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# A review article on role of information and communication technology in agriculture and factors affecting its dissemination in Nepal

## Abstract

The information and communication technology (ICT) is vital for the farming communities to intensify agricultural development in Nepal. This review presents the research in ICT highlighting the role of ICT in the agriculture sector and various factors affecting the dissemination process. About 60.4% of the total population is dependent on agriculture in Nepal. However, due to lack of awareness and higher cost of technology, the smallholder's farmers are deprived of receiving the reliable and recent information on agriculture resulting in reduction in crop production and productivity. In order to strengthen the existing extension system, it is important to minimize the cost of the technology transfer process and make people aware of the effective use of technologies. The knowledge on the new and innovative ideas need to be easily disseminated to the youth groups as they are using smart mobile phones and can easily receive the information. Furthermore, the review reveals that there is an urgent need to disseminate simple and compatible agricultural information to reduce the farming risk and maximize farm benefits.

**Keywords:** ICT, factors, dissemination, agriculture

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Aastha Bhusal,[1] Sagar GC,[2] Laxman Khatri[3]
[1]Institute of Agriculture and Animal Science, Nepal
[2]Agriculture and Forestry University, Nepal
[3]Georg August University of Goettingen, Germany

**Correspondence:** Aastha Bhusal, Institute of Agriculture and Animal Science, Nepal, Email adventureaastha@gmail.com

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## Introduction

Agriculture is the backbone of Nepals' economic development as it shares about 27.10 percent of the country's Gross Domestic Product (GDP) with an increase rate of 2.72 percent. About 65.6 percent of the population are involved in agriculture among which 60.2 percent are male and 72.8 percent are female.[1] Agriculture is the engine for the growth of pro-poor and development of the national economy as most of the poor households in the country are dependent on agriculture for their major source of earnings.[2] To reduce the poverty from 14 to 4 percent and meet the target of Agriculture Development Strategy (ADS), modifications in the existing agricultural practices are of utmost importance through the introduction of modern new technologies. Though the percentage of people engaged in agriculture is higher, the return from the agriculture sector in the country is not as expected and it cannot meet the increased demand of the food grains for the country. Traditional and subsistence farming, lack of mechanization with different tools of agriculture information results in low production rates which acts as a major factor pushing the development of Nepalese agriculture backward. The fragmentation of land and poor extension services existing in agriculture information for the smallholder farmers has hindered the commercialization and development of Nepalese agriculture. The average land holding size of a farm in Nepal is estimated at 0.8 ha.[3] This shows that almost half of the total farms have less than 0.5 ha of land, while those with less than 1 ha of land constitute nearly three-fourths of all holdings and it is decreasing over time. Though some initiations have been taken in availing the farm tools, extension services are very poor. Farmers lack the skills, techniques and knowledge of cultivation practices of the crops, control measures of disease-pests and other technological innovations in agriculture. Therefore, there's a need for suitable technology that farmers can adapt easily and solve the various problems related with extension services (Figure 1).

