngom, A., Dieng, B., Diouf, N., Diouf, J. and Noba, K., 2021. Evaluating the Impact of Weather and Climate Information Utilization on Adoption of Climate-Smart Technologies Among Smallholder Farmers in Tambacounda and Kolda Regions,(Senegal). *J. Env and Earth Sci.* [On-line]. Available: https://www.academia.edu/80781908/Evaluating-the-impact-of-Weather-and-Climate-Information-Utilization-on-Adoption-of-Climate-Smart Technologies-Among-Smallholder-Farmers-in-Tambacounda-and-Kolda-Regions-Senegal-?d-ri=1512 . [18 October 2022]

Nnenna, E.A., 2013. Access and application of information and communication technology (ICT) among farming households of south east Nigeria. *Agriculture biology J. north america*, 4(6): 605-616.

Nyarko, D.A. and Kozári, J., 2021. Information and communication technologies (ICTs) usage among agricultural extension officers and its impact on extension delivery in Ghana. *J. Saudi Soc. Agric. Sci.* 20(3): 164-172.

Palaniswamy, A. 2011. Impact of TN-IAMWARM Project On The Farm And Home of Precision Farming Beneficiaries - An Analysis. M. Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore. 75p.

Panda, S., Modak, S., Devi, Y. L., Das, L., Pal, P. K., and Nain, M. S. 2019. Access and usage of Information and Communication Technology (ICT) to accelerate farmers' income. *J. community mobilization sustain. dev.* 14(1): 200-205.

Parganiha, O., Shrivastava, S. K., Chaubey, A.K., and Nag, J. L. 2012. Impact of Kisan Mobile Advisory (KMA) on agricultural technology dissemination. *Indian Res. J. Ext. Educ. 2(Special Issue):* 175-178.

Parida, S. (2010). Utilization of Information and Communication Technology (ICT) tools by staff and students in Universities. M. Sc (Agri) Thesis. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.

Patel, B. (2015). A study on utilization pattern of communication channels by the farmers of Sehore block of Sehore district, Madhya Pradesh. M. Sc. (Ag.) Thesis submitted to University of Agricultural Sciences, Dharwad.

Patel, J. B., Chauhan, N. B., and Vinaya Kumar, H. M. 2018. Relationship between attitude of farmers towards FIG and their profile in Anand district of Gujarat. *Guj. J. Ext. Edu*, 29(2): 174-177.

Patidar, R. (2015). A study on role of online communication in transfer of technology. M.Sc. (Ag.) Thesis submitted to Jawaharlal Nehru Krishi Vishwa Vidyalaya, Gwalior.

Patil, S. D. 2017. Effectiveness of agricultural programmes of D D Kisan channel as perceived by farmers. M. Sc (Agri) Thesis. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.

Paul, J. 2022. Effectiveness of e-marketing of cardamom in Kerala-an exploratory analysis. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 128 p.

Phillips, T., McEntee, M., and Klerkx, L. 2021. An investigation into the use of social media for knowledge exchange by farmers and advisors. *Rural Ext. Innov. Syst. J.* 17(2): 1-13.

Pokhrel, S. and Chhetri, R. 2021. A literature review on impact of COVID-19 pandemic on teaching and learning. *High. Educ. Future 8*(1): 133-141.

Pothan, P. E., Taguchi, M., Santini, G., 2020. Local food systems and COVID-19. In: A Glimpse on India's Responses. Rome (online). www.fao.org/in-action/food-for-cities-programme/news/detail/en/c/1272232/. [16 January 2023].

Pudke, S. S. 2018. Attitude of farmers towards use of mobile phone services in transfer of agricultural technology. M. Sc. (Agri) Thesis. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.

Pujar, S. S. 2018. A study on utilization pattern of ICT tools by farmers of Shivamogga and Chikamangaluru district. M. Sc. (Ag) thesis, University of Agricultural & Horticultural Sciences, Shivamogga.

Rahman, M. S. 2015. Effectiveness of training programme on mushroom cultivation. M. Sc. (Agri) Thesis. Sher-e-bangla Agricultural University, Dhaka. 115p.

Ramu, Y. and Karthikeyan, C., 2022. Constraints Perceived by Paddy Farmers during Utilization of Agricultural Information Sources and Channels. *Madras Agric. J.* 109(7-9): p.1.

