ICT Productivity in Agriculture

Anoj Chhetri

Abstract

This paper describes about how to apply information and communication technologies (ICTs) to solve agricultural problems. It presents research findings on Agriculture ICT (AgICT) impact on the agricultural performance. It talks about how ICT enhances extension services by applying tools such as mobile phone, SMS, call centres, etc. This paper presents some research findings on the ICT productivity stating that farmers using AgICT in farming activities have increased 5.91% of their farm productivity compared to the immediate past year while farmers having no exposure to AgICT increased only 3.90% of farm productivity. This can apparently be assumed that the AgICT alone can contribute 2.01% increase in farm productivity.

Key words: Agriculture, ICT, Information, Ag ICT, Productivity, System, Management

1. An Overview

ICT is an umbrella term that includes any communication device or application, encompassing: radio, Television, cellular phones, computer network hardware & software, satellite systems and various services and applications associated with them such as videoconferencing and distance learning. ICTs are often spoken in a particular context such as education, health care, libraries, farming. ICT are the scientific, technological, engineering and management technologies used in the handling of information, processing and application related to computers (Olaniyi, 2013: p.362)

Mahatma Gandhi proposed a simple test for the effectiveness of any development activity: find out how the last man would be affected by it. We should adapt this as a test for ICTs in development: how will the last farmers be reached, touched and transformed by these marvelous communication tools? (HDR, 2005: p.vi).

Agricultural Information and Communication Technology (AgICT) deals with the rapidly expanding ICTs in agriculture. The AgIT provides information needed for farm production (Ninomiya, 2001, pp3-11 cited by Kaddu, 2011: p.1). An example of AgICT is registration of data from individual animals (Source: AJ). In order to reap the opportunities offered by ICTs, we should apply them in the creation, diffusion and use of knowledge which should form the basis of sustained growth strategy. However, there is no single social, political and economic model that has been the most successful at harnessing AgICT (Taylor and Zhang 2007: pp. 5-8; Hosseini and Niknami, 2009: p.424 and Zaatari, 2012: p.2).

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Author is Program Director and Adjunct Professor at the South Asia School of Rural Reconstruction, Kathmandu, Nepal: email anoj.chhetri@gamil.com
During the last decade agricultural software matured into an ICT dominated market-pull situation characterized by electronic data interchange (EDI), knowledge based networking and dedicated ICT production systems. During this process, marked differences were found in software attributes, identified end-user needs and applications. ICT adoption in the agricultural sector itself is proving to be a non-structured process – currently integrating remote sensing, GIS, knowledge systems, robotics, process control and information dissemination – within each country’s ICT policies (Gelb, et al 1998:p.1).

Increasing the efficiency, productivity and sustainability of small-scale farms is an area where AgICT can make a significant contribution. Farming involves risk and uncertainties with farmers facing many threats from poor soils, drought, erosion and pests. AgICT can deliver useful information such as crop care and animal husbandry, fertilizer and feedstock inputs, pest control, seed sourcing and market prices (Sing, 2010: p. 82 and Tantisantisom, 2011: p.iii).

Agriculture sector requires utilization and deployment of AgICT for improvement of efficiency in production and marketing of the agricultural crops as information technology have provided opportunities for development of agriculture sector through empowerment and unification of access to the available knowledge and information. Estimation results indicate that AgICT have positive and significant effect on the growth of agriculture sector (Jalae and Zeynali, 2013: p. 182).

Global studies demonstrated the fact that AgICT positively affect economic growth and productivity of inputs. The present study also showed that altogether AgICT has positive and significant impact on growth of agriculture sector. An Iranian study indicates that Ag ICT has turned into one of the inseparable elements of the world and can make remarkable contribution to the agriculture sector (Jalae and Zeynali, 2013: p. 190 and The Conference Board, 2011: p. 15).

Another study shows that only one-fifth (20%) of the farmers were highly aware about the role of AgICT. The initial response of the farmers seems positive and encouraging since AgICT is a new initiative in the extension work. It was found that the farmers using AgICT in farming activities have increased 5.91% of their farm productivity (rice production) compared to immediate past year while farmers having no exposure of AgICT increased only 3.90% of farm productivity. This can apparently be assumed that the AgICT alone can contribute 2.01% increase in farm productivity. The awareness was found to have positive significant correlation with benefit of using ICT in agriculture. Among the characteristics, level of education, training exposure, and extension media contact of the farmers were highly correlated with benefit of using ICT in farming. Farmers mostly preferred local sources while professional sources were less preferred for getting farm information (Parsekar and Cetin 2009: p.75)

