YANGON UNIVERSITY OF ECONOMICS

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ANALYSIS ON THE EFFECTS OF ICT USAGE ON PADDY FARMERS (CASE STUDY: PAUNGDE TOWNSHIP)

KHIN WUTTHMONE THIN

MEcon (Eco)-4

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ANALYSIS ON THE EFFECTS OF ICT USAGE ON PADDY FARMERS (CASE STUDY: PAUNGDE TOWNSHIP)

A thesis submitted in partial fulfillment of the requirements for
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Supervised by

Dr. Zin Zin Shwe
Professor
Department of Economics
Yangon University of Economics

Submitted by

Khin Wutthmone Thin
Roll No.4
MEcon (Economics)
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This is to certify that this thesis entitled "**Analysis on the Effects of ICT Usage on Paddy Farmers (Case Study in Paungde Township)**" submitted as a partial fulfillment towards the requirements for the degree of Master of Economics, has been accepted by the Board of Examiners.

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Yangon University of Economics

SEPTEMBER, 2023

ABSTRACT

This study aimed to analyze the benefits of ICT among farmers in Paungde Township. Descriptive method and multiple regression analysis are applied for data analyzing. This study finds out farmers use only four types of ICT tools. They are radio, television, mobile phone and internet and social media. Among them, three types of ICT tools are commonly used among farmers. Farmers use mobile phones for various purposes, with minimal utilization of radio. The primary use of ICT revolves agricultural and communicative purposes. Furthermore, farmers also engage with ICT for financial transactions at a moderate level and entertainment at a minimal level. The principal obstacles in using ICT are inadequate ICT literacy and training, as well as the absence of reliable access to electricity. The principal benefits of ICT usages to farmers are heightened productivity, increased income, improved market price attainment, and a reduction in transaction costs. This study suggests that farmers who harness ICT effectively in the realms of agriculture and communication stand to realize enhanced benefits to their farms, ultimately elevating their overall standard of living.

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Khin Wutthmone Thin
Roll No.4
MEcon (Eco)

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ABBREVIATIONS

ADP	Asian Development Bank
AED	Agricultural Extension Division
ASEAN	Association of Southeast Asian Nations
ASDP	Asian Studies Development Program
AusAID	Australian Agency for International Development
BBC	British Broadcasting Corporation
BBS	Burma Broadcasting Service
CARI	Central Agricultural Research Institute
CDMA	Code Division Multiple Access
CLMV	Cambodia, Laos, Myanmar and Vietnam
CSO	Central Statistical Organization
DAR	Department of Agricultural Research
DBT	Department of Broader Trade
DFID	Development for International Development
DTH	Direct to Home System
ECD	Environment Conservation Department
EU	European Union
FAO	Food and Agriculture Organization
GAP	Good Agricultural Practice
GDP	Gross Domestic Product
GFRAS	Global Forum for Rural Advisory Services
GIS	Geographical Information System
GNSS	Global Navigation Satellite System
GPS	Geographical Positioning System
IARI	International Agricultural Research Institute
IFAD	International Fund for Agricultural Development
INGO	International Non-Government Organization
IMF	International Monetary Fund
IOT	Internet of Things
ISPs	Internet Service Providers
IWUMD	Irrigation and Water Utilization Management Department

JICA	Japan International Cooperation Agency
LIFT	Livelihoods and Food Security Fund
NAPA	Myanmar's National Adaptation Program of Action
NCSA	National Climate Smart Agriculture
NGO	Non-Government Organization
MADB	Myanmar Agriculture Development Bank
MCIT	Ministry of Communication and Information Technology
MEDC	More Economically Developed Country
MOALI	Ministry of Agriculture, Livestock and Irrigation
MOC	Ministry of Commerce
MOST	Ministry of Science and Technology
MOTC	Ministry of Transport and Communications
MOPF	Ministry of Planning and Finance
MONREC	Ministry of Natural Resources and Environmental Conservation
MRF	Myanmar Rice Federation
SDGs	Sustainable Development Goals
SMS	Short Message Services
UAV	Unmanned Aerial Vehicle
UNCHS	United Nations Centre for Human Settlements
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFPA	United Nations Population Fund
UNO	United Nations Organization
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
VOA	Voice of America
VRT	Variable Rate Technology
WHO	World Health Organization
WIRPP	Whole Township Rice Production Program

CHAPTER I
INTRODUCTION

1.1 Rationale of the Study

All the technologies that can be used to access various types of information through communication are called Information and Communication Technology (ICT). Information and Communication Technology mainly use hardware, software and media as a medium for collection, storage, processing, broadcasting and presentation of information in the form of data, text, images, voice and video (World Bank, 2002). The role of media devices in ICT is very important. These ICT based media devices are radio, television, cellular and mobile phone, tablet, computer, internet, social media network, mobile phone application, drones, satellites, artificial intelligence etc.

At the global information age, Information and communication Technology is connecting to all sector of the country such as agriculture, education, entertainment, finance, social, health, economics and politics etc. As an agriculture-based country, ICT and agriculture sector need to be connected and used effectively. The development of the country can be accelerated by using ICT effectively in various sectors of the country. In the agriculture sector, ICT performs dissemination and sharing of knowledge and information about crops production, trading, marketing, weather forecasting, agricultural extension, fertilizers and pesticides, agricultural machinery equipment, agricultural credits, good quality seeds, soil fertility, pest management, other social communication and mobile banking transaction and so on.

ICT contribute to make easy access of information, dissemination and communication to all agricultural participants through ICT tools for the agriculture sector development. The operation of ICT is a vital supporter to the growth of agriculture sector. The important point is that ICT need to extensively accepting between government, researcher, agriculturalists, agri-business, extension workers and farmers. ICT can help technology diffusion from research and development institutions to farmers through extension workers. In Pakistan, the electronic and

interactive bridge between farmers and extension workers is ICT (Chavula, 2014).ICT play the important engine of agricultural extension by exchange and transmit of information from one to another (Mabe & Oladele, 2012).

The development strategies such as enhancing use of ICT and uplift the effectiveness and efficiency of information use in agriculture are mainly based on understanding the factors related with ICT adoption and use in agriculture (Franklyn & Tuku, 2012). Adoption of ICT in a country is means the situation in which a country begins utilizing ICT in its daily operations. The adoption of ICT in agriculture sector is varies from country to country depending on its economic, social and political situation (Mng'ong'ose & Victor, 2018). Factor influencing to adopt and use of ICT among farmers in agriculture are farmers' age, education, income, access to ICT training, perceptions, knowledges and farmers' trusty that ICT can yield beneficial results if used effectively in their farm (Franklyn & Tuku, 2012).

The connection between ICT and farmers, who are mainly involved in agricultural production, is also important. The "key users" of ICT need to be actual agricultural producers as farmers. Therefore, farmers need to thoroughly understand and use ICT. Before the advent of telecommunication, farmers mainly use radio and television for their information needs and sometimes they get necessary information from their neighborhoods. After telecommunication development, the mobile phones become an important part of human daily life activities. Farmers use budget friendly mobile phone for their information needs. Some farmers do not aware that they can get necessary information for their farm form the mobile phone, but they use it as a popular tool. Some framers are aware and use mobile phone to receive information about weather, market prices, pets and diseases, financial assistance and to get relevant services such as soil testing etc. To increase agricultural productivity, farmers should have been adequately received knowledge and information about agriculture by using ICT. Farmers gain knowledge from information through ICT tools and making decisions based on that knowledge that can increase their profitability (Amstrong et al., 2011).

ICT tools conduct a major role in creating awareness about new technologies among farmers and support farmers to make better decision for their farming operations. By applying ICT tools, farmers reduce production costs and transaction costs, increase their bargaining power and reduce climate change risks. ICT have been widely accepted and applied by farmers that can lead to sustainable agricultural

development moreover they can get greater knowledge and awareness about good agricultural practices through the use of ICTs (Fu & Akter, 2016).

Developing countries and CLMV countries have been entirely trying to transform into digital agriculture system since entered the telecommunication system. The uses of ICTs for agriculture in these countries are in initial stage. Mobile phone network is the most effective ICTs tool for digital transformation in developing countries. CLMV countries faced many reforms for agricultural development but now start applies the modernized ICTs tools trying to pursuits developed countries technology. Improving access to market information and agricultural development in developing countries is being done using modern ICT tools. It has been discovered that ICT is a solution that offers incredible potential to improve agriculture in developing countries (Armstrong et al., 2012). However, developing countries have many obstacles about using ICTs tools in agriculture especially in lack of awareness, problems of electricity and finance.

China, India, Japan, Indonesia, Thailand, Bangladesh, Vietnam, Philippines, South Korea, Malaysia are achieve successful countries in the ICT based agriculture sector among Asian Countries. It has been observed in India that the key roles of ICT, namely knowledge sharing and management are helpful for the development of agricultural sector (Rao, 2007) In China, agriculture sector have been digital transforming by the effective use of ICTs in agricultural production, operation and management (Li, 2009). Modern ICT devices utilized in agriculture especially mobile phone and internet that can elevate agricultural productivity in developing countries but developed countries have higher return than developing countries that analysis worked basically upon 81 countries in the world (Lio & Liu, 2006).

Since Myanmar is an agriculture-based country, there is need to study how ICT is being used in the agriculture sector for the development. In Myanmar, most of rural people are depending upon agriculture therefore agriculture has been representing the livelihoods of rural people. Development of agriculture and rural economy is one of the main objectives of the government of any agriculture-based country. Telecommunication system started to develop in June 2013, and a cheap mobile phone that can be used by any class are available in the country. Farmers use radio, television, mobile phone, internet and social media for their information needs. Farmers need update and accurate information from ICTs tools in order to make the correct decision about farm management. Therefore, farmers in the whole country

need to have adequate and correct knowledges in order to apply ICT tools. Myanmar and most developing countries are encountering similar problems due to weak in ICT infrastructure for agriculture and rural development.

The case study is paddy farmers in Paungde Township of Bago west region. Bago region includes four districts and twenty-eight townships. In Bago region, the main cultivation is paddy that covers over two-thirds of cultivated lands. The mobile phone subscription rate is 61% and internet subscription rate is 21% in 2018. The telecommunication and Network system in Bago region has not been lowered that trying to develop into national level. Major problem statements faced by farmers using ICT in Bago West region are insufficient electricity, weak in ICT infrastructure.

According to the 2014 census, Paungde Township has more rural population than urban population. Rural population represents the population living in villages of Paungde Township and their main occupation is engaged in paddy cultivation. Paddy farmers in Paungde Township are also using ICT because ICT is necessary tools used by everyone. The problem statement faced by paddy farmers from Paungde Township in using ICT is inadequate ICT training and insufficient electricity supply to use ICT and weak in ICT infrastructure that causes network fail. There is need to study how farmers' use of ICT and what effects it have on farmers.

1.2 Objectives of the Study

The objectives of the study are to study what types and patterns of ICT tools are using among farmers, to examine the purposes of using ICT among farmers and constraints encountered by farmers in using ICT and to analyze the benefits of using ICT among farmers.

1.3 Method of Study

Descriptive method and multiple regression models are applied for data analysis by using STATA and Microsoft Excel. The primary data are collected by using survey questionnaire. Five villages are choosing from the 224 villages of the Paungde Township by using simple random sampling method. The secondary sources are taking from central statistical year book 2021. Text books, internet websites, international journals, articles, thesis, research papers and reports on the role of ICT for agriculture are expressed in reference list for literature review.

1.4 Scope and Limitations of the study

This study focused on the farmers' perceived benefits from using ICT on their paddy production in Paungde Township of Bago Region (West). This study is limited because the survey period was during COVID-19 global pandemic. This study is emphasized only on five village; Yaesalgyi village, Kan Kyauk village, Taung gone village, Ywar Hla village, and Wet Myay Lu village. The target groups of participation in the research are farmers and their family members. Households' ownership farm size is choosing between 2 acres and 25 acres. A total of 200 respondents are selected from the 15% of 1334, the total population of five villages. Total 200 samples are selected from Yaesalgyi village, Kan Kyauk village, Taung Gone village, Ywar Hla village and Wet Myay Lu village. This study period is between the December, 2020 and January, 2021.

1.5 Organization of the Study

This study has been organized with five chapters. Chapter (1) presents introduction with the rationale of the study, objectives of the study, method of the study, scope and limitation of the study and organization of the study. Chapter (2) shows literature review on the theory and concepts of ICTs in agriculture, Diffusion of Innovation theory (DOI). Chapter (3) exhibits the role of ICTs for agriculture in Myanmar. Chapter (4) reports the results from analysis of primary data of the survey. Chapter (5) is conclusion, findings and suggestions.

CHAPTER II
LITERATURE REVIEW

2.1 The Role of ICT in Agriculture

Nowadays, Information and communication technology is important part in the human life activities such as health, education, social and economic in the worldwide. ICT mainly based on internet network and that undertakes collect, analyze, storage and disseminate information in agriculture sector and other sectors. Therefore, telecommunication companies and internet services companies are influence and successful enterprises in the digitalization era.

Developed countries do successfully precision agriculture with the assistance of information and communication technology and other digitalized technology and most developing countries do subsistence agriculture however developing countries start trying to digitalize agriculture and utilize information and communication technology. To develop the agriculture sector, information communication technology disseminates agricultural information that can be need to emphatically used by the government, non-government organization, researcher, agriculturalists, students, experts, agri-business, agricultural extension workers and farmer although the main user is farmers in practical farm working.

Farmers always consider and enquire before they grow the types of seeds by farmers to farmers or neighbours and agriculturalists because their capital is limited and risk-averse if the result is ensure profitability they decide to grow this seed. Likewise farmers inform and inquiry from the exerted farmers about the seed, types of fertilizers and pesticides, types of machinery equipments before they buy and utilize. The information is needed for farmers question curiosity for their farm therefore they need ICT to connect who answering and telling experiences such as farmers or agriculturalists or customer services. From the ICT' tools, question and answers services are the best and effective program for farmers that provide when farmers facing problem to advice and answer for much making the best personalize decisions.

When farmers are foreseeing the information, they can manage timely prevent and solution for example they are facing in natural disasters. Farmers can make the

best decision about their products planning process, harvesting and storing and selling the products that get highest prices. In the digital era, farmer can buy farm inputs and sell their products in online markets that farmers can stay home by reducing transportation costs moreover contact with many brokers and compared the products prices finally they choose the profitable prices.

The application of ICT by the multinational farm inputs business and machinery manufacturing business advertise and distribute services for the farmer. ICT can make improving widen market access, support best decision making, cost effectiveness and empower farming community, promote environmentally sustainable farming practices, disaster management and early warning, agricultural extension and advisory services (FAO, 2017). Around the world, during the causing COVID-19 diseases, people are staying in their homes, and their daily activities are increasingly dependent on information and communication technologies. The use of ICT makes peoples' lives easier and more convenient. Therefore, the role of ICT in the lives of people around the world is expanding and becoming more important.

2.1.1 Enhancing Market Access

Before applying ICT, farmers sell their products to township brokers or middleman who make the prices and mainly with control the monopoly power that make less profit for farmers and make increase prices for customers by limiting the price information. Market information is not limited by middlemen that make market efficient can provide agricultural supply chain therefore ICT are applied for improving market information assessment for farmers that leverage make better personalized decision that reduce wastages and increase welfare for farmers. ICT is essential requirement and deploy for not only quick and accurate flow of market information but also eradicate information asymmetry between famer (Tadesse & Bahiigwa, 2015).

In the digitalization age, information are unbosoming in the everywhere especially about market price in addition farmers can chose profitable results in many of things. Farmers can trade in home direct connect with traders and agriculture supply chain enterprises from mobile phone calling and social media chat box and in the market of agriculture mobile phone application. Farmers can check the market price in radio FM, television channel, mobile phone, computer and mobile application that are always express daily market prices.

Agricultural information organization sent to the subscribers famers in daily agricultural information by short messages services through the mobile phone. There are many examples assessment of agriculture market information through the mobile phone is efficient the market and effective for farmers in various crops and various countries in worldwide such as Peru, India, China, Ghana, Bangladesh, Philippines and Vietnam (Labonne & Chase, 2009) (Beuermann et al., 2012).

E-agriculture and E-commerce strategy is the reduce transportation costs and costs effectiveness, market efficiency and time saving ways not only for farmers in the rural area do not come into urban area and do not give sample products but also for agriculture value added business and many traders in the urban area they do not come into rural area and trading with mobile phone network. Farmer can connect to local, national and international market directly from the mobile phone network. When farmer irruption to reach international market, government can increases foreign exchange earnings. ICT can give mutual-benefits for farmers and traders in the trading process thus ICT provide widen market access for the farmers is the attest statement (Deichmann et al., 2016).