Raza, M. H., Khan, G. A., Shahbaz, B., and Saleem, M. F. 2020. Effectiveness of information and communication technologies as information source among farmers in Pakistan. *Pak. J. Agric. Sci*. 57(1): 281- 288.

Reddy, N. 2005. A study on knowledge, extent of participation and benefits delivered by participation farmers of Watershed Development Programme in Raichur district of Kamataka state. M.Sc. (Ag) thesis. University of Agricultural Science, Raichur. 34pp.

Riley, M. and Robertson, B., 2022. The virtual good farmer: Farmers' use of social media and the (re) presentation of "good farming". *Sociol. Rural.* 62(3): 437-458.

Riyajuddin. 2005. Role of online communication in technology dissemination. Ph.D. (Agri.) Thesis. Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. 164p.

Roy, D.E.B.A.S.H.I.S., Farouque, M.G. and Rahman, M.Z., 2013. Effectiveness of farmer field school for soil and crop management. M.Sc. (Agri) Thesis. Department of Agricultural Extension Education. Bangladesh Agricultural University, Mymensingh, Bangladesh.

Roy, M.L., Chandra, N., Mukherjee, A., Jethi, R., and Joshi, K. 2018. Extent of use of ICT tools by hill farmers and associated social factors. krishi.icar.gov.in

Roy, S. and Ghosh, S. 2022. Determinants of adaptation during COVID-19 pandemic by rural households in Cooch Behar district of West Bengal. *Indian J. Ext. Educ.* 58(3): 126-130.

Shankaraiah. 2011. Attitude of farmers and scientists towards technology dissemination through mobile message service, M.Sc (Agri) Thesis. Univ. Agri. Sci., Bangalore, Karnataka.

Sharma, M., Singh, G., and Keshava. 2014. Impact Evaluation of Training Programmes on Dairy Farming in Punjab State. *Indian Res. J. Ext. Edu.* 14(1): 105-108.

Shikuku, K.M., 2019. Information exchange links, knowledge exposure, and adoption of agricultural technologies in northern Uganda. *World Dev.* 115: 94-106. https://doi.org/10.1016/j.worlddev.2018.11.012.

Shivhare, V. 2008. Effectiveness of different communication channels of banana growers of Khaknar block of Burhanpur district of Madhya Pradesh. M. Sc. (Ag.) Thesis. R.A.K. COA Sehore, JNKVV, Jabalpur.

Shivraj, P. and Philip, H. 2016. Role of mass media in changing awareness level on climate change among small and marginal paddy farmers of Tamil Nadu. *Int. J. Humanit. Soc. Sci. Interv.* 5(4): 45-50.

Shukla, G., Ansari, M. N., Lal, S. P., and Bandhavya, M. 2022. Information Seeking Behaviour of Farmers through Mobile: An Innovative ICT Tool. In *Biological Forum–Biol. Forum – Int. J.* 14(1): 586-590.

Singh, D. K., Gautam, U. S., Pandey, S. and Singh, M. 2009. Training need of farm related crop production in Madhya Pradesh. *Indian J. Ext. Educ.* 45(3&4):51-55.

Singh, D. K. and Singh, P. 2014. Effectiveness of Training Programmes under Agricultural Technology Management Agency in Bihar. *Indian Res. J. Ext. Edu*. 14(1): 75-78.

Singh, L., Singh, A. K., and Kumar, S. 2020. Impact of COVID-19 on Agriculture and Allied Sectors. *J. Community Mobilization Sustain. Dev.* 15(1): 8–16.

Singh, V. and Kameswari, V. L. V. 2019. A Study on Content Analysis of ICT Enabled Web Portal (Krishinet). *Int. J. Agric. Environ. Biotechnol.* 12(1): 47-54.

Sobha, S. 2013. Farm telecast in Kerala. A critical appraisal. M.Sc. (Ag.) Thesis, Kerala Agricultural University, Thrissur, 112p.

Sujitha, P. S. 2015. Technology assessment of plant protection practices of economically dominant crops in homegardens. M. Sc. (Ag.) Thesis, Kerala Agricultural University, Vellanikkara, 117p.

Swaroop, B. J. 2016. Accessibility and extent of utilization of information and communication technologies in adoption of improved agricultural practices by farmers in Vishakhapatnam district of Andhra Pradesh. *J. Global Commun*. 9(conf): 152-157.