The radio and TV continues to be the most common ICT in rural households in many parts of the world. At the other extreme, Internet access is especially limited in these households: the access rate is less than 5% in almost all countries (ECLAC @LIS2 2012: p. 12).
The use of various ICT devices maximizes the delivery of key information to agricultural producers. Given the strong presence of the traditional ICTs like the radio in rural households, many projects have been designed to combine both traditional and advanced ICT thereby maximizing the number of potential users. For example, many projects combined Internet use, information gathering based on digital sensors and geo-referencing, contact with key informants, and diffusion via radio and cellphones (ECLAC @LIS2 2012: p. 12).

There is, therefore, ample potential for the effective use of ICT in agriculture and the ongoing initiatives are promising. However, much still remains to be done. Several future trends of great importance are: a) converging of media and tools for communication; b) increasing web-based storage of agricultural information; c) cheaper and improved connectivity for rural communities; d) increasing recognition of ICT in rural development; e) increasing tailor-made quality agricultural information services (Stiene, et al 2007: p. 4).

2. Agricultural Productivity

Increasing the efficiency, productivity and sustainability of small scale farms is an area where ICT can make a significant contribution. Farming involves risks and uncertainties, with farmers facing many threats from poor soils, drought, erosion and pests. Key improvements stem from information about pest and disease control, especially early warning systems, new varieties, new ways to optimize production and regulations for quality control. Awareness of up-to-date market information on prices for commodities, inputs and consumer trends can improve farmers' livelihoods substantially and have a dramatic impact on their negotiating position. Such information is instrumental in making decisions about future crops and commodities and about the best times and place to sell and buy goods (Stienen, et al 2007: p.1). A US study reveals of ICT potential that the computer equipment manufacturing industry comprised only 0.3% of the U.S value added from 1960-2007, but generated 2.7% of economic growth and 25% of productivity growth. By comparison, agriculture accounted for 1.8% of the U.S value added, but only 1.0% of economic growth during this period. This reflects the fact that agriculture has grown slowly than the U.S economy, while the computer industry has grown thirteen times as fast. However, agriculture accounted for 15% of the U.S. productivity growth, indicating a very significant role for agricultural innovation (Joregenson, and Ho, 2010:p.2).

An average farm productivity of ICT users has been increased by 5.91% as compared to the yield of previous years when ICT was not available at the locality. The farmers who did not use ICT facilities were found to increase their average farm productivity by 3.9% only. So, through simple calculation, it can be said that farmers having access to ICT mediated extension services have increased average farm productivity by 2.01% higher than the non-user of ICT. This finding revealed that the ICT mediated extension service has contributed higher farm productivity (Evenson and Mwabu, 1998: p. 3 and Taragola and Gelb 2004: p. 9).

A research finding suggests that for a given level of extension input, unobserved factors such as farm management abilities affect crop yields differently. Effects of schooling on farm yields are positive but statistically insignificant. Other determinants of farm yields that we analyse include labor input, farmer experience, agro-ecological characteristics of farms, fallow acreage and family supports (Evenson and Mwabu, 1998: p. 3 and Taragola and Gelb 2004: p.9).
ICT is crosscutting and an enabler for growth and development. Therefore, countries must establish the right policy interventions, resource investments, appropriate networks (partnerships) and enabling environment. The empirical evidence suggests that ICT capital contributed to output and productivity growth (Gera, et al 1998: p.1). It can improve quality of life through its productivity enhancing and cost-reducing effects that increase the returns accruing to small and medium producers from productive activity. A striking case of such effects is the introduction of ICT devices into the management of National Dairy Development Board in Gujarat, India (HDR, 2005: P.55).

It has been estimated that the effective integration of ICTs in different sectors of the economy will augment economic growth rates by 2-3%. Having timely and relevant information especially marketing information on transport availability, new marketing opportunities, and the market prices of farm inputs and outputs is fundamental to an efficient and productive agricultural economy (Olaniyi and Adewale, 2014: p. 24).

The productivity is enhanced by generating information output from data input by means of models. Telecommunication and data warehousing are the preconditions for distributed data processing, involving many agents, logging into the systems at different locations and at different times (kuhlmann, pp. 1-5). The improved access to agricultural financial services contributes to improvements in agricultural productivity and food security. At the same time, it generates new business opportunities and improves the business enabling environment by reducing transaction costs and improving the investment climate. By connecting rural areas more closely to national and global information, new mobile technology can motivate young entrepreneurs to stay in these regions (Source : Q and Campbell et at, 2010).