Nowadays, agricultural products marketing inhere with complex distribution channels links with E-Commerce in India, China, and African countries. Many agriculture entrepreneurs and agriculture supply chain small business enterprises are arising due to easily trading and transaction cost saving that are the effectiveness of E-commerce. E-commerce based on ICT in the worldwide and in this system farmer can create profits with timely and accurate trading that connect with the consumers through their mobile phone. ICT can facilitate empower trading activities and making the best personalized decision for farmers that is what time do you sell and what do you sell at sales prices etc. Therefore, ICT initiatives are as a greater role partaking for market system in the digitalization agriculture (Singh et al., 2017).

2.1.2 Agricultural Extension and Advisory Services

Agricultural extension and advisory services is the deliver and transfer of information inputs to farmers that do the traditional ways in the last two decades. In the traditional ways, radio and television daily announce agricultural information and extension programs for farmers and extension workers are appointed at the agriculture knowledge villages' center. Extension workers went to reach the remote areas to give advice for the farmers facing problem and distribute good agricultural practices

among farmers that costly and laborious for extension workers. Extension workers cannot always come into remote areas however they monthly come into this area thus farmers get monthly one-time information. Connection with farmers and extensions workers is insufficient and weak that cannot link with other research institutions and NGOs thereby less opportunities for rural farmers in the remote area. In developed and developing countries, information asymmetries about technology adoption among the farmers have been eradicated by the agricultural extension program (Anderson & Feder, 2007).

Agricultural extension workers need for agriculture sector to give incentives, awareness and share the benefits of ICT to know among farmers thereby farmers want to use and accept ICT for their farm production. In the digitalization, E-extension program work the field survey with the traditional way moreover extension workers launched knowledge pages, websites, blogs and groups with farmers not only they give timely answer and advice services with voice, text, videos over the mobile phone but also increase the frequency of engagement with farmers.

Extension worker connect with researchers, NGOs and agriculturalist moreover personal blogs and pages are opening for altruistically sharing their knowledge and experiences for farmers. Pages, blogs, websites and groups disseminate timely upload training video, pictures, audio files, knowledge topics, modern technology and advice the damages crops, weeds, diseases treatment techniques for farmers. However, extension workers visit the village fields and meetings with farmers while few farmers know about pages, blogs, websites and most farmers still need awareness in the remote area of developing countries.

Thus, the activities of extension workers is basic factor to improving awareness and adoption ICT tools use for agriculture sector that improve rural livelihoods to the rural development. Advisory call centers send short messages services, voice messages and answer for problem solving for subscribers famers in addition farmers emphasize agriculture products supply chain in developing counties (Francis & Addom, 2014). The effectiveness of ICT in agricultural extension and advisory services are cost effectives, timely problem solution and update information, increase adoption and accessibility, enhance cooperation, improve productivity and raise living standards of rural people (Bell & Shahbaz, 2016).

2.1.3 Financial Inclusion

ICT is the key role of digital banking system that make quickly flow of banking transactions such as transfer payments, credits, savings and insurances that can save time and transport costs financial sector mainly depend on swiftness can facilitate profits for example in trading foreign stock exchanges. Mobile banking applications are more effective and break-through in the rural area that can easily apply if the application in their mobile phone and farmers not necessary go to township however they need to go banking agent in the village. E-banking facilitates easily flow of domestic remittances and foreign exchange form internal and international migrants to their family members through mobile phone network moreover arising and expanding insurance small and medium enterprises in Kenya (Jack & Suri, 2014).

Insurance section is one of the banking transactions that are the types of savings and people can insurance in specific insurance companies or bank. Climate change insurance is important because the world is start to devastation due to industrialization the main causes is global warming, natural disasters such as flood, landslides, anticyclone, snowstorm, sandstorm, ice-storms and rainstorm etc. that can damage the harvests. The highest socio-economic risk is the lack of early warning about climate change to the public has been determined for the whole society (The Economist Intelligence Unit, 2015). In the nature of farmers facing environmental climate change problem that reduce their productivity farmers can manage the risk and resilience the product losses replace with the financial compensation by insurance in the climate change insurance companies that are especially in developed counties such as United States, Canada , Australia and France.

2.2 Types of Using ICT tools in Agriculture Sector

The types of information and communication technology used in agriculture differ depending on the country's situation, such as developing and developed countries. However, countries in the world wide have the same objective of using ICT in agriculture is agricultural information assessment and to achieve agricultural sector development. There are many types of ICT tools used in the previous studies are radio, television, mobile phone, computer, internet, social media application, agro-mobile application, CD/DVD player, camera, video conferencing etc. (Armstrong &

Gandhi, 2012) (Syiem & Raj, 2015) (Subejo et al., 2019). Therefore, fundamentals and applicable ICT tools are choosing in agriculture are express in the following.

(i) Radio

Radio for information assessment in agriculture start applied since the late of 19th century. The radio provides voice transmitting for farmers in most developing countries and the radio station transmitting the voice is effective for low literacy and conservative farmers in remote rural areas. The audio format is user-friendly and can be understood by farmers who may have low literacy levels. Radio broadcasts updates on weather forecast information, advertising farm inputs, pest control, crop management techniques, agricultural products market prices, government guidelines tips, good agricultural practices and other relevant information that can help farmers make informed decisions. Furthermore listen to the radio necessary dry battery or cell and most rural farmers afford radio than other ICT tools because it is cheaper and the amount they can afford.

The radio is foresting with modern digitization and adaption into online radio program and especially with the local language. When technology development such as wireless telegraphy, the online radio is obtainable in mobile phone or tablet or computer and can download agriculture audio file from the internet on many websites. The previous studies suggest that change farming methods and improve agricultural productivity when listening to the radio agricultural extension program (Ekoja, 2003).

The radio program performance follow the top-down hierarchy from government representatives, and research institution, extension works and farmers. The isolated broadcasting for the agriculture sector exists in most countries for example Farm Radio International program. In today, small scale farmers still use the radio as the most effective medium for building awareness and adoption of new farming practices (Nabusoba, 2014). Myers argued that radio upgrade with new digital technology can be used not only as a more two-way medium but also it can help like a bridge as the digital divide that can reap the benefits powerful information flow to reach the rural remote area (Myers, 2009). This makes radio an effective tool for sharing knowledge and improving farming practices, ultimately leading better yields and increased livelihoods for farmers.

(ii) Television

Television for information assessment in agriculture sector introduce since the early 20th century. The initial stage of television for agriculture is broadcasting voice and visual especially black and white system. When technology development from cable TV to Digital TV that with colourful visual and live stream transmitting and online TV are now available in mobile phone and computer from internet on many websites. Digital television performances are widespread and embody with multi television channel in addition only for farmers such as Farmer Channel. This Channel collocate agricultural extension program in the worldwide and nationwide video performance in one place however electricity, solar energy or power battery or engine is essential necessary to open the television program.

Farmers use television as a valuable source of agricultural information due to its accessibility and effectiveness in reaching a wide audience. Television programs and channels dedicated to agriculture provide practical tips, techniques, and updates on farming practices, crop management, livestock care, market tends, weather forecast, advertising farm inputs, training program, knowledge distribution program. The visual medium allows farmers to see demonstrations, interviews with experts, and real-time coverage of relevant events.

Television is recognized not only as the intervention linking tools with rural people but also as the important medium for communicating with rural population in developing countries. Television is the education tools for enhancement of farmers' agricultural knowledge and it is effective tools for farmers who weak in digital literacy especially for farmers (Nazari & Hassan, 2011). Television has involved an important role in conducting knowledge and technological change to Pakistan rural people by broadcasting special programmes (Chhachhar et al., 2012). Television is a good communication ICT tool in disseminating agricultural information to rural farmers (Chhachhar et al., 2012). Additionally, television can bridge the knowledge gap by reaching rural areas with limited internet access, making it a reliable and convenient way for farmers to make informed about their agricultural practices.

(iii) Mobile phone

The use of mobile phone such as cellular, keypads, handsets, landlines and hand phone for information assessment in agriculture sector is since 1975. The initial stage provide voice messages, text messages services and this is the time farmer

cannot widely accessible that is each households did not have one cellular phone however farmers connect only middle man in order to get market for their yields. Mobile phone is popular because it is easy to carry everywhere timely information assessment and easily communicate with one to another.

After digitalization revolution, smart phone and tablets are broadly using and mobile phone function are high-tech and enlargement. In 2010, mobile phone with dual SIM cards are launched in the world market and two types of advanced software platform android and apple IOS in which apple IOS is luxury brand cannot afford rural famers and android phone is the bestselling and widespread utilize in developing countries. Mobile digital divides require battery charging that is mainly based on electricity or solar energy or power battery or engine that energy depend upon situation of rural village. Internet, software application and social media, location data (GPS) and shot message services, voice calling and voice message, long-distance call, digital camera, HD Video, live stream and any other functions comprise in digital mobile phone. Mobile phone performances are most effective and best ways for agricultural information assessment than other ICT tools and additionally online radio, online television and online video attainability in it.

Farmers use mobile phones for accessing agricultural information due to several reasons. Mobile phones provide easy and quick access to a wealth of information related to crop management, weather forecasts, market prices, and pest control. This help farmers make informed decisions in real-time, improving their yields and profitability. Furthermore, mobile phones overcome geographical barriers and connect farmers to experts, extension services, and fellow farmers, enabling them to seek advice, share experiences and receive guidance remotely. It helps to adopt best agricultural practices and stay updated with the latest developments in agriculture.

Additionally, mobile phone offers a convenient platform for receiving alerts, notifications, and reminders regarding critical farming tasks such as planting, irrigation, and harvesting. It helps farmers stay organized and timely in their operations. This democratization of information empowers small-scale farmers to make informed decisions that are positively impact on their livelihoods.

African research expressed that banana farmers receive profitable prices and reduce time and transport costs that are profitable for their farm by using mobile phone (Smale & Tushemereirwe, 2007). When mobile phone provides update, accurate and quick flow of information in agricultural market that farmer can trade

their products, reduce transactions costs and bring higher earning for rural farmers' household (Silva & Ratnadiwakara, 2008). The use of mobile phone improves social interaction between farmers and the business community.

An extension program on the use of mobile phone for Philippine farmers has been launched to provide farmers with information on delivery of fertilizer advice with text messages services through mobile phones, which has resulted in better results (Chhachhar & Hassan, 2013). In rural areas of developing countries, the use of mobile phone can improve the efficiency of farmers through the use of affordable communication technologies (Chhachhar et al., 2014). The use of mobile phone for agricultural information provides farmers with a powerful tool to access timely, relevant, and location-specific knowledge that enhances their productivity and contributes to sustainable agricultural practices.

(iv) Computer

After the industrial revolution, computer started to use for agriculture information assessment moreover computer can control modern farming machinery such as autopilot tractors, artificial intelligence, drones, and robotics and remote sensors. Computer is one of the put factors changing the traditional agriculture to modern digital agriculture system. Computer plays a vital role in modern agriculture by aiding in various aspects of farming. Computers are used for various purposes such as data collection, analysis, and decision making.

Computer is widely adopted and applied in precision agriculture in the most developed countries. Farmers can precisely target their actions and minimizing the environmental impact through precision agriculture system. In precision agriculture, computer is basic element for computer controlled devices (automated system) include automatic milking system, automatic watering system and agricultural robots (Mandal, 2013). Additionally, computer-based tools assist in optimizing resource utilization, enhancing crop yield, and reducing waste. Farmers are increasingly using computers and technology to enhance agricultural development in developed countries.

Farmers use computer for agricultural information because those tools offer quick access to a wealth of data about crop management, weather forecasts, market prices, and pest control (Jain et al., 2017). Computers help farmers make informed decisions, optimize their practices, and increase productivity. They can access online

resources, collaborate with experts, and employ software for tasks like crop modeling and irrigation management (Ascough et al., 2002). The use of this irrigation technology in agriculture is efficient, it reduces risks, and ultimately provides to better yields and profits.

Computers mainly run office software such as Microsoft program; storage and transfer of big data that provide expeditious social media and manage variety data. In addition, it also facilitates decisive environmental measurements that prevent over-spraying of chemical pesticides and over-sowing of excess seed on the farm. It computing profit and loss, data running and storing, diffusion and monitor the irrigation, field mapping, soil sampling, crop scouting. Computer-enabled software applications and databases are helping farmers to track livestock health, manage inventory lists and access market information. By harnessing the power of computers, farmers can improve efficiency, increase yields, and adopt better agricultural practices.

Famers in some developing countries still cannot use computer for agriculture because computer is very expensive than mobile phone and need good digital literacy. It is difficult for farmers to adopt and use the computer however government, research institution and non-government organization use computer for agriculture research and training for farmers. Farmer improves their productivity and income if computers are effectively and expansively utilized however the main problem is the digital literacy, training and liquidity constraints for adoption of computer among farmers for their agriculture.

(v) Internet

Internet is the search engine otherwise global network for globalization information age and it use for agricultural information assessment since the 20^{th} century however developing countries are in 21^{st} century because of behind the ten-year than developed countries in the world. E-commerce, e-agriculture, e-banking, e-payment or digital payment, research, reading e-books, downloading files, software updates, online discussion groups and forums, g-mail, e-mail and social media that are the proportion of internet that is use practical in agriculture sector.

The rural farmers can use internet if telecom tower exist in remote rural area. Farmers use the internet for agricultural information due to its accessibility and wealth of resources (Haruna & Dahiru, 2017). Online platforms offer real-time updates on

weather patterns, pest control methods, crop management techniques, and market trends. This enables farmers to make decisions, optimize yields, and adapt to changing conditions. Internet can make the best flow timely and authentic information for farmers that can make profit from the online market, listen to online radio, look at online television, and self-access knowledge and good practices form online seminars, workshop and discussion groups. Internet can bring positive and rising competitive benefits for farmers (Smith et al., 2004). The use of internet is ability to connect farmers with experts and peers make it an invaluable tool for modern agriculture.

(vi) Social Media

In the middle of the 20st century, social network such as E-mail, Google, Facebook, You tube, etc. that are useful software application for information transmutation from one to another and also most popular trends at least in rural people are utilizing this social media. Cooperation with big data and internet of things provide the social network function for the efficient storing and transferring diversity data such as emails, videos, audios, text messages and documents files etc.

Social media and youth are connected these days. Every youth uses social media, and youth without social media is out of date. Social media can enable online education and training and bring employment opportunities to young people. YouTube is the world video network that is farmers can learn training and good practices techniques used by other farmers in different countries around the world. The important point is that farmers need to click the following buttons of their interesting pages, blogs and websites.

The agriculture academia, research institution, government and non-government organization create agricultural knowledge pages, blogs and websites for farmers on Facebook. Farmers can discuss and ask their farming problem in the pages chat box. Farmers can create groups such as farmers to farmers groups, farmers to experts groups on social media in addition farmers connect with agriculturalists through social media and get advice for their farm (Burbi & Rose, 2016). Farmers use social media applications as valuable tools for accessing agricultural information due to various reasons. These platforms provide a space for farmers to connect, share experiences, and exchange knowledge with peers, experts, and agricultural organizations (White et al., 2014).

The real-time nature of social media allows farmers to stay updated on the latest trends, techniques, and innovations in farming practices. Additionally, social media enables farmers to overcome geographical limitations and access information from across the globe. In developing and developed countries, social media platform links as a bridge between farmers and extension workers for agricultural extension (Jijina & Raju , 2016). By following agricultural experts, research institutions, and industry influencers, farmers can gather insights, seek advice, and troubleshoot issues. This interactive exchange of information on social media aids in making informed decisions, optimizing yields, adopting good practices, and improving overall agricultural productivity.

(vii) Agro-Mobile phone Applications

Today is the era of app-economy and the development of mobile phone applications for agriculture sector began in the middle of 20th century. In another way, it can be called **m-agriculture**. Young agriculture student, young researcher are integrated with telecommunication companies are launched and developed the agriculture application. GPS and GIS location data are basal for all agriculture mobile phone application and mobile camera and video are used for online market therefore farmers do not need to go to the traders or experts in addition that can enhance cost-effectiveness assessment and inform decision marking and reduce waste and loss in the farm.

Farmers utilize agricultural mobile phone apps to access essential information for their farming activities due to various reasons. Agricultural mobile apps are designed to help farmers with various aspects of agriculture, increasing access to extension services and from crop management to market information (Qiang et al., 2012). These apps provide real-time updates on weather forecasts, pests and disease alerts, market prices, and best practices. There are expressing some famous agro-mobile apps in the worldwide.

