

Digital Agriculture: A review on the agricultural extension system of Nepal

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ABSTRACT

This review article aims to explore the current status of extension services used in the agriculture sector and the possible way forward for the digitization of agriculture and rural development sectors in Nepal. Innovation and digital agriculture have the potential to make agriculture more productive, more consistent and to use time and resources more efficiently. Knowledge and information are basic ingredients of food and nutrition security, agri-food system and are essential for facilitating rural development and bringing social and economic change. Digital technologies are increasingly looked at as a potential source of information, knowledge, and skill to the rural people of Nepal. Nepal has gradually stepped up in the field of digitization using appropriate ICTs in agriculture and rural development sectors with enabling environment and rolling out the initiatives and policy interventions at three tiers of governments. In summary, the digitization of the agriculture extension system has the potential to transform the way we produce food and provide services but the approach is still very new, costs are high and the demand side is weak in small landholding farmers especially in developing countries like Nepal. That means to secure its wider spread adoption will require common understanding, collaboration, and consensus across the value chain to share the judicial benefit of every actor and factor in the system. Finally, to fit into the context, the agricultural digital extension should be capable enough to provide advisory services for farmers, processors, traders and other stakeholders involved in the overall value chain system of agriculture, food and nutrition security and agri-food system.

Keywords : Extension, agricultural extension system, ICTs, agri-food system, innovation, digital agriculture

INTRODUCTION

Agriculture is the principal component of the Nepalese economy that contributes (estimated) 25.8 per cent in GDP in 2020/21 (MOF 2021) with an annual growth rate of 3.2 per cent in the last decade and provides employment for 60.4 per cent of people in various ways (MOF, 2018). It is the main source of income for rural farmers and provides means of livelihood for the people. Agriculture includes growing crops, raising livestock, poultry, and fisheries and their associated business.

Globally, digitized agriculture including the use of ICTs is rapidly expanding in the agriculture sector and provides information needed for the product and services. So far there has been made a gradual effort in Nepal in harnessing the benefit from ICTs use in agriculture, food and nutrition security, and agri-food system.

METHODOLOGY

This paper is completely based on secondary information. The study represents the

national issues on the existing situation of ICTs use in agriculture and rural development sectors in Nepal. The secondary information from national policies, strategies and government reports like Economic survey-2020, 15th Periodic Plan, Agriculture Development Strategy (ADS 2015-35), National ICT Policy-2015 and others and reports from FAO, UNDP, and academic journals were reviewed. It also includes reviews of different articles and other kinds of literature.

This study examines the existing information presented in the reports and literature regarding the use of digital technology as a means of extension in the Agriculture, agri-food system and rural development sectors in Nepal. Hence, for this study, no primary data has been taken and analyzed and it is a limitation of this study.

RESULTS AND DISCUSSION

A. Agricultural Extension System in Nepal

Agricultural extension service is one of the major undertakings of the government of Nepal to

educate, disseminate information and support the livelihoods of the Nepalese farmers. It provides both productive inputs and services to teach farmers about improved technologies so that they can improve their productivity, incomes and standard of livings. Initially, the extension system in Nepal was mostly used as synonymous with government or public services, but the economic globalization, liberalization, privatization and advent of information and communication technologies have been brought tremendous changes in the field of agriculture and the agri-food system in Nepal. As a result of this paradigm shift in agriculture, the role of government extension services has also changed as a facilitator and now services have been gradually provided by the private sector.

Despite of the significant efforts made by the extension system, however, there are still several problems and issues that require attention to perform its function more efficiently and effectively. One of the major challenges for the agricultural extension system is how to serve the majority of rural poor farmers and socially disadvantaged groups who had long been neglected by extension and other services. Other problems are poor infrastructural development, insufficient human resource, and weak linkage between research, extension and education systems. However, the use of ICTs in agriculture is gradually growing these days in Nepal and from rural farmers to entrepreneurs, they have started taking benefit from digital agriculture in all value chains in agriculture.

B. Extension Approaches used in Nepal

The following are the approaches adopted in Nepal in the past

- (i) Training and Visit System
- (ii) Integrated Rural Development System
- (iii) Tuki Approach
- (iv) Farming System Research and Extension Approach
- (v) Block Production Program
- (vi) Conventional Education Approach
- (vii) Pocket Package Approach

(viii) Projectization Approach

These days the following additional extension approaches are used in Nepal to transfer knowledge from researchers to farmers, to advise farmers in their decision making, and to educate farmers to make similar decisions in the future.