In this regard, a study reveals that almost 86% of the farmers opined positively in this regard while the rest 14% opined negatively. This means the large number of farmers considered ICT center as a potential source of farm information which can make qualitative changes in their farming activities. The farmers who answered negatively were due to their ignorance about ICT center and its functions in disseminating farm information (Moon, 2013 : p.30).

It is often difficult to isolate the impact of extension approach on agricultural productivity and growth from that of other factors. Studies have demonstrated the high economic returns of investments in agricultural research and dissemination typically above 40%. Investment in agricultural research and extension is thus a crucial input of agricultural growth. At present, however, agricultural extension services in developing countries are grossly underfunded to undertake the activities required for achieving food security while protecting the productive resource base in order to keep up with population and economic growth.

Agricultural productivity cannot be tackled if the capacity of actors engaged in the sector is low. Capacity, in terms of knowledge and information, must be built in the farmers and other operators in agriculture value chain to enable them to operate efficiently in the knowledge economy. Learning is encouraged through the exchange of ideas, successes and failures between stakeholders (Glendenning, et al 2010: p.7). In this case, if ICT indeed improved the production processes, these improvements should eventually be evident. Examples would include better decisions in a specific production process, shorter supply lead-time etc. No effort was made to quantify the benefit from ICT although the negligible cost of such package contributes to the farmer’s favorable cost benefit ratio (Franklyn and Tukur 2012: pp. 42-43).
AgICT contributes about 5% in the agricultural productivity and 24% in the poultry sector. It means there is huge potential to improving poultry contribution to agricultural GDP by about 3.42-3.56% (from current 4% to 7.42-7.56%) should there be 10% increment in the total investment at the rural level integration of AgICT in poultry farming practices. It can increase the productivity from current 0.3% per annum to at least 3.42% per annum. Farmers having access to ICT mediated extension services have increased average farm productivity by 2.01% higher than the non-use of ICT. The survey revealed ICT profit is 1.89 times higher than that of control group (Chhetri, 2016:p 1)

3. Mobile Technologies
The impact that mobile communications are having on economic and social development in LDC is akin to that of other major enabling infrastructures like roads, ports and railways. All stimulates trade, create jobs, generate wealth, and enhance social welfare. Mobile communications in particular are making a profound impact by: a) delivering universal access b) delivering universal services c) boosting GDP and, creating sustainable infrastructures such as e-banking, easier access to health care, education and other Government services (ITU, 2011 : 63).

Mobile-broadband networks are allowing more people connect to high speed networks and benefit from a growing number of applications and service. While both fixed-and mobile-broadband speeds continue to increase, the price of services is falling and ICTs are becoming more affordable. In the span of four years, fixed-broadband prices have dropped by an impressive 82% (ITU, 2013: p. iii and Fu and Akter 2010 : p.3).

Mobile phones can also be used to make cash payments without the need for a bank account. Further advantages that mobile subscribers experience in developing countries are: a) reduction in transaction costs; b) enlargement of the area in which trade is performed; c) Reduced need for travel (which is a big advantage, especially for the unemployed); and d) Reduced need for travel (which is a big advantage, especially for the unemployed); and d) extended reach of public service delivery in under-serviced communities (Greunen, 2013 : p.5).
Mobile devices can really serve the social, political and cultural needs of the poorest. Poor people undoubtedly value mobile phones for the social connectivity but the share of their limited budgets to such networking remains unacceptably high (ITU, 2011: p. iv). The popularity of smart terminals and mobile broadband networks has brought about dramatic changes in people’s everyday lives; touching everything from travel, shopping, socialization, entertainment, enterprise operations, and new work styles. In fact, the mobile services that we enjoy today have long been provided on fixed terminals when they were viewed as technological progress. In the mobile era, however those services have impacted our life and work styles in completely different ways. Service ubiquity has become a reality and has changed the way we live and work (ZTE, 2014: p.2).

LAWAL-Adebowale (2015) drew very interesting findings in his Mobile ICT’s study. He concluded that in order to establish linkages with stakeholders in agricultural development 100 per cent exclusion personnel made use of Mobile Phones in preference to other ICT –tools. Similarly, 100 per cent extension personnel used Laptop in word processing of Field Reports and 100 per cent used Multi-Media Projectors especially in convergance for presentation of farm activities. Other ICT-tools like Internet Modem, I-Pad Tablets, VCD & DVD, MP Players and Digital camera had a negligible use in extension service delivery. In the light of these findings, LAWAL-Adebowale has recommended that among the several emerging Mobile ICT’s appropriation of the devices should be ensured and made available to extension agents in execution of their extension tasks.