Kishi Jagran is a popular Indian agricultural app that provides farmers with information about crop cultivation, weather forecasts, market prices, and agricultural news. It also offers expert advice on farming techniques and pest management. **Plantix** is a widely used app that helps farmers identifies plant diseases and nutrient deficiencies. Users can take pictures of their crops, and the app uses AI to analyze the images and provide recommendations for treatment.

AgriApp is a comprehensive agriculture app that covers various aspects of farming, including crop management, pest control, weather forecasts, and market prices. It aims to assist farmers in marking informed decisions about their agricultural activities. **Farmlogs** is an app designed to help farmers manage their farms more efficiently. It offers tools for tracking field activities, monitoring equipment, and analyzing crop performance data. It helps in creating plans for planting, fertilizing, and harvesting.

MyAgriGuru is an app that provides personalized agricultural advice to farmers. It offers guidance on crop management, weather forecasts, and market trends. The app uses data analysis to offer recommendations based on the user's location and preferences. **AgriMedia Vedio** is an app that delivers educational videos related to agriculture. It covers topics such as crop cultivation techniques, pest management, and innovative farming practices. Farmers can learn from experts through these videos.

Farmer Edge is a precision agriculture platform that offers real-time monitoring of fields. It collects data form sensors, drones, and satellites to provide insights into crop health, moisture levels, and yield predictions. **FarmAtHand** is a farm management app that allows farmers to keep track of tasks, inventory, expenses, and sales. It helps in organizing farm activities and maintaining records for better decision-making.

The key point is that farmers need to installing and subscribing the application in mobile phone to get daily agricultural information. These apps are valuable tools for farmers, providing them with information, insights, and resources to optimize their agricultural practices (Kumar & Agrawal, 2020). By using these apps, farmers can make informed decisions about planting, harvesting, and selling their crops, ultimately improving their yields and income. For example, farmers receive improved agricultural productivity by using agricultural mobile phone applications in China, India, Kenya, Uganda, South Africa and Tanzania countries (Okoroji, 2019). The convenience of receiving timely information on their smartphones allows farmers to overcome geographical barriers and access knowledge that can positively impact their agricultural practices.

2.3 Technology Development and Improving Agricultural Productivity

Nowhere, lack of innovating and applying of science and technology neither achieve into growth and development for the country nor pursuit into developed countries in the world. Industrialization, Urbanization, Digitalization and Globalization have been emphasized in most countries of the world simultaneously agriculture sector need to efficiently digitalize technology in the process of production, distribution, marketing, trading, transporting, financing and learning education. Technology can contribute improving agricultural productivity without devastation the natural resources and environment how to conserve environment is mainly depend on utilization of livestock manures, composts and mechanical procedure for curbing pests and diseases. Thus, the substitution between inorganic inputs and organic inputs use in practice that can foster environment and more produce quality standard food for human.

Improving agricultural productivity can promote famers' income as a result self-financing for their family, provide family's health and education, more devote in their farms in other words improving living standards of their lives. Investment in health and education by farmer is the most effective tools for rural growth and development that can increase skill labor and labor productivity. Technology plays an important role of agricultural development and rural development afterwards agricultural development promotes economic development that can be positive relevance between technology development and agricultural development. Technology adoption among farmers is the essential fact for agricultural development because if the farmers do not apply technology in agriculture, the development of agricultural sector that cannot be achieved.

Awareness for adoption of modern technology is crucial that it need to incentives and knowledge by government and non-government organization. Agricultural products price changing and high profit for agricultural business that is the result of adoption technology and normally farmers adopt the technology when the expected benefits are higher than current costs (Kijima et al., 2010). Inventions of ICT broaden not only agricultural extension and advisory services but also contribute modern digital technology adoption. An availability and affordability technology among famers is highlighted problem solution by government in most developing countries.

At digitalization epoch, animal-based farming system is virtually disappearing and many types of agriculture systems are now conceived such as digital agriculture, precision agriculture, numerical agriculture and smart farming system in the worldwide. Digitized agriculture technologies transform agricultural system by doing agriculture with using ICT tools and monitoring the whole system are widespread utilize in agriculture sector especially in developed countries.

ICT is mainly use in the whole sub-sector of agriculture such as finance, markets, value chains, advisory and extension, innovation systems, agricultural risk management, food security and traceability, irrigation system, land administration and management. The data-driven approach is replacing and regenerating from traditional farming management system and digitalized supply chains additionally mainly based on ICT tools such as big data and intent of things (Deborah & Lewis, 2015). The acceptance model of technology proved that accessibility for technology that mainly upon farmer get credible and timely agricultural information, preferable agriculture infrastructure and well management.

The functions of ICT is prevalent and any rest of the other technology mainly based on ICT that support productions intensify technologies and boost digital agriculture system and also one way of enhancing agricultural productivity in developing countries. At a result of modern technology adoption, farmer share profit with their neighbours, lowering transportation costs, achieve economies of scale, obtain agricultural development, reduce poverty and develop rural living standards. At a broader level, agricultural development is already achieve when remote areas of farmers adopting and accessing modern technology that is the main problem faced in many developing countries of the world.

2.4 The Constraints in the use of ICT among Farmers

While farmers use ICT in the agriculture sector face many constraints can be classified into social constraints and technical constraints. Social constraints includes weak awareness benefits application of ICT for agriculture, negative attitudes towards ICT, high costs for assessment of ICT devices, language problem, and other social factor such as gender, marital status land ownership, culture and traditional. Technical constraints include insufficient and lack of electricity power, poor internet connection, lower digital literacy problem, lack of basic ICT skill, lack of ICT training in agricultural education, lack of ICT adoption in agricultural institutions.

Government and research institution give incentives investment profits and awareness to agriculture entrepreneurs and financial institutions for investment in public ICT infrastructure (Kimbowa, 2013). The fundamental element is lecturing and explaining about opportunities and benefits of ICT tools using for farming activities while extension workers meet directly with the famers in rural areas. Rural farmer face constraints access to ICT tools even though strengthening public ICT infrastructure in the rural area. In the digital age, ICT tools are popular trends in the worldwide moreover most famers buy mobile phone for the purposes of communication but they do not know broad-based ICT network and it all activities.

First and foremost, mobile and social media are interrelated things that farmers incur the buying costs for mobile phone moreover they face additional costs such as phone bills, internet service costs and other relevant phone accessories costs. Government levied sales taxes the mobile phone companies is high rates of tax however companies incurred taxes added to the mobile phone prices that replace incurred by the customer buy mobile phone with higher prices in Kenya (Cheneau-Loquay, 2004). In many developing countries, Internet services companies are not expanding with the nationwide that exist only in the urban area therefore rural area used internet through mobile phone bill and cannot available Wi-Fi services that phone bill is more costly than internet services Wi-Fi.

Most of mobile phone applications are fee-based system and farmer pay subscription fee for using this application to get information that is the one type of constraints for farmer (Futch & McIntosh, 2009). National Language and English Language are mostly applying in mobile phone application moreover at least five languages describe in application in developed countries. Only local language carryout the knowledge and effective personal management decision while rural farmers searching knowledge from the web-based, websites, and internet network (Anoop et al., 2015)

Young farmers include both man and women are active and willing to adopt ICT tools and novel technologies than old aged farmers in agriculture sector in today. Gender equality in agriculture means collaboration working together in the workplace that improving the farming activities and enhance productivity. Rural literacy women as labour force implicate in the farming activities and production process moreover literacy young women implicate as entrepreneurs, traders implicate in the agriculture sector (World Bank, 2011).

ICT tools are not effectively used in agriculture sector due to lack and insufficient electricity and poor internet connection is depending on government sector. This is not the whole national problem but rural problem because some remote rural area lack of electricity that they use solar energy, engine power and harnessing and some area often cut off electricity form electric power corporation due to insufficient electricity. Insufficient power supply and infrastructure causes impediment the ICTs application among farmers in rural area (Barakabitze et al., 2015). Poor connection is relevant with ICT public infrastructure such as Telecom Tower that some remote rural area are far from telecom tower and the connection depend on the distance therefore lack of public ICT infrastructure and poor connection still take place in many rural areas in African countries (ITU, 2017).

The lower digital literacy problem and lack of basic ICT skills are face while start using ICT tools such as mobile phone and computer by rural farmers in the worldwide. Famers can learn from youth about digital tools and another way is that digital literacy training program help the digital literacy problem of rural farmers. Low digital literacy and lack of ICT expertise causes inequality of ICT adopting in agriculture (Taragola & Gelb, 2005). In developing countries, lack of ICT, lack of digital literacy training program, lack of ICT education training and lack of ICT adoption in agricultural institution are directed relevant with government, research center and low and lack investment of INGOs and public private partnerships moreover extension program do the traditional way that are institutional problem and poor financing and investment problem that associate with political situation (World Bank, 2016) .

The publication of handbooks with local language about different ICTs tools and instruction emulate by government at all level of education. Government, research institution, INGOs, Public and Private Partnerships, agricultural extension institutions and farming communities are being consolidate working together that is overcome the constraints and barriers for improving productivity and rural development (Munyua et al., 2009).

2.5 Theoretical Framework of ICT

2.5.1 Agricultural Technology Information Dissemination Model

Information dissemination is key factor for agriculture production that helps improving productivity and enhances agriculture and rural development. In 2009,

Wang and Baofeng constructed the Agricultural technology information dissemination model based on the Signaling theory (Wang & Chen, 2009). Disseminators, receipts, message, media and feedback are the main actor of information dissemination process. Government-oriented agricultural institutions, agricultural extension and advisory services organizations, rural agricultural information centers, agriculture academia organization, NGOs and research institutions are the main transmitting the information that includes disseminators and farming communities and farmers, experts and agro entrepreneurs are receipts. Messages refer to agricultural information moreover media includes print media and ICTs tools. Disseminators deliver and transfers agricultural information to the receipts by using ICTs tools that is information dissemination process.

Today, Information dissemination is quick and effective due to information and communication technology (ICT) moreover farmers need advice and guidance before their production and management, and disseminators need to provide timely and reliable information to rural farmers for improving productivity and rural development. Ministry of agriculture's web portal, Farmer's channel and Department of Agriculture Call Center are working with the process of agricultural technology information dissemination model in Myanmar.

2.5.2 Rogers' Diffusion of Innovation (DOI) Theory

Nowadays, countries in the worldwide need sustainable economic development because economic development causes environmental degradation due to industrialization and using pesticides in agriculture causes environmental pollutions and foodborne illness thus economic, social and environmental elements need to develop for sustainable economic development (Coccia, 2015) (Allen et al., 2018). Sustainable economic development should include environmental conservative technology adoption agriculture system especially aim to knowledge based agriculture system or ICT based digital agriculture system. Technology innovation and adoption are the important point for the agriculture development moreover technology diffusion and innovation relevant to the Rogers' diffusion of innovation theory (DOI) that can be used in health, education, economic, technology, political science, history and communication subjects (Rogers, 2003) (Tata & Mcnamara , 2016).

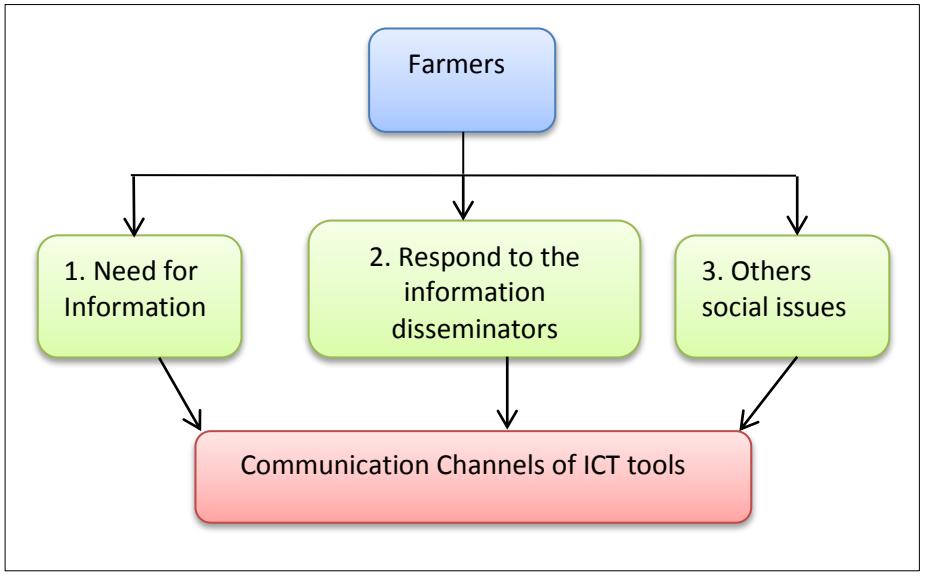
"Diffusion is the process in which innovation is communicated through certain channels over time among the members of a social system" defined by Rogers

(Rogers, 2003). Rogers stated that "Innovation in agriculture is the implementation of ideas, products, practices, processes and services or apparent improvements in certain environment with attention to benefit the society and the individuals" (Salman et al., 2019).

The Diffusion of Innovation Theory analyzes how and why decisions are made to adopt a new technology by diffusion through communication channels (Freeman & Mubichi, 2017). The diffusion of innovation theory comprises with four main factors; innovation, communication channels, time and social system. Communication channels such as ICT tools connect timely and accurate innovation information with individual and social system.

Farmers use communication channels of ICT tools such as radio, television, mobile phone, computer for the three main reasons; (i) they need information, (ii) they respond to the information in another ways is called to give their information feedbacks to the disseminators and (iii) they use for other social issues. This process is illustrated in Figure (2.1).

Figure (2.1) Three Main Reasons of Farmers using of ICT tools



Source: Diffusion of Innovation Theory

In the context of information and communication technology use among farmers in agriculture, theory provides to understand how the adoption of technology occurs. The theory identifies five adopter categories: innovators, early adopters, early majority, late majority, and laggards. Innovators are the first to embrace new

technologies, followed by the early adopters who are influential within their social circles. The early and late majority are the risk-adverse, adopting the technology as they see its benefits proven. Laggards are the last to adopt due to skepticism or lack of access.

Theory apply among farmer means recognizing that some eagerly embrace new ICT tools, while others wait for the evidence of their benefits. Effective strategies include targeting influential early adopters to create positive word-of-mouth, demonstrating the technology's benefits, and addressing concerns of the late majority and laggards to encourage wider adoption. This approach helps ensure that ICT innovations in agriculture are integrated successfully and sustainably. Theory provides social, organizational and personal motivational factor to adopter in educational-related technology adoption, agricultural innovation adoption and other information system projects stated by the previous studies (Medlin, 2001) (Tata & Mcnamara , 2016). The assumption of theory perform top down process that contribute effective adoption of innovation thus easily flow of quality innovation information from agricultural information centers to the farming communities.

Some countries use other model and theories for example; China have successful in agriculture they constructed and using ICT-based information services model for the research support the farmers applying ICT in agriculture (Zhang et al., 2015). Therefore, this study investigates the use of ICT among farmers in Myanmar agriculture sector using Rogers' diffusion of innovation theory and agricultural technological information dissemination model as a framework.

2.6 Reviews on Previous Studies

Many previous studies using diffusion of innovation theory in the use of ICT in agriculture have been researched in many countries around the world. Previous studies found that the use of ICT in agriculture by farmers can increase their welfare.

Silva and Ratandiwakara (2008) studied the using ICT to reduce transaction costs in agriculture through better communication through a case study form Sri Lanka. Their study aimed to examine the specific roles of ICT in reducing transactions costs in agriculture by enabling timely and cost-effective communication. They employed a questionnaire-based survey, concentrating on vegetables farmers within the DDEC market association. This study revealed that farmers' income increased due to improved market access and pricing resulting from the effective use

of ICT. Their study suggested that incorporating ICT, such as mobile phones, at various stages of the agricultural value chain could reduce information search costs and significantly lower transaction costs, thus enabling more farmers to participate in the agricultural value chain market.

Lokeswari (2016) investigated the use of ICT among rural farmers in India. His study objectives were to explore how farmers can use ICT and access the benefits farmers perceived from ICT usage. Method of his study was conducted interpersonal in-depth interview with agricultural market information services providers, farmers, trader and agricultural officers, with a primary basic in the Diffusion of Innovation (DOI) theory. The findings indicated that exposure to mass media was conducive to farmers embracing ICT. Furthermore, ICT had the potential to benefit all smallholder farmers by providing enhanced access to natural resources, improved agricultural technologies, more effective production strategies, better market access, and access to banking and financial services, thereby raising the living standard of rural smallholder farmers. The study concluded that the extent of farmer' ICT usage was contingent on ICT infrastructure development and training, underscoring the importance of focusing on these aspects, especially for smallholders, to establish a robust market information system.

