ABSTRACT
E-extension is the approach of extension through electronic technologies where online platforms such as web sites, mobile applications and social media is used. The lesser cost and greater effectiveness indicate future possibilities in e-extension. As seen in Nepal’s rapid increase in internet usage, e-extension has the potential to be a valuable mechanism in the prevailing system of agriculture extension. This paper aims to document the recent initiatives seen in current developments of e-extension in the country. If promoted with innovation and considerations of actual access, e-extension can have multiple positive impacts in Nepalese agriculture.

Keywords: extension, e-extension, ICT

INTRODUCTION
Agriculture extension approaches in the past have so far failed to produced the hoped results in Nepal due to poor communication infrastructure, high extension costs in sustaining of extension coverage from government and due to a high proportion of hill districts. The previously applied extension approaches have been costly in terms of human resources as well as in financial resources [1]. The insufficient number of agriculture centers compared to number of village raises the questions to the reach the extension. Even for the farmers in range of the existing extension system, those systems may not pertain to the specific local needs. Furthermore, the prioritized groups are only the lead or active farmers (who are rich in resources and can afford any inputs) and certain agro-enterprises in most cases [2]. The improper coordination among governmental bodies and other bodies in agriculture extension has hampered the extension system, whose function should have been the sharing of newer technologies with lower costs, thereby lowering the technical gap between research and extension [3].

The current main challenge of extension systems is to solve range of problems in crop and livestock production, pesticides, and many others issues faced by the farmers. Educating and equipping all involved agri-manpower with required agricultural knowledge opens the opportunity to the present extension system. Dissemination of agriculture information via the traditional extension approaches has seemingly been insufficient. The extension approaches of today should provide the agricultural information according to the needs of the target farmers with quick and reliable delivery. Such access to agricultural information is possible through Information and Communication Technology (ICT) from physical equipment for communication purposes. For this government has to play the role of developing and deploying basic ICT infrastructure [5].
Information technology helps in easy access to the latest information reducing cost to both senders and receivers. Via ICT, market information is available in hand to help in market decisions and to assist farmers in resolving technical difficulties [6]. Agriculture development is already being uplifted in Nepal due to ICTs with more involvement of marginal farmers [7]. For instance, television as a form of mass communication has been able to reach and educate farmers and has played satisfactory role in technology transfer [8]. Similarly, mobile phone penetration in Nepal has tremendously grown with estimates of more than 39.6 million phone users up to March 2019 [9]. Internet penetration in Nepal is about 79% and Nepal ranks second after Bhutan in social media penetration as of 2017. By 2020, the government of Nepal has visions to connect 90% of total population to broadband services [10]. Hence, this extent of internet accessibility, if utilized conscientiously, can reduce the distance between extension agencies and farmers.

Afzal et.al., 2016 defines E-extension as the present-time methods of services in extension where ICTs (electronic technologies) are used along with the Internet. It includes online web-portals, websites, social media, blogs, emails, smart phones and any tools that allow online media through which extension is possible. E-extension is an effective, efficient and novel mode of extension delivery, where the Internet expedites information sharing. E-extension acts as hub for farmers with all the stakeholders where they can collaborate and combine their extension innovativeness [11].

In the current scenario of Nepal having already entered into the digital age, extension in its agricultural system surely needs to account the current development of ICTs in an agro-advisory context. This paper presents the lists of initiations in e-extension from different organizations whose effectiveness is observable. Any electronic and internet based medium which has or which can have constructive impacts in Nepalese extension has been searched and included. The paper concludes with a suggested model for e-extension in Nepal.

**METHODOLOGIES**

Research articles, review papers, and books have been used as the basis for this report. Currently developed online sites, web pages and tools were searched extensively. Google Play, National newspapers, Organizational websites and social media sites were used as the tools to collect the ideas of mobile applications or other agriculture related sites being developed.
RESULTS:

Agricultural Applications

Mobile phones have been readily accepted for communication with experts, information and knowledge sharing, and increasing economic gains [12]. In addition to being widely used for real-time communication among farmers, there has also been positive impacts from mobile-phone mediated learning as well [13]. The challenges remain more in full acceptance among farmers, as a lack of operational skills can hinder taking full advantage [14]. Lack of confidence and awareness can cause adoption gaps in usage. The acceptance of any ICT tool has depended mainly on age, educational level, along with the issues of acceptability, credibility and connectivity although the knowledge of farmers have positively increased [15].