There is evidence that mobile communication is not eroding social capital but rather plays a positive role. Informational mobile phone use is a positive predictor of face-to-face leisure, social cause support, and political participation. In Korea, such use is related to community involvement perhaps because the diffusion of mobile technology is greater and more mature in that country. In the United States, the relationship between use and social capital is strongest for the young age group, while in Korea, it is strongest for the oldest group (The Conference Board, 2011:p.29). There is no a strong direct relationship between the presence and use of ICT (Either at home or at school) and educational performance (The Conference Board, 2011 : p. 32 and Cox 2011 : p-5).

**Mobile Phone**

Mobile phones are multifunctional devices. From smartphones to models available second hand in rural markets. Mobiles do much more than simply place voice calls. In designing a mobile intervention, it is important to keep in mind the various channels through which populations are reached.

As networks and devices acquire more capabilities, richer uses of phones are unfolding, and information channels are converging. Camera phones send images, data transfer brings the mobile Internet to the bottom of the pyramid, downloaded software applications provide advanced functionality, and GPS sensors provide mapping functionality. Emerging market consumers are more likely to have their first contact with the Internet through a mobile converts e-mails to SMS messages and an interactive voice response (IVR) service, in which a computer responds to voice inquires. Combining mobile phones with other technologies such as radio or telecentres can enhance their capabilities.

While infrastructure investments still remain low in many developing countries, one of the most dramatic changes over the past decade has been an increase in mobile phone coverage and adoption (Aker 2011 : p. 7). The concept of using mobile phones as a major tool for reaching farmers and transmitting timely and low cost information was highly appreciated in all the villages (Siraj, 2013 : p. 7).
The revolution in mobile communications is providing a lifeline to agricultural communities around the developing world. Mobile technology is already demonstrating its potential to provide farmers with the services and information they need to grow both their production and their standard of living. By taking steps to make financial services accessible to smallholder farmers, policy makers, enterprises and development organizations can play a role in empowering them with the tools they need to reap the return their hard work (Weisbrod, 1997).

Advances throughout the mobile phone ecosystem tend to act as a positive feedback loop. This 'virtuous circle' of innovation enables a number of benefits even for smallholder farmers:

- **Access**: mobile wireless networks are expanding as technical and financial innovations widen coverage to more areas.
- **Affordability**: prepaid connectivity and inexpensive devices, often available second hand, make mobile phones far cheaper than alternatives.
- **Appliances**: mobile phones are constantly increasing in sophistication and ease of use.
- **Innovations**: innovations arrive through traditional trickle-down effects from expensive models but have also been directed at the bottom of the pyramid.
- **Applications**: applications and services using mobile phones range from simple text messaging services to increasingly advanced software applications that provide both livelihood improvements and real-time public services.

Reduced communication cost could not only increase farmers access to (private) information, but also to public information such as those provided via agricultural extension services. The marginal cost of providing market information via SMS is cheaper than providing the same information via an additional extension visit, and is equivalent to providing the same information via radio. Reducing the costs of disseminating information could increase the extension system’s geographic scope and scale as well as facilitate more frequent and timely communications between extension agents and farmers. This could, in turn, improve the quality (or value) of the information services provided. Yet the impact of these reduced costs on farmers’ adoption decisions will depend upon the ability of such information serve as substitute to in-person mechanisms (Aker, 2011 : p.9).

The rise of the mobile phone has been one of the most stunning changes in the developing world over the past decade. The increasing ubiquity in developing countries presents both opportunities and challenge especially for critical sectors such as agriculture. Like other technologies before it, the mobile phone is likely to be the subject of inflated expectations and hopes. In the ten years before 2009, mobile phone penetration rose from 12% of the global population to nearly 76%. It is believed that more than 90% Nepali possess as set of mobile phone. The newest smartphones are far more sophisticated than the more affordable models populating poor regions, but those simple phones are still leaps and bounds ahead of devices that were cutting edge a decade ago – and they are entirely relevant to agriculture.