Freeman and Mubichi (2017) examined the ICT use by smallholder farmers in rural Mozambique through a case study involving two villages in central Mozambique. The study aimed to investigate the use of various types of ICTs tools for information acquisition among smallholder farmers, including radio, television and mobile phone. The study method was qualitative study using a deductive content analysis process and case study approach, underpinned by the DOI theory as a theoretical framework. Their study found that radio and mobile phone were the most commonly use ICT tools, each offering distinct forms of information access. The findings suggested that farmers were open to adopting ICT for agricultural information, highlighting the potential for greater adoption and its impact on agricultural practices.

Thinzar Myint Lwin (2017) studied that the use of media among farmers in Tharyarwadi Township. The study objective was the role and effectiveness of media in disseminating agricultural information among farmers. The study employed a descriptive method, utilizing survey questionnaires to collect data from farmers, with a theoretical framework on China's ICT-based information services model. This study

found that farmers' media usages for agricultural information have positively influence their farming productivity and improve their living standards. The study suggested that importance of media sector development in promoting agricultural sector growth, emphasizing the need for effective media initiatives to support farmers.

Nzonzo and Mogambi (2018) conducted an analysis of communication and information communication technologies adoption in irrigated rice production in Kenya. Their study employed a descriptive survey method, incorporating farmers and key informant interviews with two extension officers and two extension officers. The study was based on theoretical framework of DOI theory and Technology Acceptance Model. Their findings indicated that the most influential factors driving ICT adoption among rice farmers were increased rice productivity, improved knowledge and skills in rice production and access to market information. The study suggested that implementation of workshops, training programs and awareness campaigns at both the national to central government level. It also stressed the need for radio and television to broadcast more agricultural programmes at convenient times for farmers.

Mishra et al. (2020) studied the benefits of the use of ICT services perceived by farmers for acquiring agricultural information in central U.P. Their study utilized a randomized survey, involving questionnaire and interview with 120 respondents from six villages. The study encompassed various ICT tools, including radio, TV, mobile phone, internet and social media. The study categorized the level of benefits perceived by farmers, with radio was low benefit level, TV, mobile phones and internet presenting a medium benefits level, medium benefit level, mobile phone was medium benefits level, and social media resulting in a low benefits level. The study concluded that raising awareness and enhancing ICT infrastructure in rural areas were essential to further leverage the benefits of ICT for farmers.

CHAPTER-III
THE ROLE OF ICT FOR AGRICULTURE IN MYANMAR

3.1 The role of ICT in Myanmar Agriculture sector

Myanmar includes one of the agro-based countries and rural population are massive than urban population, agriculture development is needed for rural development and that two elements are interrelated for the country development proved with the academic research by Ohnmar Tun in 2011 (OhnmarTun, 2011). In the central statistical year book, total population of the country is about 54.59 million in 2019-2020 and total population of 70.1 percent live in rural areas and 29.9 percent live in urban areas (CSO, 2021).

About 23.3 percent of Gross domestic product (GDP) is agriculture sector because of the country trying to pursuit the more economically developed country (MEDC), the percentage of agriculture in Gross Domestic Product (GDP) is declining to double during the 10 years (2008-2018) with have gradually have been increasing the percentage of service, industry and other sectors. Labor force participation in agriculture is 46.47percent in 2020. Most of rural people are depending heavily upon agriculture and livestock. Agricultural exports were one-fifth of the country total exports and agricultural products exports earning were US$3.3 billion in 2019 and the main exported to China, India, Japan, Singapore, Thailand, Malaysia, Philippines, Indonesia, Bangladesh and Sri Lanka.

In last three decades, farmers already used ICT tools for assessment of agricultural information such as radio and television and most of information are off-line information. Radio and television are the effective ICT tools that have been still using in the present and with the technology upgraded that can get live-stream information and about 60-65 television programs and 16 radio programs are broadcasting in the whole country. Information and communication sector have been incipient accelerated in 2010 that took place telecommunication sector reform.

After the telecommunication revolution, government supported public telecommunication infrastructure and collaborated with international investors and

internal investor therefore enter the foreign telecommunication companies and mobile phone companies into the country that customers choose their favourable SIM cards and mobile phone. SIM cards are now available in only 1500 mmk and every household across the country uses at least one mobile phone. In the rural remote area use internet through their phone bill and internet service company mainly provide service in urban area and that cannot widespread into the rural area that accompany with the electricity sector and some remote area are still lack of electricity.

Communication is linked with all human life activities in the digital era and country's digital technology transformations was introduced in 2013 and started transform to all sector; agriculture, manufacturing, transportation, communication, education, health and political and economic sector of the country however that is latter than ASEAN countries. Nowadays, neighboring countries such as China, India and Thailand efficiently utilized high-tech agricultural system and achieve successful stories in agriculture sector that are epitome for Myanmar trying to pursuits these countries.

In 2018, the universal service fund (USF) had been started to support fund for Myanmar ICT sector infrastructure that expanding the network coverage for the whole country. The internet network is now expanding from 2G-3G to 4G-5G in June 2019 and there is now existed about more than 250 ICT companies for the whole country. As a result, the country mobile subscription rate is 126 percentage, internet subscription rate and social media penetration rate are 41percent in 2019-2020 moreover total populations of 68.24 million are obtaining mobile phone network and internet and 22 million are using internet and social media (Simon Kemp, 2020).

As mobile penetration increased, mobile network coverage expanded to the rural areas. The availability of mobile phone revolutionized communication among farmers, allowing them to connect with buyers, suppliers and fellow farmers. This accessibility also facilitated mobile money services, enabling secure and convenient financial transactions for agricultural trade. Government initiatives and partnerships with international organizations also played a role in this development. They aimed at increasing internet penetration, enhancing digital literacy and promoting technology adoption among farmers. Such efforts encouraged the integration of telecommunications tools into daily farming practices, transforming traditional agriculture into a more modern and tech-savvy industry.

The role of ICT in Myanmar's agriculture sector has been significant in several ways. ICT tools and technologies have been adopted to enhance various aspects of agricultural practices such as access to information, market linkages, precision farming, financial inclusion, extension services supply chain management, data collection and analysis, capacity building, climate resilience and policy implication. ICT provides farmers with easy access to relevant information on weather forecasts, crop prices, pest and disease management, and best agricultural practices. This empowers farmers to make informed decisions and improve their crops yields.

Through ICT platforms like mobile apps and websites, farmers can connect with buyers and market directly. This reduces the dependence on middleman and improves their bargaining power, leading to better prices for their produce. ICT tools such as drones, GPS, and sensors enable precision farming practices. Farmers can monitor soil moisture, nutrient levels, and crop health in real-time, optimizing the use of resources like water and fertilizers. ICT solution, including mobile banking and digital payment system, enable farmers to access financial services more conveniently. This helps them secure loans, manage their finances, and invest in modern farming techniques.

ICT facilitates the dissemination of agricultural extension services through video, audio messages, and online platforms. The widen reach of expert advice and guidance to remote areas where traditional extension services might not be readily available. ICT tools helps streamline the agricultural supply chain by tracking the movement of goods from farm to market. This reduces wastage and transactions costs, improves logistics, and ensures better product quality.

ICT enables the collection and analysis of data related crop production, weather patterns, and market trends. This data-driven approach allows policymakers and farmers to make more informed decisions. ICT can help farmers adapt to climate change by providing real-time weather updates and suggesting appropriate strategies to face with changing conditions. ICT can assist in implementing government policies effectively. For example, government organizations use ICT to monitor the distribution of agricultural subsidies and inputs to farmers. Knowledge and awareness program, online trading and market expansion are facilitated on the mobile application, web-based application and Facebook pages.

During the COVTD-19 crisis, agricultural products wholesalers enterprises and Organic products business, and Wholesale Grocer enterprises such as METRO Wholesale Myanmar, Farm shop and D2DFlower-Zay2Go work not only online business in Facebook Social Media but also advertising from radio and television and payment transaction are applied the mobile financial services for remote urban and rural area and products can be orders from online chat box or call the office phone and using intermediaries such as delivery services moreover customer complaints are solving by customers service center moreover customers can enquire and ask their what to know about the products at the customer services that timely reply.

Overall, ICT's integration into the agriculture sector of Myanmar enhances efficiency, reduces information asymmetry, and empowers farmers to make informed decisions, contributing to the sector's growth and the country's food security. In Myanmar, where agriculture is a significant sector, ICT has the potential to modernize farming practices, improve productivity, and uplift the livelihoods of farmers. Its role continues to evolve, contributing to the sustainable growth of the agriculture sector while addressing challenges such as limited access to resources and markets.

3.2 Types of ICT tools for Agriculture sector in Myanmar

In Myanmar, radio and television are used for agriculture since the traditional agriculture. Mobile phone, computer, internet and social media are started to use for agriculture after telecommunication revolution. Agro-mobile apps are started to use in digital agriculture transformation. The activities of agricultural information dissemination ICT tools in Myanmar are detailed under the following;

(i) Radio

"Voice of Burma" is the first broadcasted radio program on air in 1963. British government was set up Burma Broadcasting Service (BBS) that included national language and English language, music and entertainment, education and knowledge instructions and local and international news in 1946. In 1997, military government modified the BBS program to the Myanmar Radio and Television (MRTV). Over the years, radio became a significant medium for disseminating information and entertainment to the population. In the present decade, MRTV is state-run radio program undertake by Myanmar Radio and the Myanmar Radio Ministries Service have four services Yangon Service, National Service, National

Race Service and Distance Learning. In 2015, government published the Radio Broadcasting Law, allowed with joint venture and private radio FM station.

In 2019, there have been now ten FM programs; Yangon City FM, Mandalay City FM, Shwe FM, Thazin FM, Cherry FM, Padamyar FM, FM Bagan, Khayae FM, Teen Radio (Pyinsawaddy FM) and Myanmar International Radio (MIRadio) moreover Voice of America (VOA), BBC, Radio Free Asia, Democratic Voice of Burma and Radio Australia that radio program were well-liked and reachable in nationwide. Main Radio Stations have now existed in Nay Pyi Taw and Yangon and ten radio programs have difference areas coverage between seven states and seven regions and broadcasting news are being controlled by MRTV because of private radio station are joint venture with Ministry of Information.

In Bago Region are now available four radio stations; Thazin FM, Shwe FM, Padamyar FM and Myanma Radio. Nowadays, most Radio programs broadcast with on air, online and mobile phone application about education, health, economic, political and sports news, livestock and agriculture, weather forecast, Market price information, music, entertainment, national and international music moreover advertising influence in commercial radio program moreover quizzes program, popular people interviewing program, foreign language instruction program and traffic hotline to taxi drivers for traffic conjunction condition that are influence in urban areas. It is transmitting 18 hours a day in Myanmar time from 5:30 am to 11:30 pm therefore each sector are assigned with specific time.

In the digital age, radio still holds importance, but other forms of media have gained prominence. This includes television, online streaming, and social media. Despite these changes, radio remains a vital source of information and entertainment, particularly in areas with limited access to other forms of media. In 2018, evocation of the non-profit radio programs was Khayae FM that was also first community radio station that daily broadcast about agriculture and livestock, education and cooking especially for dwellers of Htan Tabin Township in Yangon Region.

Radio is the most effective information tools for rural areas because of radios are cost saving and rural residents have awareness listen to radio about weather forecasting for their farm in the past decade. In the digitalization period, most of rural people are not expressively buy to read newspapers that replacing with reading digital news from mobile phone and they can listen to radio if they have mobile phone do not expressively buy the radio.

Radio can facilitate necessary knowledge about digital agricultural technology practices for illiterate and literate farmers moreover radio program more efficient due to mobile phone (UNESCO, 2017). Radio broadcasts daily market price information with local languages such as foreign exchange price, agricultural products price and fuel price and gold price and consumer goods prices. In the Quizzes program, farmers can ask what to know and what they need about their farm connect with the radio program that is effective for rural people and well-management their farming activities that increased agricultural productivity (Thinzar Myint Lwin, 2017).

(ii) Television

In 1979, the first television program has been started testing in Yangon is the main place broadcasting television network and BBS television services was started in 1981. Since 1980, color TV used in Myanmar and HD and live stream system was available in October 2013. In the present decade, there have been five main broadcasters in Myanmar MRTV, MWD, MRTV-4, Sky Net and Canal+ Myanmar. There have been two state-owned television networks; Myanmar Television and Radio (MRTV) and Myawaddy Television (MWD) with national languages that are running by Ministry of Information (MOI) and Ministry of Defense.

There have been now private pay television services and two satellite television pay TV services ; MRTV-4 in 2005 by Forever Groups Co., Ltd, SKY NET in 2010 that established by the Shwe Than Lwin Media Co., Ltd and joint venture with MRTV and CANAL+ Myanmar in 2017 that are joint venture with Forever Group Myanmar and Canal+ Group. Total broadcasting stations were 253 stations and digital terrestrial television that established 145 stations between five years (2012-2016) for the whole country. Television program can be classified into eight groups in Myanmar; Educational programming, Agricultural program, Entertainment Program, Sports program, Religious Program, Parliamentary and Political Program, Minorities program, Information Cultural and Travel Program and Commercial Program.

State-run total broadcasting times was 17 hours a day in Myanmar time and daily transmitting form 6:00 AM to 23:00 PM and some private television was transmitting 24-hour-free-to-air system. State-run television system specified percentage inclusion extent that was information is 45 percent, education is 25 percent and entertainment is 30 percent. Most of Private Television has been large percentage

of advertising for their profits. However, specialization channel such as education channel and farmer channel and Hluttaw channel have been emphasized about specialization element. The advantages of television channel are watching the agricultural technological video as like as practical training for the literacy and illiteracy farmers. Weather forecasting program and natural disasters warning program are detail presented for each state and region furthermore market price of agro products are expressed four times a day in all channels.

The farmer channel that controlled by Department of Agricultural Research (DAR) and one of the types of MRTV free-to-air television channel that start broadcasted in September 2013 that specialized agriculture and livestock that transmitting about giving incentives and knowledge to farmers for improving technology and GPA systems, solving the problem of pant and livestock diseases, pest control management, water management, modernized production equipments, fertilizers inputs, soil quality testing and soil conservation, quality seed selection technologies, weather forecasting and earning warning climate change adaptation, agricultural credit information, market conditions and market prices, agricultural research institutes case study, enhancing exports quality products and value addition (DAR, n.d.). Television programs can give so much of awareness and knowledge moreover that facilitate better decision making about their agricultural activities for all rural farmer (Thinzar Myint Lwin, 2017).

(iii) Mobile Phone

Mobile phones stated to gain popularity and usage in Myanmar during the early 2000s. In 2001, the government introduced a joint venture with a foreign telecommunications company, which marked crucial turning point in improving mobile phone access. This partnership allowed for the introduction of GSM technology, making mobile phones more accessible to the general population. However, telegraph line cannot reachable into farmers and rural people because that are very expensive and difficult to obtain as like as luxury products in last two decades and another reason the country's ICT infrastructure is insufficient and telecommunication is behind the Southeast Asia countries that can be specified by 10-years.

In 2013, Farmers and rural people was start accessed telecommunication line after telecommunication revolution that appearance of cheaper SIM Cards and choice

of much SIM cards from wide variety of Telecommunications companies such as MPT, Telenor, Ooredoo, Mytel. Four types of SIM cards are equally determined at the same price was 1500 mmk that applying accompany with top up phone bill cards such as 1000 mmk or 3000 mmk or 5000 mmk or 10000 mmk, etc. (MOTC, n.d.).

There have been now top ten mobile phone companies; Samsung, Huawei, Xiaomi, Oppo, Vivo, Apple, Asus, Realme, KMD and Tecno Mobile. Accessible and usage of mobile phone in rural area was suddenly meliorated between the seven years (2013-2019). Mobile phone prices are classified as the branded new products and Androids mobile phone are cheaper than IOS mobile phone. Most farmers and rural people were incentives to buy android smart phone with the price at least between 150,000mmk and 200,000 mmk because of their income situation (LIFT Myanmar, 2016).