- (a) Farmers Group Approach
- (b) Farmers Field School Approach
- (c) Partnership Approach
- (d) Advisory Service Approach
- (e) Digital Agriculture Approach

As a federal context in Nepal, now a mixed type of extension approaches are in the practice at three tiers of governments and the private sector is coming forward with digital technologies to develop the product and services in the agriculture and rural development sector.

C. The digital concept and use of ICTs

ICTs help in a growing demand for new approaches. It also helps in empowering the rural farmers by providing better access to natural resources, improved agricultural technologies, effective production strategies, markets, and financial services. Lie R. and Witteveen L. (2019) says “what is new, in the past two decades or so, is that much attention has gone to so-called new ICTs as if the “T” in the abbreviation did not exist before the digital revolution. It seems limitedly recognized that e-agriculture, e-business, and e-health are becoming common terms to refer to electronic adaptations of existing concepts of knowledge exchange and learning”

According to Lokeswari (2016), the challenge of traditional agriculture is addressed significantly by using ICTs that play an important role in uplifting the livelihoods of the rural small landholders' farmers. Likewise, Serafini (2017) advocates that visual literacy was originally defined as a set of visual competencies or cognitive skills and strategies one needs to make sense of visual images”

About the policy enabling environment, Sapkota (2009) says “to achieve the government's

objective of deployment of ICTs for social and economic change, it is necessary to bring a favorable policy that guarantees the access and use of ICT for the people belongs to the different socio-economic strata of Nepal”.

In this regard, India has a successful example and Sonawane *et al.* (2020) write that “in this century information technology drives prime attention because of its faster connectivity and easy access. Recognizing this fact Government of India and the Department of Extension Education connecting farmers to digital platforms. One such connecting dot is e-NAM. National Agricultural Market (NAM) is a Pan-India electronic trading portal which networks the existing APMC market to create a unified national market for agricultural commodities”.

Witteveen *et al.* (2017) put forward an example from Sierra Leone and explain the initiative that “the Digital Farmers' Field School (DFFS) offers a tablet-based digital learning environment for farmers and extension agents for knowledge sharing and knowledge cooperation. It provides an alternative to conventional agricultural extension training and monitoring.”

FAO (2020), explains that developing, adopting, and scaling up digital innovation technologies requires that the stakeholders and decision-makers develop a better understanding of impact pathways, risk, and benefits of technologies, as well as new partnership and business models involving the public and private sectors, civil society and farmer organizations. Basic concerns over literacy remain relevant, as it is still considered an important fact that “103 million youth worldwide lack basic literacy skills, and more than 60 per cent of them are women” (UNDP 2018).

FAO's (2021) briefing report adds that digital technology is already changing the dynamics of the agri-food sector but the process has so far not been systematic. Realizing the full potential of digital farming will require the collaboration of all players in the agriculture value chain. There is a need for a clear overview on the part of actors

working in agri-food and digital products – including the private sector, governments, and other agencies – on how to exploit the opportunities of digital agriculture.

D. Digital and non-digital Innovations

Both the non-digital and digital types of innovations have been applied to food, agriculture, or rural livelihoods sectors for the benefit of farmers and entrepreneurs of Nepal.

Digital innovation is the use of digital technology and applications to improve existing business processes and thereby increase the efficiency and productivity of the workforce. In addition and even more importantly at times digital innovation enhances customer experience and help to launch a new product or a new business model. The application of digital technology in agribusinesses enables entrepreneurs to increase the efficiency of the enterprise and the entire agricultural value chain through better and timely sharing of information. It focuses on improving customer experiences such as through better reach of agricultural extension services to farmers and further expanding business operations.

Using digital innovation makes operational processes well-defined, streamlined, and transparent. It integrates the data and process to enhance the production and distribution efficiency of agricultural products.

Digital innovation thus is the process of using digital technologies to create new products and services and/or modify the existing business processes, culture, and customer experiences to meet changing business and market requirements. It transcends traditional roles like sales, marketing, and customer service and ensures better integration, both vertically and horizontally. This helps in increasing efficiency and cutting costs.