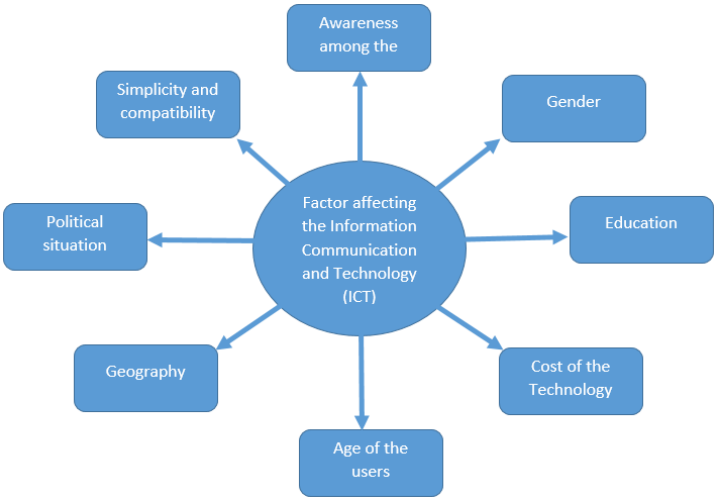


**Figure 1** Factors affecting the Information Communication and Technology (ICT).

Information and Communication Technology (ICT) can be one of the promising tools for the development of agriculture. "ICT includes all digital technologies that facilitate the electronic capture, processing, storage and exchange of information".[4] The ICT tools help to solve all the issues of poor connectivity and disintegration of the agricultural market and delayed information to the farmers, small land holdings, and non-adoption or less adoption of improved technology as they lack the reliable information due to less accessibility. There are various ICT devices such as radio, television, mobile phones, computers, tablets and networking, satellite systems which help in facilitating different farming activities and intercultural operations.[5,6] Research studies reveal that ICT has reformed the traditional agricultural system and made significant contributions in increasing agricultural productivity and sustainability by empowering farmers with the correct information at the right time and place.[7] Through the use of ICT, users can receive weather and price information, agro-advisories on agricultural products. ICT is a platform which provides solutions to the challenges in an agricultural sector.

## Role of ICT in agriculture

ICT has various roles in the field of agriculture to improve crop production and reduce loss. ICT can provide agricultural extension services easily, rapidly and in higher accuracy.[7–9] ICT also supports easy information access and communication in agricultural development.

## Decision support tool

In agriculture, the right decision at the right time is absolutely necessary. ICT plays an indispensable role in agricultural development to support the farmers. Farmers can access the weather, market and efficient mechanisms related to information in the agriculture sector for higher production through ICT. The right information on agricultural practices of various crops and livestock can be subscribed through ICT (websites, apps, bulletins etc.). Through ICT, farmers can be benefited from the sowing to harvesting of the crops.[10] ICT not only provides the potential information but also protects the farmers from rumors and mis-communicated information.[11] Farmers can decide on the crop varieties to sow in their field as per their field conditions, sowing time, harvesting time, intercultural operation to be carried out, safe management of disease and insect, and harvesting time. Farmers can make decisions on production and effective marketing through the effective use of ICT.[12] Various people like agricultural producers, extension agents, crop consultants, forest managers and even policy makers may use the ICT in the decision making process on the basis of forecasts.[13]

## Reduce farmer's risk

Farmers are always at high risk in agriculture. Due to climate change, most of the smallholder farmers do not have enough resources and capacity to cope with climatic shocks which reduces agricultural productivity. These farmers have to face various risks in agriculture including new disease and pest outbreaks, adverse weather conditions and other risks.[14] Those agricultural information that are applied in the local communities about the climate and soil properties help farmers in identifying opportunities and reduction of risks that are associated with changes occurring in their land.[15] With a correct and reliable climate forecast, farmers can choose resilient crop varieties and can manage diseases and pest problems as per the information they receive. With the help of weather forecast information received through ICT tools, farmers are able to adjust their sowing dates of different crops and manage their on farm risks.

## Strengthen the coordination and collaboration

ICT tools strengthen the coordination and collaboration of farming communities with various institutions, non-governmental organizations, and private companies through its wide networking.[10] Farmers can access the information generated by various private sector companies and organizations working in the required field. The farmers receive information on weather forecasting and market information. ICT has developed where numbers of organizations and experts from the various fields expressed that the use of ICT tools such as mobile phones, applications, software and tablets for the collection of data, monitoring and evaluation purpose of the project, and working in close contact with the rural communities and taking their feedback.[16]