Mobile phone can work many activities that available in voice call and video call, zoom meeting, online radio, online television, mobile phone application and using social media connecting with internet network and enhancing financial inclusion. Nowadays, 85 percentage of internet using with device is smartphone and other 5 percentages with computer. Lack of access to electricity rural areas are applying for solar energy, hydropower, wind energy and generator for mobile phone battery charging. Old and illiteracy farmers learn the application of smart phone from young family member agro-extension workers. Department of Agriculture Call Centre established in March 2017 that includes well-trained 50 graduated staffs possessed at least Bachelor of Agricultural Science and others are masters and PhD degrees.

Farmer connect to call centre hot line phone number **01-22399555** that always open in business days between the Myanmar time 10 AM to 3 PM and answers by staffs within 24 hours about farmers' questioning element have been consulting with agronomist. Call center facilitates timely and effective solution for the questions of modern technologies, seed technologies, packaging methods, logistics techniques, pest issues, fertilizers and environment issues, soil problem solution for farmers, agro-businessmen and entrepreneurs.

For agriculture sector, mobile phone can connect dealers and agriculturalists, market expansion, improving acceptable agricultural credits, accessible timely and update agricultural information, using agricultural mobile phone application, enhancing agricultural products exports, reducing transportation costs moreover famers can watching technology practice training video and knowledge posts at any

time at the websites. Therefore, farmers can make better decision making and market expansion and reduction transportation costs that improve agricultural productivity and increase their income by using mobile phone for agriculture sector (Thinzar Myint Lwin, 2017).

(iv) Computer

The adoption of computers in Myanmar began to gain traction in the late 1990s and early 2000s. The turning point came in the early 2000s when the government stated to loosen its control over information and communication technologies. Internet cafes and cyber cafes start to appear the internet and use computers. This led to growing interest in computing and digital communication tools among the population. Despite these developments, it's important to note that Myanmar's technological progress was hindered by various factors, including limited infrastructure, political instability, and economic challenges. The country faced difficulties in accessing the latest technologies and resources, which impacted the pace of computer adoption.

At the early stage, government cannot be sufficient supporting computer infrastructure at primary and secondary education level for the whole countries and student-computer ratio was average about 50:1 in 2014. There have been now twenty-eight computer universities and colleges in Myanmar. Moreover, there have been many private education institutions provide IT certificate courses with the level of basic computer skills, advance programming skills and diploma skills etc.

In the digital transformation, hand type-writers and accounting facilities with paper and pen that are replacing with computer at office, companies and education and all other sector. In recent years, there have been efforts to improve internet connectivity and technological infrastructure in Myanmar. As the country continues to evolve politically and economically, the use of computers and digital technologies is expected to further expand, enabling more people to engage with digital world for various purposes, such as education, communication, agriculture, and business.

Computers are widely used in government agricultural departments, Agro-services companies, fertilizers companies, microfinance institutions, researchers, students and extension workers. Computers have more storage spacing, complex functions and more efficient than mobile phone. Most of farmers and rural people are not widely used Desktop computer, notebooks and Laptop because of lower level of

digital literacy and its prices (at least 350,000 mmk) are expensive than smart phone that is constraint for the rural people. Computers are widely accessible and utilized in agricultural organization for example agro-information disseminators and that have effects on farmers and their agriculture productivity however farmers use mobile phone in spite of computer (Thinzar Myint Lwin, 2017). Farmers can adopt and use computer for their farm if the government provide the computer and digital literacy training at the village level agriculture community center in Myanmar.

(v) Internet

The internet began to be used in Myanmar arounds the late 1990s. Initially, its adoption was limited due to government restrictions and the high cost of connectivity. The situation started changing in the early 2010s when the government began to open up the telecommunications sector and promote internet access. This led to a significant increase in internet penetration and usage throughout the country. As the mobile network operators entered the market and infrastructure improved, the availability of affordable smartphones and data plans further facilitated internet usage among the population. Thus, Myanmar's internet adoption has evolved over the years, transitioning from limited access to more widespread availability driven by policy changes and technological advancements. Social media apps and agricultural mobile apps are launched and used mainly based on the internet. As everything is connected to the internet, apps can only be used when connected to the internet.

The utilization of the internet in Myanmar's agriculture sector has brought significant advancements. In Myanmar, MOALI Webportal uploads daily agricultural information for farmers in real-time. Farmers now have access to valuable information on weather forecasts, market prices, and agricultural techniques through online platforms. This enables them to make informed decisions about crop management, reducing risks and enhancing yields. Additionally, the internet facilitates online marketplaces, allowing farmers to connect directly with buyers, thereby eliminating middlemen and increasing their profits. This digital transformation has the potential to uplift Myanmar's agricultural landscape by empowering farmers with knowledge and market access.

(vi) Social Media

Social media application introduced in the mid of 2014 and YouTube, Facebook, Messager, Viber, Instragram, Twitters, Tik Tok etc. were extensively used in todays and most of rural farmers depend on Viber, Messager, Facebook and YouTube for communication and agricultural information .Viber was introduced in the later 2010 that was the first social media application and still now using 1billion of total population. In 2019-2020, Facebook was the popularity social media and about 10 billion users of total population, Messager application users about 7 billion of total population and YouTube application users about 9 billion of total population. Social media application work many kinds of activities communication, entertainment, e-commerce, online shopping, marketing and advertising, market expansion pages and blogging, group chatting, video conferencing, live streaming activities, online education and training, sharing knowledge.

Agricultural department call centre, Department of agriculture, livestock and irrigation (MOAIL), Agricultural research department, Non-profit Organizations, and Agricultural universities, Agronomists, Agricultural Extension workers, Agro-businesses, Fertilizer companies, Agricultural machinery companies, media companies especially radio and television undertake their activities disseminate with social media to the farmers however farmers connect at the business days of Myanmar time between 9AM to 5PM. Pages upload agricultural research case studies, market information, agro-credits information and modern digital technology knowledge moreover uploading elements are different from name and types of websites. Farmers increase awareness for technology adoption by using You Tube application that express worldwide agricultural technology practices and field case study video.

In democracy era, effectiveness of social media is equal access to information however farmers need awareness for pages, blogs and websites are subscriptions or following and famer easy to use social media applications downloads form the Google Play Store or shared with Zapya application from one to another and connect with internet network at any time they want to use. Social media application facilitates famers more connect with extension workers, consultant-agriculturalists and customers with national and international therefore that providing more effectives and efficient of mobile phone activities for agriculture sector (FAO & WFP, 2016) (Thinzar Myint Lwin, 2017).

(v) Agro-mobile applications

Agro-mobile applications have been begin launched in 2016 by Myanmar application developers. There have been twelve agro-mobile applications such as Site Pyo Yay, Ooredoo Site Pyo, Greenway, Thuta Myay, Htwet Toe, Goldden Paddy, Industrial Farming (AMD), Taung Thu Oo Gyi, Armo Farmer, Quality Seeds, Awba Channel, and Awba Soil Cares Adviser in 2019-2020.

Green way and Htwet Toe agro-mobile applications have 100K+ downloads users, Thuta Myay, Site Pyo Yay, Golden Paddy, Taung Thu Oo Gyi agro-mobile applications have 10K+ downloads users, Industrial Farming (AMD) and Quality Seeds agro-mobile application has 5K+ downloads users and Awba Channel, Awba Soil Cares adviser and Armo Farmer agro-mobile applications have 1K+ downloads users.

Department of Agriculture, Livestock and irrigation launched two agro-mobile applications with national Myanmar language and free-for-use for farmers and fund providing by LIFT (NGO) organizations that are Industrial Farming controlled by the Agricultural Mechanization Department and Quality Seeds controlled by Seed Division. Industrial farming (AMD) is the specialization of agro-machinery for farmers includes the seven sector that express the ways of how to choose modern agro-machinery for farm mainly depend on soil conditions, how to buy modern agro-machinery with the installment systems (3years or 7 years or 10 years), how to use modern agro-machinery in farm, how to analyze speed and time of agro-machinery, how to maintain the agro-machinery for long term use, how to calculate profit and loss for using agro-machinery in farm, providing machinery services enterprises and contact address and office phone number. Quality Seeds application is based on seed demand and supply forecasting system that includes farmers and seed producers in addition provide trading five types of seeds wheat, paddy, sesame, green peas and corn in this application (MOALI, n.d.).

Popular free-to-use agro-application Green Way that was the first agro-mobile phone application managed by the Greenovators Co. Ltd that facilitate farming record for digital notebook for livestock and agriculture , agro-product online trading, quizzes section, agro-information section, agro-inputs information, daily agro-market information, agro-extension workers' advisory and sharing farmer's experience moreover that famers can link with government organizations, farm-inputs business

and machinery rental services enterprises from this agro-application (Green Way, n.d.).

Htwet Toe agro-application that mainly funded by Myanma Awba Group that is detailed link with village of all sates and regions and consists of wide variety sectors on this free-to-use application with national Myanmar language that includes weather forecast, update market information, videos, modern technologies, quality seeds online trading, farm products online market, pests issues and advising, quizzes and answer section and incentive coupon gifts section in addition customer feedbacks are good impression (Myanma Awba Group , n.d.). Other two agro-applications developed by Awba Group such as Awba Channel and Awba Soil Cares Adviser are presented with English language that cannot be used for illiterate famers.

Golden Paddy agro-application managed by the Impact Terra and works with the theme "**agro-application for famers' benefits**" in addition that was free-to-use for farmers, retailers and others. The highlights element was available customized loan for famers that depend on ownership acres of farm by International Monetary Funds (MIF) and other microfinance institutions in these apps that include variety sections with national languages; advisory section, online trading section, advertising farm-inputs section, knowledge section, pests and water risk alarms sections, market price overview section, loan and credits sections (Golden Paddy, n.d.). Taung Thu Oo Gyi agro-application developed by Pro-X Software Development Group in this application express with national Myanmar language about the ways of how to calculate the acreages for their farm and farms' prices calculation therefore these free-to-use application only for farm land tenure and current market acre's price (Taung Thu Oo Gyi Website).

Thuta Myay agro-application launched by Myanmar Post and Telecommunication (MPT) in another way it was one kind of value added services of MPT that was free-to-use application with national Myanmar language that consists of not only agriculture and livestock information, agricultural laws, trading production technology, organic technology, current market prices information, weather forecast, agricultural calendar and agricultural articles but also entertainment, sports, cooking ideas, health and beauty, mobile TV, news and magazines, astrology and other knowledgeable articles, quizzes and lucky draw internet data moreover users subscribe in MPT SMS service **8834** for luck draw program (Thuta Myay, n.d.).

Site Pyo was developed by Ooredoo Myanmar that was free-to-use weather and agro-application that includes weather forecast and emergency alerts, soil and water management, weeds and pests control techniques, quality seeds production techniques, harvesting and storing guidelines in addition that facilitate Agro VIR, Agro Call Centre, Agricultural SMS tips and Agro Voice OBD (Site Pyo, n.d.). Site Pyo Yay free-to-use agro-application with national Myanmar language designed by Myanmar Dev Apps and that includes agricultural productions technologies, agricultural articles, news and magazines, fertilizers and the ways of how to make organic fertilizers. Agro-mobile applications intended better decision making for agricultural processes, enhancing qualified production, increasing bargaining power, enhancing income and improving livelihoods for agro-sector related people during the digitalization period.

3.3 Agricultural Research, Extension Training Activities and Advisory services

Under the Ministry of Agriculture, Livestock and Irrigation (MOALI), Department of agricultural research (DAR) attends the workshop, seminars of research training from International Agricultural Research Institutes (IARI). Agricultural extension Division (AED) facilitated training and visit (T&V) system in the past and knowledge, information and technology (KIT) system implement in the current situation. There have been five types of training; training by universities and institutes, central government training, overseas training, training under the UN agencies and Training by NGOs.

Training by universities and institutes was simple that depend on normal education program with diploma certificates, bachelor degree, master degree, professor degree and abroad education exchange program moreover training periods was at least 1 years to 7years based on the degree program. Central Agricultural Research and Development and Training Centre (CARTC) and Central Agricultural Research Institute (CARI) under the Central Government Training provide three types of training for agricultural extension agents; pre-service training, on-the-job training and in-service training.

Overseas training are facilitated by Mexico, New Zealand, Thailand, Korea, Japan, China, Norway, Italy, France, United Kingdom and Nepal about the elements such as post-harvest technology, hybrid rice production technology, wheat production

technology, flower wheat cultivation and processing, seed technology, sustainable agriculture and rural development, agricultural development in mountain areas, extension education, integrated agriculture and rural development through participation of local farmers etc. In August 2018, IWUMD, DOA, MOALI, ASDP and Cornell University in USA were jointly collaborated the training about agricultural extension executive and nutrition-sensitive agriculture capacity building training for agricultural managers and extension officers of MOALI (Dr. Khin Mar Cho, 2018).

FAO, UNO, UNOPS, UNCHS, UNESCO, WHO, USAID, UNFPA, UNDP, JICA, EU, ASEAN, DFID and AusAID facilitates HDI projects such as humanitarian needs and sustainable development, agriculture and rural development issues, poverty alleviation, agricultural extension, forestry conservation, microfinance, health, education, transportation, seed production technology, value added production technology, climate change management, water management, technical training for farmers with the form of projects and programmes.

In the view of the foregoing, training priorities determined based on review of various studies and existing literature that facilitated research section; hybrid rice research, oil seeds crop research, food legumes research, industrial crops research, vegetable and fruits research, soil research, water utilization research, agricultural engineering research, agronomy research, post-harvest technology research, seed bank research, biotechnology research, agricultural microbiology research, plant pathology research, entomology research. Moreover, community telecom centers, public private partnership for farm development, market led extension, market information farmer participatory extension, establishing farmer producer organizations, small farm mechanization, paddy-fish integrated farming system, industrial crop production technology, pure seed production technology, climate smart agriculture system are implemented in the present.

Agricultural advisory services started using to resistance the natural disasters and climate change management for the purposes of prevents the loss of natural disasters and increases farm productivity and farmers' incomes. Advisory services include specialized services such as seed selection, soil health, and fertilizer usage and pest and disease management. Furthermore, farm advisory squads and groups are facilitated collaboration with farmers, soil scientists and agriculturalists.

Advisory services provided through radio, television, mobile phone and effective's ways was call centers, text messaging and digital channel that deliver timely and accurate information to the targeted famers and groups of farmers. Department of agricultural extension controlled and managed with the top-down system administrative format that in the form of agricultural extension general manager to each 14 states and region to district manager to township mangers to village tract manager to resident farmers of villages and their performances are informed and submitted to general manger and work meeting one time in 15 days.

FAO stated that there have been six main types of extension methods; farm and home visits, group methods, demonstration, training, office calls and mass media in the Myanmar extension sector country programming framework (2012-2016) and modernized agricultural extension services depend on information and communication technology. "Strengthening Communication and Awareness Program" and "Adaptation Information and Advisory Service Program" are facilitated by taking the lead from MOALI. Nowadays, farmers easily connect and discussed with extension workers at any time about their problems in farming permits through the mobile networks and agro-mobile application (FAO, 2012).

However, Myanmar agricultural extension sector is understaffed and the existing workers are facing various constraints in their work. Limited resources, such as funding, technology, and transportation, hinder their ability to reach remote areas and provide adequate support to farmers. Transport facility such as motorcycles is needed to provide for extension workers as a result increase their working incentives (Aye Aye Khaing, 2017). Lack of proper training and professional development opportunities also impact their effectiveness. These challenges collectively limit their capacity to deliver valuable agricultural knowledge and assistance to farmers across the country.

3.3.1 Natural Resources Management &Water and Irrigation Management

As a country plentiful in natural resources, natural resources management was the first priority and agriculture related to natural resources such as land and water moreover depend on climate that in turn forestry. Country faced with environmental issues such as climate change and deforestation because of excessive exploitation of natural resources and development process such as industrialization and urbanization. Land tenure and land preparation, soil testing and soil conservation, water resources

management and fertilizer management were the basics facts of agriculture sector and mainly take responsibility by extension workers, environmental conservation department under the MONERC, department of land management and statistics, and department of irrigation and water utilization management under the MOALI.

Irrigation and water utilization management department (IWUMD) facilitate maintaining flood production embankments and polders system and preparing storm shelter and drinking water pond, and management of water storage with dam, weir, barrages, tanks, sluice gates and drainage channel distributed to the agriculture water use in 91 percent and domestic water use in 6percent and industrial use in 3percent for the whole country and central dry zones cannot attain sufficient rainwater therefore irrigation water has to be supplemented for agriculture water. According to the statistical year book 2021; 235 dams, 107 weirs, 71 tanks, 168 sluice gates, 208 pump irrigation, 227 embankments, 234 drainages and 3710 total irrigation were facilitated in the whole country (CSO, 2021). The percentage of paddy crops under the irrigation was the biggest than other cereal crops.