Thakre, P. 2017. Attitude of beneficiary farmers about jalyukthshivar campaign in Nagpur district. M. Sc. (Ag.) Thesis, Dr. PDKV, Akola.

Thakur, D. and Chander, M. 2018. Use of social media in agricultural extension: Some evidences from India. *Int. J. Environ. Sci. Technol*. 7(4): 1334-1346.

Thasneem, S. 2016. Technology utilization of banana in Thiruvananthapuram district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 166p.

Thomas, R. A., Kenyon, P. R., Morris, S. T., Ridler, A. L., Hickson, R. E., Greer, A. W., Logan, C. M., and Blair, H. T. 2017. Farmer perceptions of the relative usefulness of information providers and technology transfer methods. *New Zealand J. Agric. Res.* 60(3): 245-262.

Tsan, M., S. Totapally, M. Hailu, and B. K. Addom. 2019. *The Digitalisation of African Agriculture Report 2018*-2019. The Technical Centre of Agricultural and Rural Cooperation, The Netherlands, 240p.

Tumbo, S. D., Mwalukasa, N., Fue, K.G., Mlozi, M. R., Haug, R., and Sanga, C. 2018. Exploring information seeking behavior of farmers' in information related to climate change adaptation through ICT (CHAI). *Int. Rev. Res. Open Distance Learn* 19(3): 299-319.

Xu, H. and Ebojoh,O. 2007. Effectiveness of online learning program: a case study of a higher education institution. *Issues in Info. Syst.* 8(1). 160p.

Yaseen, M., Luqman, M., Umer, M., and Kaleem Abid, M. 2020. Constraints faced by young farmers in adopting ICT tools in Agriculture: a case study of district Sargodha. *Int. J. Biosci.* 17(1): 13-23.

APPENDICES

APPENDIX I
JUDGES RATING

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF AGRICULTURE
Department of Agricultural Extension
VELLAYANI - 695 522
THIRUVANANTHAPURAM

Dr. Sangeetha K. G.
Assistant Professor
Dept. of Agricultural Extension
Training Service Scheme **email:sangeetha.kg@kau.in**
College of Agriculture, Vellayani **Mobile no: 9495118208**

Date: 10-05-2022

Sir/Madam,

Ms. Arya P. S. (Ad. No. 2020-11-082), the post graduate scholar in the Department of Agricultural Extension, College of Agriculture, Vellayani is undertaking a research study entitled "**Effectiveness of online agricultural technology transfer during COVID-19 pandemic**" as part of PG work. Variables supposed to have close association with the study have been identified after extensive review of literature.

Considering your vast experience and knowledge in the subject, I request you to kindly spare some of your valuable time for examining the variables critically as a judge to rate the relevancy of them. Your kind and quick response will help us to complete the study in time.

Thanking you

Yours faithfully

Dr. Sangeetha K. G.

Effectiveness of online agricultural technology transfer during COVID-19 pandemic

Objectives

Assessment of the effectiveness of online agricultural technology transfer for the farmers during COVID-19 pandemic; appraisal of the methods adopted by extension personnel for online agricultural technology transfer; exploration of constraints in availability, accessibility and utilization of online platforms for agricultural technology transfer; delineation of a blended e-learning package for effective online agricultural technology transfer for farmers.

Dependent variables

Effectiveness of online agricultural technology transfer is the dependent variable.

Independent Variables

The following independent variables are identified for the study based on the available literature. Please ✓ mark the relevancy of the variables in terms of **MOR-Most Relevant, MR- More Relevant, R-Relevant, LR-Less Relevant, LER- Least Relevant** against the appropriate column.

Sl. No.	Variable	Operational definition	Relevancy rating (R - relevant)				
			MOR	MR	R	LR	LER
1.	**Age**	Refers to the number of calendar years completed by the farmers at the time of investigation.					
2.	**Education**	Defined as the level of formal education attained by the farmers at the time of investigation.					
3.	**Farming experience**	Refers to the number of years the farmers has been engaged in farming.					
4.	**Size of land holding**	Refers to the actual land owned by the individual and the control he/she has in its resources for a secure living.					