Mobile phones use in Nepal is undoubtedly increasing in recent years, which lends it the enormous potential as an agricultural information disseminating tool. A large number of different mobile applications (as listed in Table 1) have been developed in Nepal.

<table>
<thead>
<tr>
<th>Name of the App</th>
<th>General Features</th>
<th>Developers</th>
<th>Installs</th>
</tr>
</thead>
</table>
| Smart Krishi      | Package of practices, agriculture news, documents, e-books, weather info, online queries to experts | Smart Krishi          | 100,000+ | https://play.google.com/store/apps/details?id=com.sudip.smartkrishi  
| Krishi Guru       | Crop advisory, weather info, package of practices, agriculture news, consultation with agriculture expert, agri SMS, (some features available offline) | ICT for Agri          | 100,000+ | https://play.google.com/store/apps/details?id=com.ictfa.krishiguru  

<table>
<thead>
<tr>
<th>Service</th>
<th>Description</th>
<th>Provider</th>
<th>Downloads</th>
<th>Website Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Krishi TV</td>
<td>App of agricultural TV channel in the form of an app</td>
<td>Krishi Television and New IT Venture Corp.</td>
<td>5,000+</td>
<td><a href="https://play.google.com/store/apps/details?id=com.krishitv.app">https://play.google.com/store/apps/details?id=com.krishitv.app</a></td>
</tr>
<tr>
<td>Krishi Ghar</td>
<td>Information on agricultural practices, focused on location specific consultation</td>
<td>ICT in Agriculture Nepal</td>
<td>1,000+</td>
<td><a href="https://play.google.com/store/apps/details?id=com.krishi_ghar">https://play.google.com/store/apps/details?id=com.krishi_ghar</a></td>
</tr>
<tr>
<td>Aadhunik Krishi</td>
<td>App for aimed to supply and selling modern agriculture equipments</td>
<td>AAdhunik Krishi Kishan Sansar</td>
<td>1,000+</td>
<td><a href="https://play.google.com/store/apps/details?id=com.dwn.aadhunik.krishi">https://play.google.com/store/apps/details?id=com.dwn.aadhunik.krishi</a></td>
</tr>
<tr>
<td>Tomato Nepal</td>
<td>Provides information on tomato cultivation, focused on business planning with tomato farming</td>
<td>Offered By DreamWork Solution</td>
<td>1,000+</td>
<td><a href="https://play.google.com/store/apps/details?id=com.tomato.Nepal">https://play.google.com/store/apps/details?id=com.tomato.Nepal</a></td>
</tr>
<tr>
<td>Krishi Network</td>
<td>Agricultural information and news</td>
<td>krishinetworknepal</td>
<td>1,000+</td>
<td><a href="https://play.google.com/store/apps/details?id=com.BBT.kishan">https://play.google.com/store/apps/details?id=com.BBT.kishan</a></td>
</tr>
<tr>
<td>Mobile Krishi</td>
<td>Agriculture related information, news, weather updates</td>
<td>Offered By Swift Technology</td>
<td>500+</td>
<td><a href="https://play.google.com/store/apps/details?id=com.swifttechnology.smartkrishi">https://play.google.com/store/apps/details?id=com.swifttechnology.smartkrishi</a></td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------------------------------------------------------</td>
<td>----------------------------</td>
<td>------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Dhankuta Smart Krishi</td>
<td>Package of practices, news and notifications Dhankuta Municipality</td>
<td>Offered By SmartGov</td>
<td>100+</td>
<td><a href="https://play.google.com/store/apps/details?id=com.upasarga.dhankutakrishi">https://play.google.com/store/apps/details?id=com.upasarga.dhankutakrishi</a></td>
</tr>
<tr>
<td>GeoKRISHI</td>
<td>Package of practices, weather forecast, focused on location specific farming</td>
<td>Pathway Technologies and Services Pvt. Ltd.</td>
<td>100+</td>
<td><a href="https://play.google.com/store/apps/details?id=com.pathway.geokrishi">https://play.google.com/store/apps/details?id=com.pathway.geokrishi</a></td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
<td>App Name</td>
<td>Downloads</td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>Digo Krishi</td>
<td>Shares information about Conservation Agriculture-based Sustainable Intensification (CASI) technology and practices</td>
<td>Digokrishi</td>
<td>100+</td>
<td></td>
</tr>
<tr>
<td>Agri-tech Nepal</td>
<td>For solving calculations related to fertilizer, insecticides, seed area and other agri. related applications.</td>
<td>AgritechNepal</td>
<td>100+</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Mobile based applications with their features
Agri news sites
There are number of agriculture news sites currently online. They provide recent news, notifications, and analytical prospective in the agricultural sector, and mostly success stories and farming knowledge are shared.