In the digitalization era, monitoring and controlling the irrigation system with the digital technology such as smart precision system with the smart phone depend on the temperature that can adjustment automatic watering and air temperature in hydro plant production. Drip irrigation, sprinkler irrigation and solar-powered pumps, mister, lightweight plastic water pump, ground sprayer, mobile foot-powered water pump and automated watering-can-styled irrigation, climate smart irrigation system etc were widely utilized for agriculture sector in the country.

3.3.2 Financial Inclusion

In the early 20th century, 70 percent of rural populations were still unavailable private banking financial services. Thus, Myanmar financial sector reform began take place in 2011 and government liberalized seven foreign banks and foreign investment companies are entered the country and private banks undertake the foreign exchange transactions and ATM machines are construct across the country. In 2013, Central Bank of Myanmar permitted licenses for private banks and financial services institutions and most financial institutions undertake in urban area. Nowadays, there have been 13 foreign banks and 31 local banks that can be classified into four groups; central banks, state-run banks, semi-government banks and private banks and state-run banks include four banks, semi-government banks include nine banks and private

banks include eighteen banks moreover there have been over 150 microfinance institutions and serving over 3 million clients.

Agricultural credits and subsidies for rural people are worked by the Myanmar Agricultural Development Bank, Rural Development Bank, Global Treasure Bank, Ayeyarwady Farmers development Bank (A Bank), Glory Farmer Development Bank (G-Bank), Shwe Rural and Urban Development Bank (Shwe Bank) and Myanmar Microfinance Bank however private commercial banks content about less than two percent and other large amount provided by Myanmar Agricultural Development Bank (MADB) that largely facilitated in paddy sector seasonal loans for smallholder farmers. For the agriculture sector financed supporting by four types; crop loan, livestock loan, small business loan and on-the-Go-loan for famers and rural entrepreneurs by MADB and NGOs. In 2016, financial sector with application of information and communication technology (ICT) transformed the digital financial sector and the private banks are well-developed with modern digital technology than other state-run banks.

Mobile banking is very effective for the rural people and quickly infiltrate to the unbanked population and providing a new potential channel to expand financial inclusion among smallholders because of quickly and save time that mainly used for the internal remittances for family because of internal migration to the urban area of Garment industry and other industries. Telecommunication companies are joint venture with private banking companies that facilitate financial services such as Wave-Money, KBZ Pay, Mytel Pay, MPT Pay, CB Pay, AGD Pay etc. For example, wave money payment application are used by 1.1 million peoples per month and more than 45,000 wave shops around the country in 2019 moreover CEO Mr. Jones said that "**quick and easy payment, secure and safe cash remittances and access to a wide range of financial services especially for unbanked population**".

The introduction of mobile banking and digital payment platforms has expanded financial inclusion, enabling people in remote areas to access banking services without the need for physical branches. It is linking as the bridge for the gap between urban and rural populations, promoting economic participation and reducing poverty. Mobile financial services that facilitate empower women participation and enhancing women employment opportunities that can get in benefits from the explosion of mobile economy or E-commerce. Moreover, ICT has streamlined transaction processes, reducing the time and costs associated with traditional methods.

Online banking, mobile wallets, and electronic fund transfers have made financial transactions faster and more convenient for individuals and businesses alike. The efficiency has contributed to a more vibrant and dynamic economy.

In January 2018, Global World Insurance Co. Ltd launched crop insurance pilot project in Myanmar with the permission of Ministry of Planning and Finance and that project was two years project in Magway, Ayeyarwady, Yangon and Mandalay region of paddy sector and project insurance term was one year, premium rate for one acre was 5000 kyats per year and based on market price. As a trial period, six month pilot project was in Magway and Ayeyarwady region and 300 acres were accessible services in these regions during this situation three times a day in television program and FM radio, mass media and social media disseminated about crop insurance knowledge. As a result, farmer knowledge awareness about insurance was weak and limited therefore government need to establish National insurance committee, crops insurance law and crop re-insurance services were observed in this pilot project.

In Myanmar, farmers are increasingly adopting ICT tools to enhance financial inclusion. These technologies, such as mobile phones and internet connectivity, enable farmers to access financial services, market information, and payment systems. Through mobile banking and digital payment platforms, farmers can securely save money, access credit, and make transactions without the need for traditional banking infrastructure. The integration of ICT powers, farmers by reducing transaction costs, increasing transparency, and expanding their access to formal financial services, ultimately contributing to their economic growth and inclusion in the financial ecosystem.

3.4 ICTs and Agricultural Supply Chain in Myanmar

The country trying to transform **"From Rice bowl to Food basket"** in Southeast Asia therefore agricultural value added and supply chain management are important. Agricultural supply chains process includes six stages; factors of production inputs markets and research and development, farm production, collection by traders, wholesale markets, storage processing, retail markets, consumption in domestic and foreign markets that are facilitating by the help of information and communication technology.

However, the country conduct emphasized the three sector; modernizing small-farm production, modernizing inputs markets and modernizing output markets and supply chains for the purposes of effective value chain competitiveness among neighboring countries and Southeast Asia countries. Farm credit system for supply chain and foreign direct invest for agro food supply chain were first important things in least developed country moreover famers, agro entrepreneur and agro business can work efficient supply chain process if they have financial support from the government or private organization.

Lack of finance and finance insufficient problem in production stage that cannot reap high value products because of farmers face constraints with insufficient income to buy necessary inputs for farm or cannot use sufficient inputs for their farm. By default, foreign investor always more interested exported oriented to the global market than local market oriented however Myanmar trying to upgrade through local market-oriented foreign investment to export oriented to the global market. Government organizations such as ministries and national banks, private microfinance institutions, international NGOs and national NGOs and UN agencies are undertaken not only the financial projects and regional program but also technology training program towards agro value chain. Financial investors can save investigating and monitoring costs in addition reduce downside risks with the help of information communication technologies.

When working with quality in mind, high value agro products with using modernized packaging system from the organic farming or GAP standard farming, production of new the ready-made consumer goods or products by value adding and setting brand for advertising and marketing at the market. Smart-agriculture system for the purposes of high value supply chain that are mainly based on information and communication technologies (ICT) in the form of call center, ICT modern classroom for agro-education, agro-mobile application for extension, and web portal for share update information. ICT based digital technologies is an attractive approach in creating incentives to expand access to financial services in order to promote financial inclusion for supply chain and enhance emerging small and medium agro enterprises in today moreover by working with digital technologies in production process, storing and packaging, distribution, value adding, advertising and marketing process can be leveraged efficient and effective for the agro food value chain.

In the globalization era, ICT can help easily flow of trading facilities into the world that in turn to encourage and pierce trading activities from national to global supply chain (Rajasekera & Nyi Nyi Aung, 2010). Ministry of commerce (MOC) and department of broader trade (DBT) were facilitated broader trades activities form web portal, online border trade system and price data based software system by using iPstar satellite and fiber network connection. In 2010, World Bank approved that ICT is a major factor to improve trade logistics performance such as transport, warehousing, cargo consolidation, border clearance, distribution and payment system.

In addition, ICT reduce transport costs, save time, expand market for all export and import and encourage improve quality of supply chains therefore ICT becomes a new drivers of global economy therefore agricultural sector activities were widely transforming by ICT applications that increase opportunities towards digital agricultural development into the future. ICT initiatives are incorporating in agriculture sector digitalization by the ways of equipments, investment, marketing, institutional, educational and cultural activities that are linking to agriculture and rural development for the country development moreover the country was trying to implementing ICT based activities for all country's socioeconomic sector therefore ICT development and demand of ICT are important for both public and private sector digitalization.

3.5 Government Policies Implication for ICT and Agriculture Sector

Guidelines, laws, regulations, policies and institutions published by the government are fundamental elements for the achievement of intended development objectives of the country, first and foremost ICT sector development requirement for the agriculture sector development therefore it is important to have good ICT policies and institutions. Ministry of communications and information technology (MCIT) and Ministry of transport and communications (MOTC) conduct under the Ministry of science and technology (MOST) in addition Ministry of communications and information technology undertaking to guide and investment for the country's ICT sector development. ICT projects and action plans are funding by World Bank provide 60 percent and Asia Development bank provides 40 percent. Three laws were published for the ICT sector in the past such as computer science law (1996), electronic transaction law (2004) and the telecommunication law (2013).

The current ICT policy includes five elements (i) to promote cooperation for ICT development (ii) to enhance competitiveness of the ICT sectors (iii) to promote cooperation to reduce digital divide (iv) to promote cooperation between state and private sectors and (v) to increase the availability of the information technologies to all the citizens of our country. Similarly, telecom policy includes six elements (i) to increase the development of national IT infrastructure (ii) to provide a financially viable telecommunications sector conducive to sustainable investment in telecommunications (iii) infrastructure (iv) to improve the efficiency and effectiveness of telecommunications service delivery to end-users (v) to provide telecommunication services at the affordable price and (vi) to fulfil universal services obligation to the people of Myanmar.

In the mid of 2017, the digital economy development committee (DEDC) integrated with eleven related ministries of governments, DEDC undertakes nine priority sectors (i) education, (ii) healthcare (iii) agriculture, fishery and livestock (iv) tourism and hospitality (v) financial services (vi) technology sector and startup ecosystem (vii) digital trade (ix) transportation and logistics. While the country empowered and improved digital transformation, digital government, digital trade and digital security that can achieve digital economy road map that was the objectives of DEDC in addition these activities and action plans are correspondence with Sustainable Development Goal-9; build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation and Goal-12; ensure sustainable consumption and production partners and these sustainable development goals are intended to achieve in 2030.

Moreover, ICT master plan (2011-2015) that sets in motion with the 2013 telecommunications laws and includes agriculture as a priority sector therefore ICT and agriculture sector are linking workings for the digital agriculture development. Agriculture is one of priority sector in national sector strategies for digital development therefore agricultural ministries pay much attention to digital issues in their agro sector policies for implementing a comprehensive strategy of agricultural and rural development.

According the E-government master plan, agriculture institutions work with computerizing procedures action in addition inform, announce and share knowledge about agriculture sector from their ministries and institutional web pages while e-government system develops therefore e-government strategies and digital initiatives

always have an impact on the agriculture sector. Government set in first the policies for establishing modernized agricultural institutions by providing ICT infrastructure such as ICT classroom, digital training, training of smart agriculture technologies, agro supply chain and extension services moreover ICT for agriculture management and administration activities are mainly control by the MOALI and to under their other agricultural ministries with top-down hierarchy.

Agricultural ministries, departments and institutions appoint skilled technical staff in the areas of research, extension services, training, trade and marketing. Similarly, government set the policies for famers by providing a knowledge share access centers such as information public relation center, public telecom centers and rural schools for improve ICT access in rural areas and increase awareness of ICT needs for agriculture and enhance adoption of ICT among smallholder farmer. Therefore, government provides ICT infrastructure and digital literacy program for rural famers through agricultural institution and extension workers that enhance adopting and using the ICT technologies for agriculture sector.

MOALI and agriculture institutions conduct in-housing training or online training through mobile phone and mobile application for farmers and providing ICTs extension services to boost the awareness ICT for rural farmers. First and foremost, the agricultural institutions provide digital literacy that is needed the digital skills for farmers to work with ICTs in agriculture sector. In addition, farmer fields school are started launching ICT into technical and productive development activities and action plans working together with farmers by the purposes of providing technical assistance and introducing ICIs for farmers in rural area (USAID, 2016).

Government is creating and prescribing comprehensive and expressive strategies and action plans for promoting ICT awareness and usage at the regional to national level and institutional integration sections are required to undertake joint strategies and action plans because to take benefits of institutional cooperation and working together with rural farmers, extension workers, agriculturalists, agricultural ministries and government, UN agencies and NGOs. Government policy implication are supervising and monitoring on systematic use of ICTs on the different activities of agriculture institutions and rural farmers as a result agriculture sector have to be raised to top priority level on national digital development program.

CHAPTER IV
ANALYSIS ON SURVEY DATA

4.1 Survey Profile

"Analysis on the Effects of ICT Usage on Paddy Farmers" in this study survey is collected in Paungde Township of Bago Region (West). Paungde Township was one of among twenty-eight township of Bago Region and it was located in Pyay District in the west of Bago Region. Township was comprised with forty-three village tracts that have been two hundred and eleven villages were located in the rural areas. All rural areas in this township were occupied in agriculture sector. The main crop was paddy and other were bean, betel, vegetables and flowers. According to the 2014 census, total population was 134,195 and 109,609 population were live in rural areas in addition 48.9 percent of township total population was occupied in agriculture sector other are merchants, public servants, craftsmen and hard workers.

The survey period is during the causing of COVID19 diseases global pandemic therefore only five villages are choosing from the 224 villages of the Paungde Township by using simple random sampling method. These five villages are not including in same village tracts because villages are selected by cast draw lots; Yaesalgyi, Kan Kyauk, Taung gone, Ywar Hla, and Wet Myay Lu.

A total of 320 households live in Yaesalgyi village and there is a basic education middle school, a rural library and a rural health clinic. A total 280 households live in Kan Kyauk village and there is only one basic education primary school. A total of 227 households live in Taung Gone village and there is also a basic education primary school, a distribution center for agricultural technology information and one Telenor telecommunication tower. A total 240 households live in Ywar Hla village and as it is adjacent to Taung Gone village, the basic education school and the agricultural camp are shared. Electricity is still unavailable in the above mentioned four villages. The total 267 households live in Wet Myay Lu village and there is a basic education primary school and it has access to electricity provided by the government.

When asking for interviews with respondent farmers by using survey questionnaire, the respondent farmers contributes full answers with actively participating because they get more awareness to gain new knowledge previously unknown for their farming that are learnt from this survey. Relevant townships authorities and respondents farmers are warm and friendly welcome to help and support to do findings for their township.

4.1.1 Survey Design

The survey period is during the December, 2020 and January, 2021. A total 1334 households live in these five villages and selected 200 (1334*15%) households for this study. Total 200 samples are selected as follows; 48 respondents from Yaesalgyi village, 42 respondents from Kan Kyauk village, and 34 respondents form Taung Gone village, 36 respondents from Ywar Hla village and 40 respondents from Wet Myay Lu village. Table (4.1) illustrates the sample size distribution for this study.

Table (4.1) Sample Size Distribution

No.	Village Names	Total Households	Sample Households (Total *15%)
1	Yaesalgyi Village	340	48
2	Kan Kyauk Village	280	42
3	Taung Gone Village	227	34
4	Ywar Hla Village	240	36
5	Wet Myay Lu Village	267	40
Total		1334	200

Source: General Administrative Department, Paungde Township

This study applies descriptive method and multiple regression analysis. Descriptive research method required to analyzing the relevance research problem moreover this method was performed with the help of survey questionnaire for the purposes of obtaining primary data. Multiple regression analysis is a statistical techniques used to examine the relationship between a dependent variable and two or more independent variables. It assesses how these independent variables collectively influence the dependent variable while controlling for their interdependencies.

The quantitative method is using to find out the primary information that express the condition of ICTs using among rural farmers in this study. Primary data were get form rural farmer households interviews in the rural areas of Paungde Township's agricultural sector with survey questionnaire to achieve the requirement data and results for the study objectives. Before the survey, survey collector need to explain research purpose and respondent farmers were asked to get full answer for the survey questionnaire.

The survey questionnaire was comprised with section (I) includes family background characteristics, section (II) patterns, types and purposes of using ICT among farmers and section (III) includes farmer encountered constraints and benefits while using ICT tools. Multiple response questions, closed end questions and three point Likert scale questions were applied in the survey questionnaire. The scale reliability coefficient of question no.40 (benefits from using ICT) is 0.7. The survey questionnaire is described in Appendix. The total of 200 respondent farmers were asked with survey questionnaire, whereupon this collected primary data are firstly coded, categorized, tabulated and analyzed with Microsoft Excel and STATA.

4.2 Demographic Characteristics of Respondents of Households

Section (I) of the survey questionnaire includes the demographic characteristics of respondents of households involved in present situation of respondent's gender, age, relationship of the household, family size, education, income, types of crops, ways of production, availability of internet and electricity status etc that are explained with descriptive method. These demographic data are circumstantiating with the table (4.2.a) and table (4.2.b).