5.	**Family size**	Defined as the total number of members in the respondent's family at the time of investigation.					
6.	**Family income**	Refers to the total earnings of the family for one year from farming and other sources expressed in terms of rupees.					
7.	**Cosmopoliteness**	Refers to the degree to which the respondent is oriented to his/her immediate social system.					
8.	**Mass media exposure**	Operationalized as the extent to which farmer is exposed to different mass media channels such as radio, television, newspaper, information material and farm magazines etc.					
9.	**Extension Agency contact**	It was operationalized as the degree of contact of farmers with various agricultural officials for acquiring information on farming and other activities.					
10.	**Risk bearing ability**	Referred as the degree to which the farmer was oriented towards encountering risks and uncertainty during COVID-19 pandemic					
11.	**Scientific orientation**	Defined as the degree to which a farmer is motivated towards the use of scientific method in farming during COVID-19 pandemic					
12.	**Economic Motivation**	Operationally Defined as the extent to which a					

		farmer is oriented towards attainment of the maximum economic ends during COVID-19 pandemic.					
13.	**Information sources utilization**	Refers to the sources from which respondent receives relevant information on farming during COVID-19 pandemic					
14.	**Innovativeness**	Refers to the degree to which the respondent was relatively earlier in adopting new ideas for increasing the production, income from farming during COVID-19 pandemic					
15.	**Information seeking behaviour**	Refers to the view of farmers on search and use of data sources based on frequency of participation, extent of usefulness of various sources of information.					
16.	**Self confidence**	Refers to the sense of farmer about his ability, initiative and zeal to achieve his goal or aim.					
17.	**Problem solving ability**	Operationally defined as the ability of the respondent to recognise the problem, find the solution, decide on the best one and employ it.					
18.	**Gender**	Gender was operationalized as the biological distinction of the farmers as either male, female or others.					
19.	**Economic orientation**	Defined as the position an individual or a family occupied with reference to the prevailing average					

		standards of cultural possessions, effective income, material possession and participation in the community.					
20.	**Retrievability**	Extent to which information provided can be easily located and received by any user.					
21.	**Relevancy**	Opinion of respondents about suitability of information provided to the user situations.					
22.	**Farm stress**	Operationally defined as the physical, psychological, and emotional reaction that occurs during processing, transportation, storage etc. at the time of COVID -19 pandemic.					
23.	**Trainings undergone**	Refers to the number of days of online training received during COVID-19.					
24.	**Resilience capacities**	Defined as the robustness, adaptability, and transformability of farmers which can ensure the ability of livelihood strategies to secure livelihoods in the face of COVID 19 pandemic risks and stresses					
25.	**Social participation**	Defined as degree of involvement of farmers in various social activities and programmes					
26.	**Level of aspiration**	Operationally defined as degree to which the individual gets his goals realistically in relation to					

		his physical and mental attribute					
27.	**Flexibility**	Refers to the degree to which respondent alters his/her decisions as per the demand of the situations.					
28.	**Others if any please specify**						

APPENDIX II

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF AGRICULTURE, VELLAYANI

DEPARTMENT OF AGRICULTURAL EXTENSION

TOPIC: EFFECTIVENESS OF ONLINE AGRICULTURAL TECHNOLOGY TRANSFER DURING COVID-19 PANDEMIC

Note: i. The study period is 2020-21

ii. The information given by you is exclusively used for education purpose.

iii. The information will not be revealed to other organizations/individuals etc.

1. Name of the respondent:
2. Place:
3. Phone number:

II. Personal and Socio-psychological Characteristics

1. Age (years):

2. Education

Sl. No.	**Category**	**Response**
1	Illiterate	
2	Primary school	
3	Secondary school	
4	Collegiate	

3. Innovativeness

Sl. No	**Statements**	**SA**	**A**	**UD**	**DA**	**SDA**
1	You would feel restless unless, you tryout an innovative method which you have come across					

2	You are cautious about trying new practices.					
3	You like to keep up to date information about the subjects of your interest.					
4	You would prefer to wait for others to try out new practices first.					
5	You opt for the traditional way of doing things than go in for newer methods.					

4. Social participation

1. Nature of Participation

Nature of participation refers to the membership position of members in social organizations.

2. Frequency of Participation

Frequency of participation refers to the nature of participation of members in social organizations.