Mobile phones significantly reduce communication and information costs for the rural poor. This not only provides new opportunities for rural farmers access to information on agricultural technologies, but also to use ICT’s in agricultural extension services. Since 2007, there has been a proliferation of mobile phone-based applications and services in the agricultural sector, providing information on market price, weather, transport and agricultural techniques via voice, SMS, radio and Internet (Aker, 2011 : p.3). As example mobile payment systems have become very popular. Kenya, South Africa, and the Philippines have significant mPyament
programs, which are increasingly linked with bank accounts. Mobile network operators run the systems (Brugger, 2011: p. 31-33 and Smith, 2001 : p.1). Until recently, connectivity in rural areas was limited to slow dial-up lines. Satellite connections now make broadband access possible in remote areas. Use of mobile phones has seen an enormous increase in recent years (Singh, 2010: p. 83). A successful large-scale schemes: ‘M-Pesa’ one of the best known examples of successful use of mobile phone technology for economic development in Kenya. M-Pesa, meaning “mobile cash”, is a mobile banking service that now counts about 10 million customers. (Source: Q).

Mobile money services, prominent in many countries, originally began as informal mechanisms between family and friends. Software engineers in developing countries are creating locally appropriate applications to be deployed inexpensively. This form of innovation is possible due to the functionality of mobile phones, but capacity needs to be grown and technological barrier such as incompatible networks need to be addressed,

Kenya is a hotbed of technological innovations such as M-farm, a mobile service that aims to improve Kenya’s agricultural sector by connecting farmers with one another. Peer-to-peer collaborations can improve market information and enhance learning opportunities. Based around farmers’ traditional need such as market price and weather information, M-Farm is a relatively new subscription service that works with larger institutions such as NGOs and the Government to connect them with farmers. The Village Phone program of the International Finance Corporation may also benefit rural women. The program provides microloans to rural entrepreneurs who purchase a mobile phone, long range antenna, solar charger, and airtime. The recipient earns a livelihood by operating a phone kiosk in areas underserved by mobile networks. As it is typical in microfinance, the loan recipients tend to be women. Since the program’s inception, nearly 6,000 women have received loans and close to 10,000 have been trained in countries such as Madagascar, Malawi and Nigeria (Meera, et al 2004: p. 5).

In a far flung country like Uganda, community knowledge workers use mobile phones to provide poor farmers with real-time information on agricultural topics including market prices and are supported by a call-center staffed with highly skilled agricultural experts. iKisan provide information such as crop diagnostics, disease and pest management; soil testing, sampling and fertility; information about agricultural equipment other inputs and their availability; market information; crop insurance information; information regarding cropping patterns and systems; question- and-answer services; poultry-and animal husbandry-related information (Meera, et al 2004: p.5).

Wims and Byrne (2015) have reported that 100 per cent Irish farmers use Mobile Phones, almost one-third of them possess Smart Phones, in gathering information on farm-related subjects practically daily. Similarly 94 per cent Irish farmers use Computer for SMS messaging and e-mails on internet for a range of services especially to contact extension workers and other farmers. However, when it comes to specific and detailed advice on farming issues, there is still a strong preference for more traditional methods of communications such as farm & home visits, farm walks, office consultations and discussion groups. They have, therefore, drawn a point that in order to ensure maximum efficiency in face to face communications, the ICT-tools must be the part and parcel of extension workers and farmers so that they could have easy access to transfer of information on the internet PC and Mobile Phones.
In some instances, access to mobile phones has been associated with increased agricultural income. A World Bank study conducted in the Philippines found strong evidence that purchasing a mobile phone is associated with higher growth rates of incomes. One reason for this findings is that farmers equipped with information have a stronger bargaining position within existing trade relationships, in addition to being able to seek out other markets. A study of farmers who purchased mobile phone in Morocco found that average income increased by nearly 21% (Ilahinane 2007).

Mobile phones seem to influence the commercialization of farm products. Subsistence farming is notoriously tenuous but smallholder farmers lacking a social safety net are often highly risk averse and therefore not very market oriented. A study from Uganda found that market participation rose with mobile phone access (Muto and Yamano, 2009). Although better market access can be a powerful means of alleviating poverty, the study found that market participation still depended on what producers had to sell: perishable bananas were more likely to be sold commercially than less-perishable maize. Mobile phones can serve as the backbone for early warning systems to mitigate agricultural risks and safeguard agricultural incomes. In Turkey, local weather forecasts transmitted through SMS provided very timely warning of impending frosts or conditions that favoured pests.

Mobile platforms may also have potential for enabling rural people to find employment. In Uganda, Grameen AppLba partners with Government and NGOs to employ farmers to collect information. This method, which relies on local people to transmit data to more centrally located research and extension staff, is much less costly and can provide much more timely information than traditional disease surveys.