<table>
<thead>
<tr>
<th>News Site</th>
<th>Weblinks</th>
<th>Medium of Language</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>krishionline</td>
<td><a href="https://krishionline.com">https://krishionline.com</a></td>
<td>Nepali</td>
<td>Text, video</td>
</tr>
<tr>
<td>krishtelevision</td>
<td><a href="http://krishtelevision.com">http://krishtelevision.com</a></td>
<td>Nepali</td>
<td>Text, Video</td>
</tr>
<tr>
<td>halokhabar</td>
<td><a href="http://halokhabar.com">http://halokhabar.com</a></td>
<td>Nepali</td>
<td>Text, video</td>
</tr>
<tr>
<td>krishakkhabar</td>
<td><a href="http://krishakkhabar.com">http://krishakkhabar.com</a></td>
<td>Nepali</td>
<td>Text</td>
</tr>
<tr>
<td>Bos Agriculture</td>
<td><a href="https://www.youtube.com/channel/U">https://www.youtube.com/channel/U</a> CxlhaLv8tpLfYPd5TfoI7Cw</td>
<td>Nepali</td>
<td>Video</td>
</tr>
<tr>
<td>Nepal</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: List of agriculture web sites in Nepal

Social Media and Websites
Social media platforms in agricultural extension are being used more for sharing the news, notices and current developments from stakeholders. The current use of social media in Nepal has been a helpful platform to express, share and ask queries. In particular, Facebook pages and groups are being used to communicate and share information. Social media has the strong potential to help overcome in interaction between extension agents and farmers. The social presence in social media is however mainly beneficial more to the literate farmers.

All ministries of Nepal have their websites, although their user-friendliness may need to be assessed. As of 2018, the Government of Nepal has prepared its initiatives for every government office to have its own twitter handle [16]. Facebook pages also exist of many other government offices.

Government of Nepal, Ministry of Agriculture and Livestock Development, Singhadurbar, Kathmandu, Nepal

<table>
<thead>
<tr>
<th>Website</th>
<th><a href="https://www.moald.gov.np">https://www.moald.gov.np</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Email</td>
<td><a href="mailto:infp@moald.gov.np">infp@moald.gov.np</a></td>
</tr>
<tr>
<td>Twitter</td>
<td>twitter.com/Hello_MOALD</td>
</tr>
<tr>
<td>Facebook</td>
<td>fb.com/gunaso.moald</td>
</tr>
</tbody>
</table>

Agri-portals
After Nepal was selected for Pilot Program for Climate Resilience (PPCR) in 2009, the Building Resilience to Climate-Related Hazards (BRCH) project was designed as one of the five projects.
Agriculture Management Information System (AMIS) is one of the components of BRCH, and has been developed to provide agro-advisory services.

| Soil Map | https://nsafmap.github.io/ |

The Nepal Seed and Fertilizer project (NSAF), funded by the United States Agency for International Development (USAID), as part of The International Maize and Wheat Improvement Center (CIMMYT) project; CIMMYT has jointly worked with Nepal’s Soil Management Directorate and the Nepal Agricultural Research Council (NARC) to develop the interactive digital soil map for precise knowledge of soil properties (accessible at https://nsafmap.github.io) [17]. Although helpful for scientists and academics for the soil information, the application needs to be farmer friendly for its proper achievements among the farmers.