Organization	**Nature of participation**			**Frequency of participation**		
	Not a member	Member	Office bearer	Never	Sometimes	Regularly
Panchayat						
Co-op society						
Farmers club						
Youth club						
Socio-cultural organizations						

5. Information source utilization

Sources	Frequency			
	Most often (once in a week)	Often (once in a fortnight)	Sometimes (once in a month)	Rarely (once in a year)

1. Mass media sources				
Farm publications				
Television				
Films				
Newspaper				
Agricultural exhibitions				
2. Personal cosmopolite sources				
Research scientists				
Agrl.officers				
Agrl. assistants				
Others ,specify				
3. Personal localite sources				
Progressive farmers				
Neighbour				
Friends				
Family members				
Relatives				

6. Information seeking behaviour

	Sources	**Regularly**	**Once in fortnight**	**Whenever problem arise**	**Never**
Media sources	Television				
	Radio				
	Newspapers				

	Agricultural publications				
Formal sources	Scientists of KVK/KAU				
	Agricultural officers				
	BDO				
Informal sources	Family members				
	Neighbours				
	Friends and relatives				

7. Extension agency contact

Extension personnel	**Frequency of contact**		
	Regularly	Occasionally	Never
Agricultural scientist			
Agricultural officer			
Agricultural assistant			
KVK			
ATMA			
Others			

8. Mass media exposure

Sl.No	**Mass media**	**Frequency of exposure**		
		Regularly	Occasionally	Never
1	Radio			
2	Newspaper			

3	Television			
4	Farm magazines			
5	Bulletins			
6	Books			
7	Films			
8	Social media			

9. Social media participation

Which social media channels are you most active on?

Social media channels	**Very often**	**Somewhat often**	**Rarely**
Facebook			
Instagram			
Twitter			
Telegram			
Whatsapp			

How many hours do you spend on social media every day?

Time	**Response**
1hour	
2-3hours	
3-5hours	
More than 5hours	

10. Trainings undergone

Sl.No	**Trainings undergone**	**Response**
1	1	
2	2-4	
3	>5	

11. Information Credibility

Sl. No	Statements	Highly effective	Effective	Ineffective	Highly ineffective
1	Information provided through online training were reliable				
2	Information provided were clear and accurate.				
3	Sources of provided information were authorized and professional.				
4	Transfer of incompatible agricultural technologies were less.				
5	Prompt responses from the authorities during the sessions were received.				

12. **Information Adequateness**

Sl. No	Statements	Highly effective	Effective	Ineffective	Highly ineffective
1	Sufficient information were received through online training				
2	Information received were adequate with the situation				
3	Users could find the technology purposeful during the time				

4	The online methods were able to provide information suitable to the user resources.				
5	Online trainings offered the most updated information.				

13. **Information Understandability**

Sl. No	**Statements**	**Highly effective**	**Effective**	**Ineffective**	**Highly ineffective**
1	The received information were easily understandable by the user.				
2	Complex concepts were explained well by the speaker.				
3	Simple language were used for conveying information.				
4	Issue of information overflow were not there.				
5	Clarity of information conveyed were not affected by the distraction in the medium.				

14. **Information Accessibility**

Sl. No	**Statements**	**Highly effective**	**Effective**	**Ineffective**	**Highly ineffective**
1	Information provided were easily retrievable by the farmers.				
2	Recordings of the sessions were accessible for the farmers.				

3	Convenience of accessing the information through online training were better than conventional training.				
4	Session handlers were accessible in post training phase.				
5	Materials containing information were shared through web applications.				

15. **Information Applicability**

Sl. No	**Statements**	**Highly effective**	**Effective**	**Ineffective**	**Highly ineffective**
1	Information provided were applicable to the real time situation.				
2	Information provided were appropriate to the user needs.				
3	Information provided were feasible.				
4	Information conveyed were useful in practical dimension.				
5	Information provided were useful in future context.				