Txteagle provides employment for relatively educated users and even the very poor in rural areas could eventually benefit from access to a mobile job board. Farmers could advertise when they need additional labor for harvesting or other high-intensity tasks via mobile phone, creating and simple advertising portal. Workers could find jobs without wasting time or money traveling. A group called BabaJob is developing such a service in India where recruiters and workers submit listings by SMS.

The numerous capabilities of mobile phones provide ample opportunities to deliver traditional and innovative services. Traditional agricultural extension agents are increasingly being outfitted with mobile phones through programs to increase their effectiveness by networking them to knowledge banks. Extension can reach more clients through mobile-based learning platforms – textual or richer platforms such as video- that provide tips to farmers to improve agricultural skills and knowledge.

**Short Message System**

In much of the world, voice is still king owing to widespread illiteracy but other considerations such as cost, ease of use, and trust influence user’s choices. In Africa, the high cost of calls has made 160-character text message (SMS) very popular. With the widespread use of mobile phones, voice and SMS solutions should find more use as they offer easy accessibility. They also face some challenges: the SMS carries only a limited amount of information and requires a basic level of literacy. Voice-based solutions are complicated to develop as they require machines to produce natural speech or good speech synthesis. They also do not offer detailed information such as pictorial illustrations as in web solutions. Nonetheless, the voice solution is still by far the most promising platform for the farmers as it can be customized for aluagug. It is readily accessible and very natural as it entails using the mobile phone through direct response to specific questions (Gakuru, et al 2009; p-2) SMS based platforms – which are often the easiest to establish – can only hold limited information and require that users have some literacy skills and technological knowledge (Aker, 2011:...
Using ICT to enable agricultural innovation systems for smallholder’s attraction of SMS-based systems seem to predominate at this time, there is hope that technology and infrastructure will progress beyond short texts to allow use of more complex information, including images (Palmer, 2012: p.2, Gakuru, et al 2009: p. 10 and Deglise, 2012).

**Internet**

The WWW has drastically changed the way of information dissemination especially in the field of education and in particular for open and distance learning (Singh, 2010: p. 71). The rise of the Internet is regarded as both a cause and an enabler for widespread development. The current young generation has grown up with the Internet. Traditional class teaching does not seem to fit very well with the learning style of these digital natives (The Conference Boars, 2011: pp 34). Farmer organizations play an important role in the Internet adoption provision of subject matter content and funding for information generation and dissemination. The organization’s goals do not always correspond to individual member’s goals (Gelb and Bonati 1997: p.9).

This is in sharp contrast to the findings of Deegan et al (2014). In their experiment, they found no significant difference between traditional method of teaching and Tablet-PC used method of teaching in classroom. They have, therefore, suggested that an already established successful education environment need to be enhanced through introduction of Tablet-PC technology into agricultural education systems of teachings and extension services. In this endeavor, more practical in-service training to extension personnel in ICT’ application is essential so as to successfully integrate Tablet-PC into agricultural and extension education domains.

The sellers and buyers can trade without seeing each other through the Internet. Thus, the firms can decrease their cost and increase the possibility of reaching wider crowds and promotion options (Paresker, and Cetin 2009: p.75). Internet users clearly recorded exponential growth in all regions of the world. However, the forthwith in the Asian region was the highest. Asian Internet users have also increased exponentially. The guiding factor for Internet users have also increased exponentially. The guiding factor for Internet development are inputting of information that farmers/extension want and/or need; identifying a tangible benefit of information users; defining and serving target audiences packaging information in a way that it can be understood and applied; a simple, user-friendly search engine and interface design, information quality and reliable (Gelb and Bonati 1997 : p.1). There are about 25% of the farmers who have been buying through the Internet. Products ordered from the Internet are feed, management equipment and semen (Source: AJ).

The internet now provides low-cost and efficient communication where developments in data encryption and electronic payment facilities are providing an increasingly safe desktop environment for conducting business. When these factors are combined with adequate information services for technical and marketing data, the scene is being set for the most significant leap forward in efficiency that the sector could hope for (Singh, 2010: p. 4).

**Email and Skype**

Emails lets people get in contact with people all over the world in a blink of an eye and is much faster and more effective that traditional post which might take a few days to arrive. People tend to adopt a more casual approach to email etiquette but should nevertheless be aware that email is just as legally binding as any other written correspondence. Additionally an employer should inform employees if it read their emails. Skype enable farmers to have join vide conference and conversation in a cost effective manner. Between 2004 and 2010, the number of registered skype users
increased by almost 30 times, up to 560 million worldwide (Atkinson and Stewart 2013: pp 7-8).