Table (4.2.a) exhibits demographic data of the respondent households. Firstly, table state that gender distribution that included 58.5% is male and 41.5% is female therefore it express that the gender ratio in the survey area is not differing significantly. With regard to the age of respondents, the age below 30 years old are considered young with respondents of 14%, the age between 31 to 60 years old are considered middle aged with 64%, over 60 is the age of aging and that include 22%. The maximum number of respondents is middle aged and the minimum number of respondents is young.

Tables (4.2.a) Demographic Characteristics of the Respondents of Households

No.	Characteristics	Frequency (N=200)	Percentage (100)
1	Gender		
	Male	117	58.5
	Female	83	41.5
2	Age(years)		
	Young (Below 30)	28	14
	Middle aged (31-60)	128	64
	Old aged (above60)	44	22
3	Relationship of the households		
	Head	108	54
	Spouse	55	27.5
	Son/Daughter	29	14.5
	Son/Daughter in law	8	4
4	Family size		
	Small size (Below 2 acres)	49	24.5
	Medium size (3-5 acres)	144	72
	Large size (6-8 acres)	7	3.5
5	Education level		
	Primary Education	65	32.5
	Secondary Education	111	55.5
	Higher Education	24	12
6	Farm size (acres)		
	Small farm size (Below 10acres)	152	76
	Medium farm size (11-20)	40	20
	Large farm size (Above 20)	8	4
7	Non-farm income activity or Business		
	Yes	88	44
	No	112	56

Source: Survey data, (2021, January)

At the relationships of the households, 54% of respondents are household heads, 27.5% of respondents are spouse, 14.5% of respondents are son or daughter,

and 4 % of respondents are sons in law or daughter in law and grandchild. The maximum number of respondents is household heads and the minimum numbers of respondents are sons/daughter in law.

At the family size, family member below 2 respondents are considered small family size that include 24.5%, family member between 3 to 5 respondents are considered medium family size that include 72% and family member between 6 to 8 people are considered large family size that include 3.5%. As a result, more than two-thirds of the respondents are medium family size and large family size respondents are the least.

According to the education level, 32.5% of respondents have attended primary education, 55.5% of respondents have attended the secondary education and 12% of respondents are higher education level. There is no one illiterate person and post-graduated person among the survey respondents. All respondents can read and write only Myanmar language and they cannot read and write any language.

With regard to the farm land ownership**,** small land ownership is classified the respondents own below 10 acres that includes 76% of respondents. Medium farm size ownership is defined the respondents own between 11 acres and 20 acres that includes 20% of respondents, large farm size ownership is defined the respondents own above 20 acres that includes 4%. As a result, more than two-thirds of the respondents are small scale farmers and large scale farmers respondents are the least.

In this table, all the respondents engage in agriculture and agricultural activities is the main occupation for all respondents moreover 56% of respondents work exclusively in agriculture and 44% of respondents work in both agriculture and non-farm income activity. The non-farm income activity or business includes private grocery store sale, carpentry, masonry, public servant, private servant and so on. However, the main purposes of the agricultural activities are for both household consumption and for sale of all respondents.

Table (4.2.b) shows other six demographic characteristics of respondents. According to the average monthly income level of all the respondents, low income households who earn below 200,000 kyats per month is 17.5%, the lower middle income households who earn between 200,001 kyats and 500,000 kyats per month is 42.5%, the upper middle income households who earn between 500,001 kyats and 1,000,000kyats per month is 28% and the higher income households who earn above

1,000,000kyats per month is 12%.As a result, upper middle income households are the most common and high income households are the least.

At the ways of cultivation, 52% of respondents do the agriculture with modern way and the remaining 48% of respondents are engaged in agriculture in modern and traditional collaboration ways. No one respondent do the agriculture with exclusively traditional ways of cultivation and most of the respondents do the agriculture with the modern ways.

Table (4.2.b) Demographic Characteristics of the Respondents of Households

No.	Characteristics	Frequency (N=200)	Percentage (100)
1	Monthly Household Income (kyats)		
	Low income (Below 200,000)	35	17.5
	Lower middle income (200,001-500,000)	85	42.5
	Upper middle income(500,001-1,000,000)	56	28
	Higher income (Above 1,000,000)	24	12
2	Ways of Cultivation		
	Modern Agriculture system	104	52
	Modern and Traditional Collaboration	96	48
3	Other types of crops besides paddy		
	Bean	9	4.5
	Vegetable & Flower	26	13
	Betel	19	9.5
4	Types of Seasons		
	Two seasons	195	97.5
	Three seasons	5	2.5
5	Electricity		
	Yes	40	20
	No	160	80
6	Another Source for Electricity		
	Solar Energy	149	74.5
	Engine motors	11	5.5

Source: Survey data (2021, January)

With regard to the types of crops, paddy is the main crops for all the respondents. In addition to paddy, beans, vegetables & flowers and betel are planted together with paddy in the survey areas. The respondents of 4.5% plant both paddy and bean, 13% of respondents plant both paddy and vegetables &flowers and 9.5% of respondents plant both paddy and betel. The respondents cultivate in two seasons are 97.5% and 2.5% of respondent cultivate in the three seasons. Most all the respondents grow monsoon paddy and irrigated summer paddy for two seasons.

In the survey areas, the average paddy productivity is 81 baskets per acre, while the CSO data for 2020 reports a yield of 75 baskets per harvested acre. A comparison of these figures reveals an increase in paddy productivity. Communication tower and internet lines are available and use in the survey area. The 20% of respondents are available government gird as the primary source of electricity for their households and 80% of respondents are not available government gird as the primary source of electricity for their households. Most respondents cannot available government gird as the primary source of electricity and they use another source of electricity such as solar energy, and engine motor. The 74.5 % of the respondents use solar energy, 5.5% of respondents use engine motor with applying fuel.

4.3 Patterns and Types of Farmers' ICT Usage

The section (II) of the survey questionnaire includes patterns and types of using ICT tools and purposes of using ICT among rural farmers that are described with descriptive method. Farmers use four types of ICT tools; radio, television, mobile phone, internet and social media in the survey areas. All the respondents of households are aware that they can get agricultural information by using ICT tools.

4.3.1 Patterns of using ICT tools by Farmers

Table (4.3) shows patterns of using ICT tools by farmers. There are four patterns of farmers' ICT usages; farmers use one type of ICT tools, farmers use at least two types of ICT tools, farmers use at least three types of ICT tools and farmers use all four types of ICT tools. Respondent using at least one type of ICT tools is 11%, respondent using at least two types of ICT tools is 38%, respondent using at least three types of ICT tools is 43.5% and respondent using all four types of ICT tools is 7.5%. Respondent uses all four types of ICT tools because he knows more about ICT.

Table (4.3) Pattern of Farmers' ICT Usages

Patterns of Using ICT tools	Frequency	Percentage
Using at least 1 types of ICT tools	22	11
Using at least 2 types of ICT tools	76	38
Using at least 3 types of ICT tools	87	43.5
Using all 4 types of ICT tools	15	7.5
Total	200	100

Source: Survey data (2021, January)

4.3.2 Patterns of using ICT tools by Farmers' Demographic Characteristics

Farmers' demographic characteristics such as gender, education, age, income are selected for joint relation between using patterns of ICTs tools. Table (4.4) shows using patterns of ICT tools by gender. Male farmers use more ICT tools than female farmers. Table (4.5) represents patterns using ICT tools by farmers' education. Farmers with primary education use at least one type of ICT tools. As farmers get higher level of education, they use more and more types of ICT tools.

Table (4.4) Patterns of using ICT tools by Gender

Patterns of using ICT tools	Gender of ICT users				Total	
	Male		Female			
	Freq	%	Freq	%	Freq	%
At least 1 type	9	4.5	13	6.5	22	11
At least 2 types	43	21.5	33	16.5	76	38
At least 3 types	55	27.5	32	16	87	43.5
Using all 4 types	10	5	5	2.5	15	7.5
Total	117	58.5	83	41.5	200	100

Source: Survey data (2021, January)

Table (4.5) Patterns of using ICT tools by Education

Patterns of using ICT tools	Level of Education						Total	
	Primary		Secondary		Higher			
	Freq	%	Freq	%	Freq	%	Freq	%
At least 1 type	13	6.5	9	4.5	0	0	22	11
At least 2 types	31	15.5	41	20.5	4	2	76	38
At least 3 types	19	9.5	50	25	18	9	87	43.5
Using all 4 types	2	1	11	5.5	2	1	15	7.5
Total	65	32.5	111	55.5	24	12	200	100

Source: Survey data (2021, January)

Table (4.6) Patterns of using ICT tools by Age

Patterns of using ICT tools	Age of Respondents						Total	
	Yong (Below 30 years)		Middle Aged (31-60 years)		Old Aged (Over 60 years)			
	Freq	%	Freq	%	Freq	%	Freq	**%**
At least 1 type	0	0	7	3.5	15	7.5	22	11
At least 2 types	5	2.5	44	22	27	13.5	76	38
At least 3 types	20	10	65	32.5	2	1	87	43.5
Using all 4 types	3	1.5	12	6	0	0	15	7.5
Total	28	14	128	64	44	22	200	100

Source: Survey data (2021, January)

Table (4.6) describes the using patterns of ICT tools by respondents' age. Most of the old aged respondents use at least one type of ICT tools. Most of the young and middle age respondents use at least three and all types of ICT tools. Moreover, young and middle aged farmers use more types of ICT tools than old aged farmers. As the farmers get older, the use of ICT tools will decrease.

Table (4.7) states the using patterns of ICT tools by respondents' monthly household income. Most of lower income class respondents use at least one type of ICT tools. Most of higher income class respondents use at least three types of ICT

tools. Most of middle income class respondents use at least two, three and all four types of ICT tools. As the income higher and the more types of ICT tools can be used. However, this study finds that the middle income classes of farmer more use all types of ICT tools than higher income class of farmers.

Table (4.7) Patterns of using ICT tools by Monthly Household Income

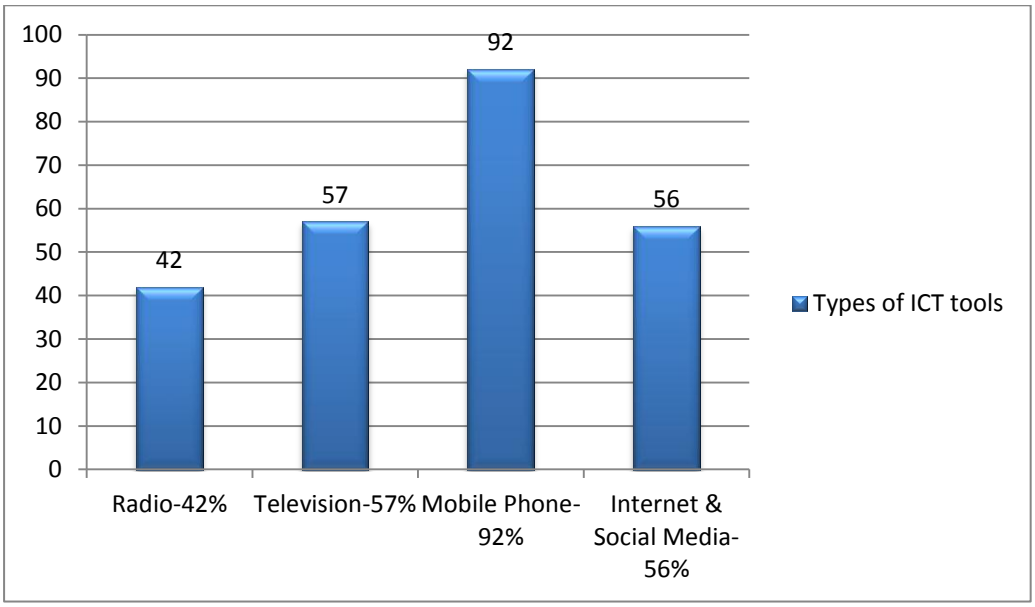
Patterns of using ICT tools	Monthly Household Income (Average)								Total	
	(Below 200,000kyats)		(200,001-500,000 kyats)		(500,001-1,000,000 kyats)		(Above 1,000,000 kyats)			
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
At least 1 type	5	2.5	12	6	4	2	1	0.5	22	11
At least 2 types	17	8.5	36	18	17	8.5	6	3	76	38
At least 3 types	12	6	28	14	32	16	15	7.5	87	43.5
Using all 4 types	1	0.5	9	4.5	3	1.5	2	1	15	7.5
Total	35	17.5	85	42.5	56	28	24	12	200	100

Source: Survey data (2021, January)

4.3.2 Types of Farmers' ICT Usage

Radio, Television, Mobile phone, Internet and Social Media are using by farmers in the survey area. Figure (4.1) represents the respondents use of types of ICT tools to obtain agricultural information that includes 42% of respondents use radio, 57% of respondents use television 92% of respondents use mobile phone, 56% of respondents use internet and social media. Therefore, the maximum number of respondent use mobile phone, the minimum number of respondents use radio and half of the respondents use internet and social media among the use of mobile phone.

Figure (4.1) Farmers' Types of ICT tools Usages



Source: Survey data (2021, January)

The respondents have been using the radio for agricultural information assessment for an average of sixteen years and the respondents have been using the television for agricultural information assessment for an average of fourteen years. Moreover, the respondents have been using mobile phone for agricultural information assessment for an average of six years and the respondents have been using internet and social media for agricultural information assessment for an average of three years.

4.4 Purposes of the using ICT tools in the households

Farmers use ICT with the purposes of entertainment, communication, agriculture and finance transactions. Table (4.8) shows the main purposes of using ICT tools among farmers. The respondents use ICT tools mainly for communication is 1.5%, 33.5% of respondents use ICT tools mainly for communications, 59% of respondents use ICT tools mainly for agricultural purposes and the remaining 6% of respondents use ICT tools mainly for financial transactions. Therefore, more than half of the respondents use ICT tools mainly for agricultural purposes and the minimum number of respondent use ICT tools mainly for the purposes of entertainment.

Table (4.8) The main purpose of the using ICT tools in the households

No.	Purposes of using ICT tools	Frequency	Percentage
1	Entertainment	3	1.5
2	Communication	67	33.5
3	Agriculture	118	59
4	Finance Transactions	12	6
Total		200	100

Source: Survey data (2021, January)

Table (4.9) Level of purposes of using ICT tools in the households

Purposes of using ICT tools	Low		Medium		High		Total	
	Freq	%	Freq	%	Freq	%	Freq	%
Entertainment	103	51.5	94	47	3	1.5	200	100
Communication	15	7.5	68	34	117	58.5	200	200
Agriculture	0	0	52	26	148	74	200	100
Finance Transactions	88	44	100	50	12	6	200	100

Source: Survey data (2021, January)

Table (4.9) describes the level of purposes of using ICT tools in the households. Farmers use ICT tools for entertainment is low (51.5%), farmers use ICT tools for communication is high (58.5%), farmers use ICT tools for agriculture is high (74%) and farmers use ICT tools for finance transactions is medium (50%).

4.5 Constraints encountered by farmers in using ICT

Table (4.10) describes the main constraints encountered by farmers in using ICT. 19% of respondents face services costs, 9% of respondent face network failure, 35.5% of respondents face lack of electricity, 36.5% of respondents face weak in ICT literacy and training. As a result, the major constraints faced by respondents are weak in ICT literacy and training and lack of electricity problem.

Table (4.10) The main constraints encountered by farmers in using ICT

No.	Constraints	Frequency	Percentage
1	Services costs	38	19
2	Network failure	18	9
3	Lack of Electricity	71	35.5
4	Weak in ICT Literacy and Training	73	36.5
Total		200	100

Source: Survey data (2021, January)

4.6 Benefits of Farmers' ICT Usages

According to the literature, farmers' benefits can be measured by farmers' income increasing, good management and prevention in farm from climate change that reduces wastes, their transactions costs reducing, their productivity increasing, getting good market prices and quality crops increasing (Silva & Ratnadiwakara, 2008) (Nzonzo & Mogambi, 2016) (Shemfe, 2018). Farmers get the benefits mentioned above from using ICT, but only the main benefits are listed in the Table (4.11). The 20% of respondents receive increasing income, 7.5% of respondents receive good management and prevention in farm from climate changes, 15% of respondents receive reducing in transaction costs and 30% of respondents receive increasing productivity, 25% of respondents receive a good market price, 2.5% of respondents receive increasing quality crops.

Table (4.11) The main benefits from using of ICT by farmers

Benefits	Frequency	Percentage
Increase Income	40	20
Good management and prevention in farm from climate changes	15	7.5
Reduce Transaction costs	30	15
Increase productivity	60	30
Getting a good market price	50	25
Increase quality crops	5	2.5
Total	200	100

Source: Survey data (2021, January)

As a result, the maximum numbers of respondents receive increasing productivity but the minimum numbers of respondents receive increasing quality crops because of only by being educated respondents with the high agricultural knowledges and working with government extension workers they can receive the good quality crops increasing.