16. **Online methods used by farmers**

I. Digital devices used by farmers

Digital devices	**Frequency of use**				
	Never	Rarely	Sometimes	Often	Most often
Smartphone					
Laptop					
Desktop					
Tablet					
Smartphone+ laptop					

Smartphone + desktop					
Laptop + tablet					
Desktop + tablet					

II. Digital platforms used by farmers

Digital platforms	**Frequency of use**				
	Never	**Rarely**	**Sometimes**	**Often**	**Most often**
Google meet					
Zoom					
Webex					
Microsoft teams					
KAU MOOC					

Frequency of digital platform used	**Tick against the option given**
Only Google meet were used	
Only zoom were used	
90% Google meet and 10% zoom were used	
70% Google meet and 30% zoom were used	
50% Google meet and 50% zoom were used	
90% zoom and 10% Google meet were used	
70% zoom and 30% Google meet were used	

III. Digital applications used by farmers

Digital applications	**Frequency of use**				
	Never	**Rarely**	**Sometimes**	**Often**	**Most often**
Whatsapp					
Facebook					
Instagram					
Telegram					

Twitter					
You tube					
Agri related apps					

17. **Constraints faced by farmers**

i. Constraints in availability of online technology transferring methods

Constraints	**Extremely important**	**Important**	**Moderately important**	**Slightly important**	**Not at all important**
Poor internet connectivity					
Poor quality of content provided					
Information were not received in time					
Lack of satisfactory solution for individual problems					
Limited availability of devices					
Any others, specify					

ii. Constraints in accessibility of online technology transferring methods

Constraints	**Extremely important**	**Important**	**Moderately important**	**Slightly important**	**Not at all important**
High cost of digital devices					
Expensive internet packs					
Unstable power connection					

Poor conditions of equipment					
Health problems					
Any others,specify					

iii. Constraints in utilization of online technology transferring methods

Constraints	**Extremely important**	**Important**	**Moderately important**	**Slightly important**	**Not at all important**
Lack of experience in handling digital devices					
Poor knowledge in handling online platforms					
Lack of two way interaction					
Lack of understanding certain topics which requires practical knowledge					
Noise and other physical disturbances					
More usage of technical language					
Difficulty in making use of given theoretical information					
Any others, specify					

18. **Blended learning**

a. Have you heard of blended learning? (Yes/No)

b. Mark your preference on different modes of learning

Mode of learning	**Most preferred**	**More preferred**	**Preferred**	**Less preferred**	**Least preferred**
E-learning					
Traditional classroom learning					
Blended learning					

19. **Suggestions to improve the effectiveness of online agricultural technology transfer**

APPENDIX III

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF AGRICULTURE, VELLAYANI

DEPARTMENT OF AGRICULTURAL EXTENSION

TOPIC: EFFECTIVENESS OF ONLINE AGRICULTURAL TECHNOLOGY TRANSFER DURING COVID-19 PANDEMIC

Note: i. The study period is 2020-21

ii. The information given by you is exclusively used for education purpose.

iii. The information will not be revealed to other organizations/individuals etc.

1. **Name and designation of the Extension Personnel**:

2. **Online methods used by Extension Personnel during online trainings**

I. Digital devices used by Extension Personnel

Digital devices	**Frequency of use**				
	Never	Rarely	Sometimes	Often	Most often
Smartphone					
Laptop					
Desktop					
Tablet					
Smartphone+ laptop					
Smartphone + desktop					
Laptop + tablet					
Desktop + tablet					
Any others, specify					

II. Digital platforms used by Extension Personnel

Digital platforms	**Frequency of use**				
	Never	**Rarely**	**Sometimes**	**Often**	**Most often**
Google meet					
Zoom					
Webex					
Microsoft teams					
KAU MOOC					
Any others, specify					

Use of Digital Platforms in percent

Statements	**Response (Tick against the preference)**
Only Google meet were used	
Only zoom were used	
90% Google meet and 10% zoom were used	
70% Google meet and 30% zoom were used	
50% Google meet and 50% zoom were used	
90% zoom and 10% Google meet were used	
70% zoom and 30% Google meet were used	

III. Digital applications used by Extension Personnel

Digital applications	Frequency of use				
	Never	**Rarely**	**Sometimes**	**Often**	**Most often**
Whatsapp					
Facebook					
Instagram					
Telegram					
Twitter					
You tube					
Agri related apps					
Any others, specify					

3. Constraints faced by extension personnel in organizing and implementing online training programs for effective technology transfer

Constraints	**Extremely important**	**Important**	**Moderately important**	**Slightly important**	**Not at all important**
Poor infrastructure facilities					
Inadequate staff strength					
Poor internet connectivity					
Lack of training to improve technical knowledge					
Lack of support from authorities					
Poor co-ordination and co-operation among different agencies under					

same department					
Lack of active participation of farmers					
Poor communication skills					
Poor technical skills					
Limited availability of devices					
Maintenance problems					
Health problems					
Any others, specify					

4. Blended learning

a. Mark your preference on different modes of learning

Mode of learning	**Most preferred**	**More preferred**	**Preferred**	**Less preferred**	**Least preferred**
E-learning					
Traditional classroom learning					
Blended learning					

b. Suggestions to improve online agricultural technology transfer through blended learning

EFFECTIVENESS OF ONLINE AGRICULTURAL TECHNOLOGY TRANSFER DURING COVID-19 PANDEMIC

by

ARYA P. S.