**Website**

Simple websites are a start of more complex agricultural trade systems to match offer and demand of agricultural produce. These sites tend to evolve from local selling/buying website and price-information systems to systems offering marketing and trading functions. Typically, price information is collected at the main regional markets and stored in a central database. The information is collected at the main regional markets and stored in a central database. The information is published on a website accessible to farmers via information centers. To reach a wider audience, information is broadcast via rural radio, TV or mobile phone, thereby creating a ‘level paying field’ between producers and traders in a region (Stienen, et al 2007: p2 and Kameswari et al 2011: p.1).

### 4. ICT for Farm Management

The most widely used and available tools of farmers’ advisory services are-telephone based tele advisory services, the mobile based agri-advisory services, television and radio based mass media program, web based online agri-advisory service, video-conferencing, online-agri-video channel, besides traditional media like printed literature, newspapers, farmers exhibition/fair etc. The farmers or extension workers can choose any medium to seek the relevant information and advice. Majority of farmers want information with respect to crops (varieties, package of practice, plant protection etc.), planting material availability, soil, agri-market information, weather information, information on agriculture allied activities like dairy, poultry, beekeeping, mushroom production etc. along with information about marketing of the products, credit facility, incentives, Government policies and schemes, supportive measures like subsidies etc (Singh, 2010: p. 29 and Henri-Ukoha, et al 2012)

### 5. ICT Productivity in Poultry

A study the ICT potential on poultry production by calculating ICT value, net profit generated by ICT reveals that ICT productivity ranges from 4.24 to 2.32 with an average value 3.29, but looking at the net between the control group and treatment group, the latter group benefits by 1.87 times (Chhetri, 2016).

AgICT contributes about 5% in the agricultural productivity and 24% in the poultry sector thereby holding a huge potential to improving poultry contribution to the agricultural GDP by about 3.42-3.56% (from current 4% to 7.42-7.56%) should there be 10% increment in the total investment dedicated to the ICT penetration at the rural level integration of AgICT in poultry farming practices. It can increase the productivity from current 0.3% per annum to at least 3.42% per annum. Farmers having access to ICT mediated extension services have increased average farm productivity by 2.01% higher than the non-user of ICT. The survey revealed ICT profit is 1.89 times higher than that of control group. The findings also suggest a cross-fertilized neo-ICT theory with an urge for scholars to revisit existing ones and develop a converging ICT framework (Chhetri, 2016).

### 6. Conclusion

ICT is an umbrella term for any communication device or application encompassing radio, television, cellular phones, computer network hardware and software, satellite systems as well as the various service. ICT in the agriculture sector called Agricultural Information and Communication Technology (AgICT) deals with rapidly expanding ICTs and provides information needed for farm production.
During the last decade ‘agricultural software’ matured into an ICT dominated market-pull situation characterized by electronic data interchange (EDI), knowledge based networking and dedicated ICT production systems Agriculture sector requires utilization and deployment of AgICT for improvement of efficiency in production and marketing of the agricultural crops.

Global studies demonstrated the fact that AgICT positively effect economic growth and productivity of inputs. The study also shows that AgICT has positive and significant impact on growth of agriculture sector. It was found that the farmers using AgICT in farming activities have increased 5.91% of their farm productivity (rice production) compared to immediate past year while farmers having no exposure to AgICT increased only 3.90% of farm productivity. This can apparently be assumed that the AgICT alone can contribute 2.01% increase in farm (Paresker, and Cetin 2009: p.75).

Verma and Sharma (2013) reported that this increase is largely attributed to the judicious use of ICT’s in different aspects of Agriculture. They found the use of Computers is made by extension personnel to the extent of 43.76 per cent in Agricultural operations. Similarly, they further revealed that the use of Internet in Agriculture is made to the extent of 39.81 per cent, use of Mobile phones 68.69 per cent, use of Kisan call centers 36.79 per cent and the use of Information kiosks 27.72 per cent. They concluded their findings that by and large the majority of extension personnel (56.25 per cent) apply ICT-tools in their agricultural extension activities. Based on these findings, they recommended that in order to increase application of ICT’s in Agriculture, extension personnel should be well-equipped with all the ICT-tools free of cost. They further suggested that extension personnel should be made well-trained in the proper use of ICT’s.