## Access quality products through market information

Through the use of ICT, farmers can be benefitted by shortening the value chain. An educated farmer having a mobile phone with an android processor can easily contact any vegetable, fruits, and cereals traders and negotiate directly with the sellers to minimize the cost to be paid to the middleman. Furthermore, they can also access the market information of the products through ICT and link directly with the customer/consumer and increase their return. In other ways, farmers can be provided with the market information with vegetable price which helps them to calculate the possible amount they can earn from each product as per the rate in the bigger market. The farmers are not well informed about the updated information on the commodity prices, places for selling their produce, consumer's preference and this acts as the major problems in the agriculture sector. In this context, ICT can play an instrumental role in increasing the market space of farmers by reaching directly to the consumers or other potential users so that they can gain maximum profits. Farmers can use ICT and contact the buyers directly in order to receive the information about the current market price of their produce.[7] Information about the price of commodities is the most widely shared information among farmers through ICT. Such information increases the bargaining power of smallholder farmers to negotiate the price with the traders and reduces the personal travel cost of the farmers.[17] Following this system, farmers can sell their fresh produce on time at the maximum price and consumers can get quality products.

## Factors affecting use of ICT

There are various factors that affect the use of ICT in the agriculture sector.

## Awareness among the people

There are technical challenges for the dissemination of ICT in Nepal.[18] The development in information and communication is rapidly increasing in Nepal, however it's still new for the people residing in the rural areas. There are various ICT tools that can help the farmers but they are unaware about the facilities and even do not have the capacity to use these technologies and get benefit from the agriculture production. At present, 63 percent of the Nepalese people have access to the internet and smartphones.[7] ICT can play a pivotal role in the Nepalese agriculture to take it to the next level. There are various television channels and FM radio which are broadcasting programmes and different mobile applications and websites from where farmers can get the reliable information related to agriculture. However, farmers lack access to such information. Awareness is pivotal to provide guidance for using these extension services.

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## Gender

There's a clear gender difference in the use of ICT.[19] Nepal is a male dominated country where mostly male possess access in every sector/process either education, or decision making in the family. Similarly, most of the male members are either abroad for better job opportunities or work at office; however, most females are still engaged in household chores and agricultural work. With the fact that females are less educated than male, this has pushed females even back in the use of ICT, resulting in poor agricultural growth. Unlike cities and towns, females in the rural areas do not use mobile phones and other means of communication. Males are found to use more mobile phones i.e., 14 percent more than females which indicates that they have limited access to the mobile phone that impacts farmers receiving information and services.[20] In contrast to this, there's no significant difference in the use of ICT by gender.[21] The boys/men take up the tougher scientific courses including computing, which is reflected in the higher ratio of male to female students especially in the science-based subjects.[5]

## Education

A study illustrates that out of the total respondent, 54.4 percent of the respondents who are using ICT services have secondary education followed by the 42.2 percent of the respondent with higher education and only 3.3 percent of the respondent with primary level education.[22] Lack of education and knowledge deprives rural people from using ICT. The use of various ICT materials and exposure helps in building a positive attitude towards the implications of ICT. People using it widely makes them aware about the benefits and creates a positive attitude among the users.[17] People with higher education get in touch with advanced technology where they can learn better, faster and understand its importance. A person with a higher level of education perceives more information through ICT compared to a person having lower education.[5]

## Cost of the technology

There are three main branches of ICT in agriculture such as i) Computer technology ii) Communication technology and iii) Information management technology. These technologies are widely used in processing and sharing the information to the farmers. However, the cost of these technologies are very high in Nepal and smallholder farmers cannot afford them. Agriculture is becoming more science driven and knowledge intensive where this system of extension has become time consuming, less effective and costly. This results in failing to meet the expectation of the farmers involved in the agriculture production.[31] So, the use of these modern and advanced technologies need to be promoted for the effective communication among farmers, researchers and extension workers for transferring the information in a cost effective way. Nevertheless, the high cost of ICT acts as a barrier for the use of ICT services. Since android mobile phones are more applicable to access the ICT services, the poor farmers cannot afford such devices. In Nepal, the poor and disadvantaged farmers lack the access to quality information on agricultural production. The cost was the main barrier to adoption of ICTs by farmers in the agricultural sector in Tanzania.[23]