(2020-11-082)

ABSTRACT

Submitted in partial fulfilment of the

requirements for the degree of

MASTER OF SCIENCE IN AGRICULTURE

Faculty of Agriculture

Kerala Agricultural University

DEPARTMENT OF AGRICULTURAL EXTENSION

COLLEGE OF AGRICULTURE

VELLAYANI, THIRUVANANTHAPURAM 695 522

KERALA, INDIA

2023

ABSTRACT

The study entitled “Effectiveness of online agricultural technology transfer during COVID-19 pandemic” was undertaken during 2021-2022. The objectives were the assessment of the effectiveness of online agricultural technology transfer for the farmers during COVID-19 pandemic, to appraise the methods adopted by extension personnel for online agricultural technology transfer, exploration of constraints in availability, accessibility and utilization of online platforms for agricultural technology transfer and delineation of a blended learning package for effective online agricultural technology transfer for farmers.

The study was conducted in Kerala among the farmers who had undergone online trainings and extension personnel who organized online trainings. A total of 150 respondents comprising of 100 farmers and 50 extension personnel, were randomly selected for the study. The effectiveness of online agricultural technology transfer was the dependent variable and ten socio economic and psychological variables selected through review of literature and judges rating were the independent variables.

On analysis it was found that majority of the respondents (51%) surveyed belonged to the middle age category, and 51 per cent were with educational qualification of secondary school. Majority of respondents (49%) were having medium level of innovativeness and social participation. About 49 per cent of the respondents exhibited medium level of information source utilization pattern, while 45 per cent of the farmers belonged to the medium category of information seeking behaviour. Majority of the respondents had high extension agency contact (44%) which is promising in technology transfer and adoption. Nearly half of the respondents had medium level of mass media exposure and social media participation. Majority of respondents (62%) undergone 2-4 number of trainings.

The results revealed that the perceived effectiveness of online trainings fall under medium category (51%) followed by high (25%) and remaining in the low category (24%).

The results of Karl Pearson correlation analysis revealed that independent variables namely, age, education, social participation, information source utilization, information seeking behaviour, extension agency contact, mass media exposure and social media participation showed significant correlation to the effectiveness. Innovativeness had no significant association with effectiveness. From the results of chi square analysis, education and trainings undergone showed significant relationship at 0.05 level. The regression analysis revealed that age had negative and significant relationship with the dependent variable.

The important constraints faced by the farmer respondents were poor internet connectivity, expensive internet packs and high cost of digital devices. The major constraints faced by extension official during organizing and implementing online training programs were poor internet connectivity, poor infrastructure facilities and limited availability of devices.

More than 62 percent of the farmers and extension personnel used mobile phones for online agricultural technology transfer. Among the digital platforms, Google meet and Zoom were mostly preferred by both farmers and extension personnel. WhatsApp was the mostly used digital application by the respondents.

Among different modes of learning, traditional class room learning was found to be the most preferred platform by 40 per cent of farmers, followed by blended learning (35%). Similarly, the most preferred teaching platform for the Extension personnel was traditional class room learning (46%), followed by blended learning (42%). Online learning was the least preferred platform by both farmers and extension personnel. Based on the results of the study, review of related studies and expert discussion, a blended learning package was delineated for improving the effectiveness of online agricultural technology transfer for farmers.

സംഗ്രഹം

കോവിഡ് - 19 കാലഘട്ടത്തിലെ ഓൺലൈൻ കാർഷിക സാങ്കേതിക വിദ്യകളുടെ കൈമാറ്റത്തിന്റെ ഫലപ്രാപ്തി എന്ന തലക്കെട്ടിലുള്ള പഠനം 2021 - 2022 കാലയളവിൽ നടത്തുകയുണ്ടായി .