The radio and TV continues to be the most common ICT in rural household in many parts of the world. At the other extreme, Internet access is very limited in these households. The use of various ICT devices maximizes the delivery of key information to agricultural producers. Given the strong presence of the traditional ICTs like the radio in rural households many projects have been designed to combine both traditional and advances ICTs. The future ICT trends will relate with : a) converging of media and tools for communication; b) increased web-based storage of agricultural information; c) cheaper and improved connectivity for rural communities; d) increased recognition by the Governments of the importance of ICT in rural development; e) increased tailor-made quality agricultural information services.

Basically, applications of ICT in support of agricultural and rural development fall into five main areas. These are : a) economic development of agricultural producers; b) community development; c) research and extension; d) small and medium enterprises development; e) media networks. Some agricultural development services applying AgICT are a) online services for information, education and training, mentoring and consultation, diagnosis and monitoring and transaction and processing; b) e-commerce for direct linkages between local producers, traders, retailers and supplier; c) the facilitation of interaction among researchers extension (knowledge) workers, and farmers; d) question-and-answer service where experts respond to queries on specialized subjects applying ICT for greater efficiency; e) up-to-date information, etc.
AgICTs facilitate research and development, and information sharing on agricultural farm extension technologies and approaches. In India, the development of linkages between research and extension is exemplary to be replicated to tackle the scale and demands for services required by extension personnel. The VASAT of ICRISAT is an example.

The convergence of IT and CT and hyper-connection brings economy. A number of factors have their bearing in influencing application of AgICT. Because innovation is a major driver to economic change. It is important to consider all factors that make like better for people such as increasing the value of products for the producer and/or consumer of new or different products. In fact, investing in ICT can help countries increase their annual GDP growth by 0.6-0.8% on average on an annual basis for each increase of 10% in household penetration. Many studies have examined the determinants of household computer and Internet adaptation and have identified age, education and income as the main drivers. Education, openness, and institutional quality are expected to be among the major determinant of the variation in ICT contribution to output growth across the economies. Some factors such as human capacity, content, process, technology have their bearing in influencing application of AgICT.

Lackadaisical performance of extension services can be improved by the application of ICT in extension making it diversified, more knowledge-intensive, and more demand driven, and more effective in meeting farmers’ information needs. During the past two decades, there has been a revolution in ICT products with mobile phones becoming a key tool for transmitting knowledge and market information to farmers. E-Agriculture is an emerging field focusing on the enhancement of agricultural and rural development through improved ICT processes. It is also known as agriculture informatics. The main applications of ICT in agriculture sector include: office automation, knowledge management system, e-learning, e-commerce, ICT for managing agricultural resources and services, CAM, CAD, RFID’s wireless technologies. It facilitates exchanges and flows of information between parties all along the supply chain and can be used to manage transactions, arrange logistics and ensure that quality specifications are clearly understood. It produces information at significantly lower cost; transfers information and knowledge rapidly over large distances through communications networks; enables cost advantages by playing a direct or indirect role in the cost of various activities in the value chain. Two prominent value chain management examples are the micro-soft excel (Bangladesh) and Suguna Poultry (India). An average farm productivity of ICT users has been increased by 5.91% as compared to the yield of previous years when ICT was not available at the locality. The farmers who did not use ICT facilities were found to increase their average farm productivity by 3.9%. Hence, AgICT contributes about 5% in the agricultural productivity and 24% in the poultry sector. Poultry holds improving contribution to the agricultural GDP by about 3.42-3.56% (from current 4% to 7.42-7.56%) should there be 10% increment in the total investment dedicated to the ICT penetration at the rural level integration of AgICT in poultry farming practices.

Information management is key to achieve above claims as it impacts on planning organizing, structuring, processing, controlling, evaluation and reporting of information activities. There are several tools such as GIS, GPS, systems (MIS, expert system, decision-making system and mobile technology. Mobile-broadband networks are allowing more people to connect to high speed networks and benefit from a growing number of applications and services. Mobile phones can be used to make cash payments without the need for a bank account. It benefits farmers by : a) reduction in transaction costs; b) enlargement of the area in which trade is performed;
c) Reduced need for travel (which is a big advantage, especially for the unemployed); and d) extended reach of public service delivery in under-serviced communities. There are several initiatives such as KCC with telecom infrastructure; KHETI, eChoupal allows farmers to negotiate sale of their produce online. Nepal agriculture information is based on radio and TV program. The application of ICT such as mobile phone is very rare but there are telecenter in remote villages.

14. Reference

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