Today, digital innovation is at the heart of every business organization, including agriculture. It is needed to digitize internal operations to do things better, faster, and cheaper exploring new

ways to engage users and bring new products and services to market. Driving digital innovation, however, involves hard work especially in the agriculture sector where both the producers and marketers are lagging in using it due to the limited availability of internet services. However, changing market conditions and consumer demands ask for the use of competitive and faster digital technologies to be available in the market.

On the other hand, non-digital innovations (conventional) are the use of technologies that are dated, time-consuming, and less efficient. The development of promising varieties and breeds through a process of varietal and breed development and their use in the agriculture sector are examples of non-digital innovations. Moreover, the use of large and analog types of machinery and equipment in production, processing, and marketing are also examples of non-digital innovations. These are also areas where the application of digital technology is difficult.

Both the aforementioned innovations are related to each other, however faster and efficient uses of non-digital technologies are possible only if we combine those with digital technologies. For instance, modern crop production technologies can be disseminated in a faster and efficient way by the development and use of apps developed using digital technology.

Ministry of Agriculture and Livestock Development Nepal has been involved both in the development of digital and non-digital (conventional) technologies that are being used in agriculture systems in Nepal; for instance, mobile applications regarding weather forecasting, agro advisory services, digital soil mapping, farmers' call center, online farmers registration and listing, and others. Likewise, the ministry has also continued the conventional innovation approaches such as FFS, IPM, IPNS, farm demonstrations, and others.

When compared to digital innovation, conventional innovation takes more time and also demands the use of more financial and human resources.

E. Digital Ecosystem

When presented with new digital services or innovations, there are some of the obstacles that may face small farmers, rural households, and rural communities.

Despite the speedy growth of digital agricultural technologies, scaling up of most ICTs-based solutions is challenging especially in the rural sector where there is the predominance of poor rural farmers. Some of the obstacles are highlighted as follows:

- There is a lack of guidance for entrepreneurs on scaling strategies of those technologies in under-served markets.
- Rural people are different from urban people in many respects. Rural farmers are characterized by low income, are scattered widely, have a low level of education, are poorly exposed to modern media, and can invest fewer resources on buying necessary equipment like smartphones due to resource constraints.
- Basically, rural people are conservative and deprived of many infrastructures. They show the tendency to resist changes, as they tend to be risk-averse.
- Rural sector also lacks requisite infrastructure including electrification, transport, and communication. Regarding IT infrastructure, the network coverage in rural areas is usually limited.

Overall, rural areas are attributed to weak technological infrastructure, high costs of technology, low levels of e-literacy and digital skills, weak regulatory framework, and limited access to services leading to the risk of being left behind or left out from the digitalization process.

F. Technology fluency

There are many examples of a digital innovative tool used, developed in the context of project, policy, or capacity development related activities in Nepal. For example, the Ministry of Agriculture and Livestock Development (MoALD)

has been collaborating with World Bank (PPCR Project), FAO, UNDP, EU, USAID, ICIMOD, and other national and international entities in strengthening the use of ICTs and digital applications in agricultural planning and food security decision making in the following key areas:

- Development and launch of digital soil mapping in Nepal
- Development and launching online farmer's registration/listing
- Development and launch of Web-based GIS in the form of digital agriculture atlas of Nepal
- Development of National Drought Watch and its use in the National Agricultural Management Information System (NAMIS)
- Initiation of Digital-Village establishment
- Development and launch of farmers call center
- Development of Kisan Credit Card
- Customizing FAMWES (Fall Armyworm monitoring and early warning system)
- Installation of digital boards with daily price information
- Telecasting and broadcasting agricultural information through Television, FM Radio, and local networks
- Development and implementation of Hamro Krishi mobile app and SMS service
- Initiation of Remote Sensing based crop area estimation and reporting
- Pilot on localizing agricultural advisory process through the integrated use of mobile apps, ICT, and climate data products
- Developing a web-based software- AGRIS/NIASS
- Developing and disseminating short technical videos through mobile phone, collaborating with the public and private sector (Rice-mill models).

It is a fact that agriculture is a highly weather-dependent phenomenon. Nepalese agriculture is being affected by various weather events as well as climate changes. In this context, the agro-met advisory services help farmers to optimize

their production through timely and judicious resources management based on the weather information and reduce the losses caused by extreme events. Further, while the change in the structure of the agricultural extension system in the federal policy, the dissemination of the information is a challenging proposition. So, the agro-met advisory generation is a shift from conventional extension to digital innovation in Nepal.