ഓൺലൈൻ കാർഷിക സാങ്കേതിക വിദ്യ കൈമാറ്റത്തിന്റെ ഫലപ്രാപ്തി , അതിനായി ഉപയോഗിച്ച മാധ്യമങ്ങൾ , കർഷകരും ഉദ്യോഗസ്ഥരും നേരിട്ട പരിമിതികൾ, കൂടാതെ കർഷകരിലേക്ക് സാങ്കേതിക വിദ്യകൾ ഫലപ്രദമായി എത്തിക്കുന്നതിനുള്ള ഒരു ബ്ലെൻഡഡ് ലേർണിംഗ് പാക്കേജ് രൂപപ്പെടുത്തുക എന്നതായിരുന്നു പഠനത്തിന്റെ പ്രധാന ലക്ഷ്യം . ഓൺലൈൻ ക്ലാസുകളിലും മറ്റും പങ്കെടുത്ത 100 കർഷകരെയും അത് നടപ്പിലാക്കിയ 50 ഉദ്യോഗസ്ഥരേയും ആണ് വിവരങ്ങൾ ശേഖരിക്കുന്നതിനായി തിരഞ്ഞെടുത്തത്.

51 ശതമാനം കർഷകരും മധ്യവയസ്കരും സെക്കൻഡറി വിദ്യാഭ്യാസ യോഗ്യത ഉള്ളവരുമായിരുന്നു. 49 ശതമാനം കർഷകരും നൂതനത്വ സ്വഭാവമുള്ളവരുമായിരുന്നു. പകുതിയിൽ അധികം കർഷകരും ബഹുജന മീഡിയയും സോഷ്യൽ മീഡിയയും കാർഷിക ആവശ്യങ്ങൾക്കായി കൈകാര്യം ചെയ്യുന്നവരായിരുന്നു. 62 ശതമാനം ആളുകളും 2 - 4 ഓൺലൈൻ പരിശീലന പരിപാടികളിൽ പങ്കെടുത്തിട്ടുള്ളവർ ആയിരുന്നു. ഓൺലൈൻ കാർഷിക സാങ്കേതിക വിദ്യ കൈമാറ്റത്തിന്റെ ഫലപ്രാപ്തി വിശകലനം ചെയ്യുമ്പോൾ 51 ശതമാനം കർഷകരും ഫലപ്രദമാണ് എന്ന അഭിപ്രായമാണ് രേഖപ്പെടുത്തിയത്.

ഇന്റർനെറ്റിന്റെ ലഭ്യത കുറവ്, അമിത വില എന്നിവയാണ് കർഷകർ നേരിട്ട പ്രധാന പരിമിതികൾ. അടിസ്ഥാന സൗകര്യങ്ങളുടെ ലഭ്യത കുറവ്, ഇന്റർനെറ്റിന്റെ വേഗത തുടങ്ങിയവയാണ് ഉദ്യോഗസ്ഥർക്ക് നേരിടേണ്ടി വന്ന പ്രധാന തടസ്സങ്ങൾ.

കൂടുതൽ പേരും മൊബൈൽ ഫോണുകളാണ് കാർഷിക സാങ്കേതിക വിദ്യ കൈമാറ്റത്തിന് ഉപയോഗിച്ചിരുന്നത്. ഗൂഗിൾ മീറ്റ് സൂം എന്നീ ഡിജിറ്റൽ പ്ലാറ്റ്ഫോമുകളാണ് ഓൺലൈൻ ക്ലാസുകൾക്കായി ഉപയോഗിച്ചിരുന്നത്.

40 ശതമാനം കർഷകർ അഭിപ്രായപ്പെട്ടത് പരമ്പരാഗത ക്ലാസ്മുറിയിലുള്ള പഠനത്തിനാണ് മുൻഗണന നൽകുന്നതെന്നാണ്. 35 ശതമാനം ആളുകൾ ബ്ലെൻഡഡ് പഠന രീതിയിലും തത്പരരാണ്. പഠനത്തിന്റെയും വിദഗ്ധരുമായുള്ള ചർച്ചയുടെ അടിസ്ഥാനത്തിലും ഒരു ബ്ലെൻഡഡ് ലേർണിംഗ് പാക്കേജ് തയ്യാറാക്കുകയുണ്ടായി..