The registered seeds will be available and information on seed demand and supply will also be shared from Digital Seed Information System (DSIS), also as the part of NSAF will be completed in 2020. The system is also thought to act as seed portal and seed market information system helping Nepalese farmers in selecting suitable varieties [18].

**Online Courses and MOOCS**

No online courses or MOOCS especially designed for the to facilitate learning in any agriculture topics do not appear to have been developed. There is a dire need to introduce sites like AgMOOCS in the country (as seen in India). It requires willing collaboration at the university level, and with other bodies working in uplifting agriculture. Even aside from this, online courses remain as a yet to be explored topic in the country, although there has been initiation from Kathmandu University (as http://mooc.ku.edu.np) in 2016 accepted to be good enough by participants [19]. The praiseworthy step is also the opening of Nepal Open University (https://nou.edu.np) in 2016 whose potential exist in development of any online courses.

**Online Libraries**

NARC online library and E-pustakalaya are the two main online libraries to browse e-books, documents, journals, and articles online in Nepal. Both the sites have books related to agriculture topics. The websites of stakeholders may also provide access to e-books.

- E-pustakalaya: https://pustakalaya.org/en/
Overview

Warschauer explains availability to be not the main factor for access to ICT as there requires the need of physical, digital, human, and social resources for the real access of ICT [20]. Tools such as computers and internet only have act as the functioning tools. Bridges.org lists a set of criteria for true reach of ICT: Physical access, affordability, appropriateness, relevancy, integration, human capacity, economic environment, legal frame, political support and public interest. These factors are the determinants of the ranges in ICT [21].

Awareness of use of ICTs are being increased in sharing, collaborating and disseminating of information [22]. The pathways to possible impact in agriculture from ICTs in Nepal still needs more research as the multiple possibilities in e-extension exist (Paudel et al., 2018). The proper adaptation, integration and development of ICT tools and initiations are however lacking in governmental extension [23]. The needs are also to understand the factors previously mentioned by ‘Bridges.org’, which should be incorporated and addressed to the e-extension. The prevailing extension system can be improved, and boosted only by e-extension in the present scenario in Nepal.

Advantages of e-extension can be listed in [24]:

1. Reduction in cost with ability to reach large audiences in limited time makes e-extension effective.
2. Feedback mechanism is rapid; interaction between experts and farmers is possible in a quick manner.
3. Visual presentation helps the message to get through quickly; use of multimedia makes the messages more understandable.
4. Public and private relationships can become stronger; weak relations between farmers with extension institutions get stronger.
5. Further possibilities for e-trading and e-learning exist.
6. Issues of finance and insurance become more reachable to farmers.
7. Chances to study and adopt precise farming are achievable.
Figure 1: A possible model for e-extension in Nepal
CONCLUSIONS

As the modern Nepal has entered into a federal system of government, new topics and discussions have already emerged even in the agriculture extension in Nepal. Schedule 6 of Constitution of Nepal, 2015 A.D. has grouped "Agriculture and Livestock Development" to be in the state power. Similarly, Local Governance Act 2017 A.D. has demarcated agricultural extension in the duties of municipalities in Nepal. 'Agriculture' remains in the Concurrent Power of Federation, State and Local level according to Schedule 9. The challenges are to overcome the issues that remain, and improvements are undoubtedly necessary in overall mechanism from all tiers of government in Nepal. Difficulties still exist in aligning and directing extension, education and research in proper manner. Here, e-extension will act as the bridging tool assisting in the growth of agriculture development in Nepal.

E-Extension and ICT in Nepal stands more as the broader scope as it is the future of agriculture extension. Innovativeness in e-extension can lead to more continuation, adaptation and sustainment in the system. The challenges are not to study how e-extension has improved or can improve the extension in general, but to find, innovate and lead e-extension to make the positive impacts necessary in Nepalese agriculture.
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