Likewise, newly developed the digital soil map for Nepal provides access to location-specific information on soil properties - for any province, district, municipality, or particular area of interest. The interactive map provides information that will be useful for new crop and site-specific fertilizer recommendations for Nepal. The Prime Minister of Nepal officially launched the digital soil map on 24 February 2021. This digital innovation is produced by the ministry in collaboration with CIMMYT/NSAF and Nepal Agriculture Research Council (NARC) and the digital platform is hosted and managed by the NARC system. It updates the database periodically to ensure its effective management, accuracy, and use by local governments and relevant stakeholders.

G. Digital governance and role of private sector

Digital innovation policy requires both government and private sector involvement to achieve the result on public-private partnership initiative on digitized agriculture, food and nutrition security, and agri-food system.

According to the 2019 Digital Framework, Nepal has enjoyed incredible success in expanding digital adoption. According to the Nepal Telecommunication Authority (NTA), there was an addition of 2.25 million new Internet users in 2017 alone, translating into approximately 250 new Internet users every hour. The growing popularity of social media is a crucial driver for Internet adoption in Nepal. As of January 2018, Nepal has nearly 9.3 million Facebook users. Entertainment and video sharing are other popular use cases with more than 6.4 million registered users on YouTube.

For decades, the Nepal government has used numerous policy instruments to improve farm productivity. The agriculture sector has made some progress in the use of soil health cards, modern irrigation methods, and mobile apps to access agricultural information and e-commerce platforms. However, the initiatives seem too few, scattered, and not scaled-up even when pilots succeeded. The future design would be contingent on a consolidated and centralized ICT policy, led by the state or the federal governments, with concerted efforts targeting specific ways of action.

However, the Nepal government has taken several initiatives in digital agriculture such as;

- E-Haat bazar (e-market)
- Precision agriculture
- Digital disbursement of minimum support price and fertilizer subsidy
- Digitization of land records
- Web-based “brain gain center”
- Smart irrigation projects
- Smart livestock and wildlife management
- Televet medical center establishment
- Agriculture input and product quality tracking system
- Public-private digital partnership on market information
- Digital education and training program for farmers

Besides these, Nepal has experience of private sector-led piloting of Digital Village model at Nangi, Annapurna Municipality in Myagdi district. In addition, the following are some of the examples working with the private sectors especially in the field of digitized agriculture, such as (i) crop and livestock monitoring, (ii) insurance for crop and livestock (ii) tracking and monitoring of seed systems (iii) digital price display (iv) radio and TV programs, and (v) tracking and monitoring of chemical fertilizer distribution.

CONCLUSION

For regulatory and policy aspects, ICTs

assist with implementing regulatory policies, frameworks, and ways to monitor progress. ICTs have been contributing to the capacity building and empowerment aspect by widening the reach of local communities, including youth and women, and provide new business opportunities thereby enhancing the peoples' livelihoods. Financial inclusion, insurance, and risk management are also the major areas that digitized systems have been contributing in increasing access to financial services for rural communities, helping to secure savings, find affordable insurance, and tools to better managing risk.

Digital technologies contribute to food safety and traceability in helping deliver more efficient and reliable data to comply with international traceability standards. The technologies enhanced market access by facilitating access for inputs as well as product marketing and trade. Mainly, digital agriculture can be instrumental in supporting the agricultural extension and advisory services in bridging the gap between agricultural researchers, extension agents, academia, and farmers, thereby enhancing agricultural production and productivity. Further, ICTs promote environmentally sustainable farming practices which help to improve access to climate-smart solutions as well as appropriate knowledge to use them. ICTs contribute to disaster management and early warning systems providing actionable information to communities and governments on disaster prevention, in real-time, while also providing advice on risk-mitigation techniques.

The findings from this review contribute to the knowledge of innovation and digital agriculture and the use of ICTs in the agricultural system and rural development sectors. At the community level, the finding tells how the ICTs facilities are using at the field level and the policy level, the review findings furnish precise information about constraints and opportunities and a whole future prospectus of digital agriculture in Nepal. The findings can help to formulate the policies and programs related to digitized agriculture and rural development of Nepal.

The Agriculture extension is going through a major transformation with the changing time and demands, and therefore the extension should work as a facilitator providing agriculture advisory services to the people over the value chain system.

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