## Age

Research studies show that younger people have higher reach to ICT compared to older people.[24] In another study, the percentage respondents on the use of ICT according to the age groups were reported as 60 percent, 21.2 percent and 12.8 percent of young age people, middle age people and old age people respectively.[22] There is higher work productivity in the farmers with 25-40 years age group people.[25] As the young people are more active, educated and enthusiastic in learning new innovations and technologies, they are more responsive to ICT. However, the flow of information on agricultural production among youths has been limited by under-utilization of information and communication technologies (ICTs) as the updated information is not well digitized through web sources.[26,27] The ICTs have increased agricultural opportunities and motivated the young people to engage in profitable agricultural production targeting various niche markets.[28]

## Geography

Due to uneven geographic location, Nepal faces a difficulty in providing extension services to the farmers especially in the rural areas. The hilly region covers 68 percent of the total land and Terai and Mountainous region covers 17 percent and 15 percent, respectively. Due to easy access of the information and communication services, it's relatively easier to disseminate the reliable information to the farmers in the Terai as compared to the Hills and mountains. However, since the communication system is rapidly developing, ICT can play a pivotal role in the dissemination of agriculture related information to the farmers in all the regions. The farmers especially in the rural areas are not well-informed about prevailing market prices.[29] This results in cheating of the farmers from the middlemen which compels farmers to sell their products in lower amounts.[30]

## Political situation

Political instability now and a few years back is a barrier for the ICT dissemination in the agricultural sector in Nepal. The political leaders are well aware of the importance of agricultural advancement, but there's a lack of efficient efforts. There's a high probability that political leaders will bring about transformational change in agriculture. The leaders who interact regularly with farmers can influence their daily perceptions, feelings and performance, and ultimately boost the overall capacity of rural communities to achieve.[31] As leaders are the people's representative, people will follow them so with their small motivation and encouragement the communities can increase their use of ICT for agriculture activities and maximize their return. So, there's utmost need for such leaders to make themselves updated with the new innovation in the technology so that they could disseminate the advanced technology and practices to the farmers.

## Simplicity and compatibility

Simplicity refers to an innovation that can be understood and applied easily. Some of the innovations developed are easily adopted by farmers whereas some are complex. Similarly, compatibility of information is another factor affecting the use of ICT. The compatibility in ICT refers to the degree to which an innovation is perceived consistently with the existing information, past experiences, and needs of potential adopters.[32] Technology should be simple to operate and convincing to the farmers.

## Technological innovation

50 percent of the population of Gulmi district of Nepal were not able to use internet facilities.[18] This is with the fact that most of the farmers are uneducated and not familiar with the advancement in the technologies and they lack the basic skills in using the tools of ICT effectively. This will become a burden to the farmers which decreases the use and speed of technology dissemination. In the recent era of advancement, most of the Nepalese people have enhanced their capacity to afford mobile phones. Similarly, the people from rural

areas have access to televisions which reflects the gradual trend of ICT development. Similarly, a study by Tonny revealed that the percentage of people accessing information related to agriculture using different technologies were 91 percent from voice calling, 75 percent from short message service, 52 percent from the use of the internet, 39 percent from the different television programs and only 15 percent from the radio in Bangladesh.[33–35]

## Conclusion

ICT is a promising option in the agriculture sector to maximize crop production and productivity. The awareness of the importance of the various information and communication technologies among the people plays a key role in regards to access and use of reliable information for agricultural operations. The effectiveness to understand its implication on the ground is utmost essential for the smallholder farmers of Nepal. The young people are using the technologies however the extent of its use is not broad in addressing the issues in agriculture. Hence, effective and simplest communication mechanisms should be explored and capacity building training should be provided to the farmers which ultimately helps to generate skills and knowledge to access information from various sources.

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## Conflicts of interest

The authors declare that there is no conflict of interest.

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