Table (4.12) shows the average benefits from using ICT among farmers. According to the answer to the question asked on a three point Likert scale, the average total benefit from using ICT among farmers is 2.0575. The average benefit is greater than 2 that mean farmers get more benefits from using ICT**.**

Table (4.12) Benefits from using of ICT by farmers

No.	Benefits from using ICT tools	Average
1	Increase Income	2.36
2	Good management & prevention from climate changes	2.07
3	Reduce Transaction costs	2.15
4	Increase productivity	2.38
5	Getting a good market price	2.25
6	Increase quality crops	1.14
Total Average		2.06

Source: Survey data (2021, January)

4.6.1 Analyzing the Benefits from using of ICT by farmers

This sector confirms whether farmers can get benefits or not benefits from farmers' ICT usages. Table (4.13) describes the effects of ICT usage on benefits to farmers. The dependent variable is benefits from using ICT for farmers. The independent variables are types of ICT tools, gender, age, education, non-farm income activity, farm size and household size. Correlation coefficient (r) and probability value (P-value) is used to test the null hypothesis concerning the relationship between two variables. One percent (0.01) and five percent (0.05) and ten percent (0.10) level of probability is used as the basis for rejecting the null hypothesis.

Table (4.13) Effect of ICT usage on Benefits to Farmers

Dependent Variable	Independent Variables	Coefficient	Standard Error	P-value
Benefits from using ICT	Types of ICT tools			
	At least two ICTs	0.138	0.053	0.010***
	At least Three ICTs	0.254	0.060	0.000***
	All	0.282	0.078	0.010***
	At least one ICT tool (Ref)			
	Gender	-0.128	0.031	0.000***
	Education	0.286	0.025	0.000***
	Age	-0.009	0.001	0.000***
	Non-Farm Income Activity	-0.076	0.042	0.070*
	Farm size-acres	0.015	0.004	0.001***
	Household size	-0.002	0.029	0.950
Observation	200			
R-squared	0.6756			
F- test	66.99			
Probability>F	0.0000			

***Coefficient is significant at the 0.01 level

** Coefficient is significant at the 0.05 level

* Coefficient is significant at the 0.1 level

The coefficient of at least two types of using ICT tools is 0.138 and p-value is less than the significant level of 1% level of probability. It explains that using at least two types of ICT tools provides 13.8 percent more benefit than using at least one types of ICT tools. It is statistically significant and thus, the null hypothesis is rejected. As the two types of using ICT tools user increase, benefits from using ICT tools tends to increase.

The coefficient of at three types of using ICT tools is 0.254 and p-value is less than the significant level of 1% level of probability. It explains that using at least two types of ICT tools provides 25.4 percent more benefit than using at least one types of

ICT tools. It is statistically significant and thus, the null hypothesis is rejected. As the three types of using ICT tools user increase, benefits obtained from using ICT tools tends to increase as well.

The coefficient of all four types of using ICT tools is 0.282 and p-value is less than the significant level of 1% level of probability. It explains that using at least two types of ICT tools provides 28.2 percent more benefit than using at least one types of ICT tools. It is statistically significant and thus, the null hypothesis is rejected. As all four types of using ICT tools user increase, benefits obtained from using ICT tools tends to increase.

The coefficient of gender of ICT users (-0.128) explains that males farmers are 12.4 percent more benefits than female farmers from using ICT. Since p-value is less than the significant level of 1%, it indicates the correlation is highly statistically significant. Therefore, the null hypothesis is rejected. As gender changes of ICT users, there is a slight tendency for benefits received from using ICTs to decrease. This means that female of ICTs user increases, the benefits from using ICTs will decrease.

The coefficient of education of ICT users is 0.286 and p-value is less than the significant level 1% level of probability. There is a highly statistically significant and strong positive relationship between education of ICT users and their perceived benefits of using ICT tools. Therefore, the null hypothesis is rejected. As the level of education of ICT users increase, the benefits they derive from using ICT tools also tend to increase significantly.

The coefficient of age of ICT users is (-0.009) and p-value is less than the significant level of 1% level of probability. There is statistically significant and weak negative relationship between age of ICT users and advantages of using ICTs. Therefore, the null hypothesis is rejected. This explains that as the age of ICT users increase, there is a slight tendency for the perceived benefits of using ICT tools to decrease.

The coefficient of non-farm income activity of ICT users is (-0.076) and p-value is less than the significant level 10%. There is statistically significant and the null hypothesis is rejected. This means that there is weak evidence to support a meaningful relationship between non-farm income activity of ICT users and the benefits gained from using ICT tools.

The coefficient of farm size of ICT users is 0.015 and p-value is less than the significant level 1% level of probability. There is statistically significant and an

extremely weak positive relationship between farm size of ICT users and benefits they receive from using ICT tools. The null hypothesis is rejected. As the farm size of ICT users increase, the benefits gained from using ICT tools will increase.

The coefficient of household size of ICT users is (-0.002) and p-value is greater than the significant level of 10% level of probability. There is no statistically significant and weak negative relationship between household size of ICT users and benefits from using ICT. Therefore, the null hypothesis is accepted. As the household size of ICT user increases ha a little impact on benefits derived from using ICT tools.

The R-squared value of 0.6756 indicates that approximately 67.56% of the variation in the benefit from using ICT can be explained by the independent variables which include farmers' use of types of ICT tools, gender, age, education and their farm size. This is a relatively high R-squared value, indicating that these independent variables are collectively good predictors of the dependent variable.

The F-test is used to determine the whether the overall regression model is statistically significant. In this case, F-test value is quite high (66.99), which suggests that the independent variables have a significantly impact on the dependent variable. According to these statistical results, farmers' using types of ICT tools, gender, age, education and farm size have a highly significant and strong explanatory power in predicting the benefits derived from farmers using ICT. Therefore, farmers can get benefits from farmers' ICT usages.

CHAPTER V
CONCLUSION

5.1 Findings

According to the survey analysis, the gender ratio is not differing significantly in the survey area however male population is larger than female population. The majority of respondents fall into the middle aged category, accounting for is 64% of the total respondents, and 82% of the respondents comes from small families. Regarding household relationships household, head includes 54% of the respondents are heads of their households. Most of the respondents have completed secondary education and are not illiterate respondents. Furthermore, all the respondents are proficient in reading and write only in Myanmar language.

Agriculture is the primary occupation for all respondents and 44% of respondents engaged in both agriculture and non-farm income activity to supplement their household expenses. The majority of respondents fall into the lower middle income category, while higher income category is the least common. About 76% of respondents own small agricultural land acres. Most respondents employ modern agricultural techniques, while some use a combination of modern and traditional methods. More than half of the respondents cultivate paddy in two seasons. Notably, this study finds that the average productivity of respondents is 81baskets per acre in the survey areas, assuming increase productivity when we compare to the 2020 CSO's average productivity of 75 baskets.

In terms of ICT usage among farmers in the survey areas, farmers make use of radio, television, mobile phones, internet and social media. Mobile phone usage is the most prevalent, followed by television, while radio usage is the least common. Internet and social media usage among farmers is about half as prevalent as mobile phone usage. Interestingly, none of the respondents use agricultural mobile phone applications and computers. Some respondents are aware of these applications but do not use them, instead relying on information from Facebook. Factor inhibiting computer use includes affordability, availability, digital literacy and training, as the government does not support computer access in village community centers.

The study identifies four patterns of ICT usage among farmers; farmers using at least one type of ICT tool, at least two types of ICT tools, at least three types of ICT tools and using all four types of ICT tools. According to the survey data, most respondents use at least three types of ICT tools, while the number of farmers using all four in the lowest. Additionally, conservative farmers tend to use fewer ICT tools in their farming activities.

All surveyed respondents have access to mobile internet and over half use solar energy as their primary source of electricity for operating various ICT tools. There are associated costs of ICT tool usage, but all respondents are aware of and have a positive attitude towards using for agricultural information. Farmers use ICT for agriculture, communication, financial transactions, and entertainment, with varying degrees of emphasis. Entertainment ranks lowest, financial transactions are moderate, while agriculture and communication are the primary purposes.

The study identifies a lack of electricity and weak ICT literacy and training as the primary constraints for farmers when using ICT. Network failures and services costs are the least frequently encountered constraints. Farmers primarily benefit from using ICT by increasing productivity, obtaining better market prices for their crops, increasing their income, reducing transaction costs, and adapting their farming practices to climate change. However, only a few farmers report an increase in the quality of their crops.

Multiple regression analysis reveals that farmers using types of ICT tools, age, education and farm size have a positive influence on farmers' perceived benefits from using ICT. One significant finding is that farmers primarily gain agricultural knowledge and market information through ICT for communication purposes. Effective ICT usage is crucial for realizing these benefits. In summary, improving rural farmers' access to and use of ICT tools can improve their productivity, income and living standards. This underscores the importance of facilitating ICT access for farmers.

5.2 Suggestions

According to the findings of this study, radio and television continue to be valuable and cost-effective tools for rural farmers, with a track record spanning more than a decade. However, there is need for further development in free-to-air channels and FM radio coverage in rural areas. While farmers rely heavily on mobile phones,

internet and social media networks have become more extensive and effective compared to traditional radio and television.

To address the connectivity issues faced by rural farmers, it is imperative to enhance the telecom tower and information and communication technology infrastructure. The government should also promote reading awareness programs and ICT literacy initiatives among farmers by establishing rural libraries and ICT rooms at each village's community center. Furthermore, the government should increase investment in rural electrification, implement compulsory high school education and broadcast ICT literacy programs. It is essential to provide effective ICT training facilities through agricultural staff members to support rural farmers. Additionally, all agricultural rules and guidelines that use languages other than Myanmar should be translated into Myanmar to eliminate language barriers.

Radio and Television should focus on broadcasting programs that educate rural farmers on the correct usage of ICT to enhance their digital literacy. Government extension workers need to visit villages regularly, ideally once a week, to provide training and guidance to rural farmers because some villages face lack of training due to irregular visits by extension workers. Therefore, government extension workers must explain the benefits using ICT tools for acquiring knowledge and information related to farming. In addition to ICT literacy programs, government extension workers should conduct awareness campaigns to highlight the advantages of using ICT in agriculture. Incentives should be offered to farmers to increase crop yields, boost their income and reduce transaction costs. Special attention should be given to providing digital training to rural women, as it can enhance their contribution to farming activities.

The study suggests that when farmers learn how to use ICT effectively, they can experience significant benefits. To fully realize these benefits, farmers must use ICT for agriculture and communication purposes. The government's roles is crucial in effectively disseminating agricultural information through various ICT tools to rural farmers, thereby contributing to the development of the agriculture sector and improving the living standards of rural communities. While Ministry of Agriculture, Livestock and Irrigation (MOALI) is already engaged in numerous action plans and projects for sector development, it is essential to ensures that qualified personnel at all government levels adhere to established information dissemination models to effectively reach rural farmers.

As Myanmar is an agriculture based country, the agriculture sector holds the potential to create a broader market for both raw material and value-added products, benefiting the overall country's economy. Rural farmers depend on agriculture for their household consumption and main source of income, making their living standard directly tied to the agriculture sector's performance. This study suggests that living standards of rural farmers can be significantly improved by maximizing the perceived benefits derived from using ICT. In conclusion, by fostering collaboration form the central government to grassroots farmers, Myanmar can regain its status as the "Rice Bowl of Asia" and thrive alongside other Asian countries.

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APPENDIX

Survey questionnaire

I'm a candidate for Master's degree from Master of Economics, Academic year (2022-2023). The title is "Analysis on the Effects of ICT Usage on Paddy Farmers" would deeply appreciate it you would answer the attached questionnaire to provide required data to complete my thesis. This survey must be used only for the research and your name and anything about you will not be disclosed. I sincerely thank you for taking your time to complete the questionnaire.

Supervisor

Dr. Zin Zin Shwe

Professor

Department of Economics

Yangon University of Economics

Candidate

Khin Wutthmone Thin

MEcon (eco) II-4

Department of Economics

Yangon University of Economics

Section (I) Background and family Characteristics

Please answer the following questions as known as you can or mark in the box that you think right (√)

1. What is the name of your village?

   ----

2. What is the name of your village tract?

   ----

3. Were you born in this village tract?

   □Yes □No

4. What is the relationship of the households?

   □Head □Spouse □Son/Daughter

   □Son/Daughter in Law □Grand Child

5. How many family members do you have?

   ----

6. What is your gender?

   □ Male □Female

7. Express your marital status?

   □ Single □Married

8. What is your age?

   ---

9. Can you read and write in any language?

   □Yes □No

10. What is your education level?

    □ Primary Education

    □Secondary Education

    □ Higher Education

11. Do you work in any kind of non-farm income activity or business?

    □Yes □No

12. Do you work on agriculture activities (farming, raising livestock, fishing or forestry)?

    □ Yes □No

13. Are these agricultural activities your main occupation?

    □Yes □No

14. What is your average monthly household income?

    □ Low income (Below 200,000kyats)

    □ Lower middle income (200,001kyats-500,000 kyats)

    □ Upper middle income (500,001kyats-1,000,000kyats)

    □ Higher income (Above 1,000,000 kyats)

15. Do you own any farm or cultivated any lands?

    □Yes □ No

16. If yes, how many acres of land do you own?

    ---

17. What kind of way do you do the farm?

    □Traditional agriculture system

    □Modern agriculture system

    □Modern and Traditional Collaboration

18. Besides Paddy, what else do you plant in your farm?

    □ Bean □ Vegetable and Flowers □ Betel

19. How many season do you grow crop in your farm?

    □One season □Two seasons □Three seasons

20. How much produce per one acre in your farm?

    ---

21. Do you available mobile phone internet in your village?

    □Yes □No

22. Do you available government gird as the primary source of electricity for your household?

    □Yes □No

23. If no, what is the source of electricity for your household?

    □ Solar Energy □ Engine motors

24. Can you choose the following ICT tools that use in your family?

    □Radio □Television □ Mobile phone

Section (II) Patterns, Types and Purposes of Farmers' ICT Usages

25. Are you aware that you can get agricultural information using ICT tools?

    □Yes □No

26. Which ICT tools do you use to obtain agricultural information and technology?

    □ Radio

    □ Television

    □ Mobile phone

    □ Internet & Social Media

27. How many years have you been using Radio for agricultural information assessment?

    ---

28. How many years have you been using Television for agricultural information assessment?

    ---

29. How many years have you been using Mobile Phone for agricultural information assessment?

    ---

30. How many years have you been using internet for agricultural information assessment?

    ---

31. Express the main purpose of using ICT tools in your household?

 Entertainment

 Communication

 Agriculture

 Financial transaction

32. Express the level of purposes of using ICT tools in your household?

No	Purposes	Low	Medium	High
1	Entertainment			
2	Communication			
3	Agriculture			
4	Financial transaction			

Section (III) Constraints and Benefits of Farmers' ICT Usages

33. Are there costs associated with agricultural information assessments when you use ICT tools?

 Yes No

34. Have you had any training on how to use ICT for agriculture information assessment?

 Yes No

35. Do you receive the accurate and fast agricultural information from ICT tools?

 Yes No

36. Do you think you receive the agricultural information form ICT tools that are benefits for your farm?

 Yes No

37. Do you have positive attitude on the use of ICT in agriculture?

 Yes No

38. Which constraints is the most difficult for farmers by adopting and using ICTs?

 Service costs

 Network failure

  Lack of Electricity

 Weak in ICT Literacy and Training

39. Which constraints is the most difficult for the farmer to adopt and use of ICT in agriculture? Express the level of its difficulty?

No	Factors	Low	Medium	High
1	Services costs			
2	Network failure			
3	Lack of Electricity			
4	Weak in ICT Literacy and Training			

40. Can you choose the advantages for your farm if you are using ICT tools (Television, Radio, Mobile phone, Internet etc)

 Increase Income

Good management and prevention in farm from climate changes

 Reduce Transaction costs

 Increase productivity

 Getting a good market price

 Increase quality crops

41. Can you express the level of benefits for your farm if you are using ICT tools (Television, Radio, Mobile phone, Internet etc)

No	Benefits	Low	Medium	High
1	Increase Income			
2	Good management and prevention in farm from climate changes			
3	Reduce Transaction costs			
4	Increase productivity			
5	Getting a good market price			
6	Increase quality crops			

Thank you