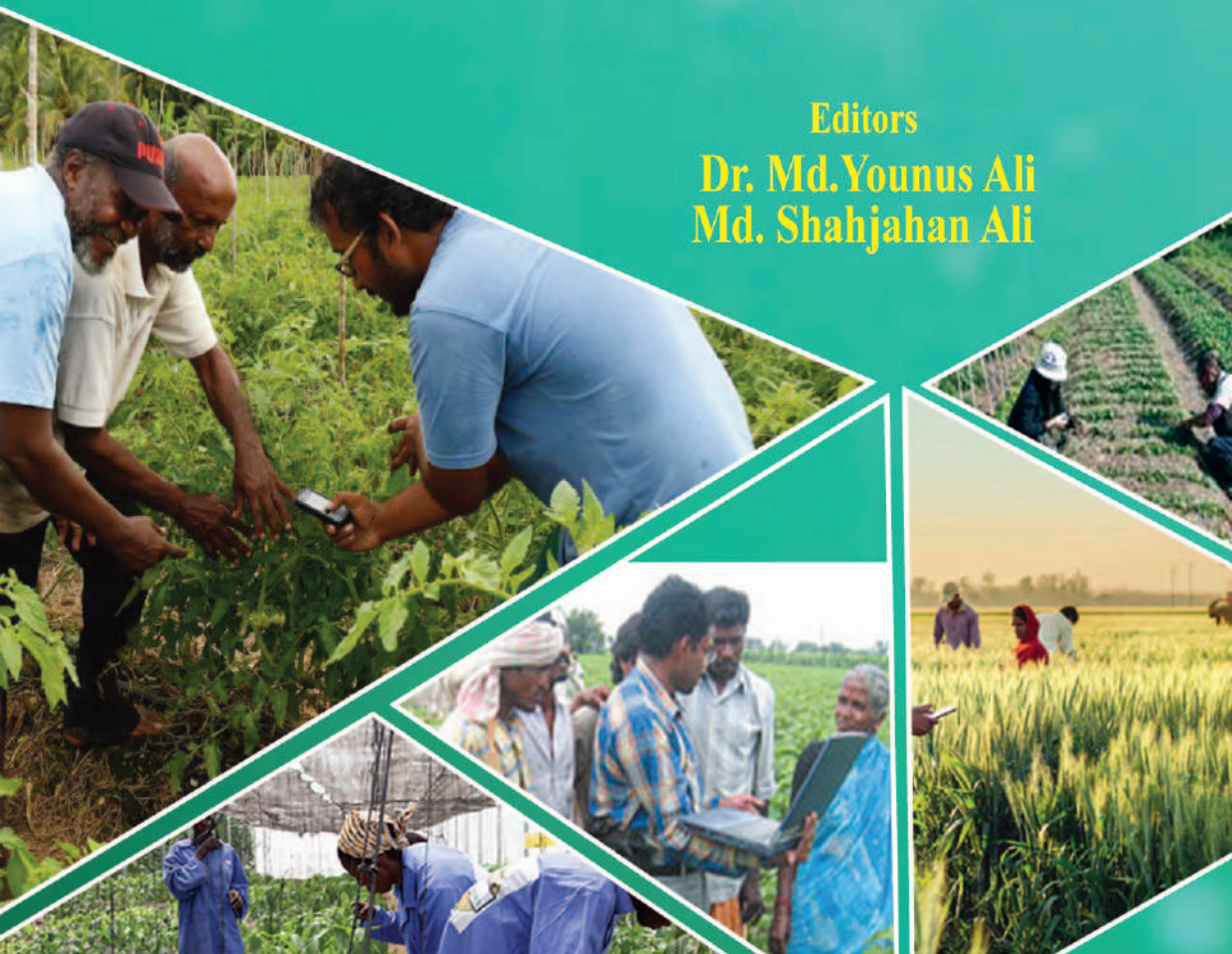


ICTs for Development of Rural Agriculture in South Asia: Policy Concerns

Editors

Dr. Md. Younus Ali
Md. Shahjahan Ali



SAARC Agriculture Centre (SAC)
South Asian Association for Regional Cooperation



CIRDAP

Enabling Rural Communities

The Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP)

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Regional Expert Consultation Meeting on ICTs for Development of Rural Agriculture in South Asia: Policy Concerns held on 29-31 October 2018 in Rural Development Academy (RDA), Bogura, Bangladesh

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Foreword

South Asian agriculture is in a new cross road that will bring lower prices for consumers (through reduced waste and more efficient supply chain management), contribute to 'smart' agriculture and motivate farmers (for example, through higher income) to increase their production. Private and public sector have been searching for effective solutions to address specific challenges in agriculture including how to address the abundant information needs of communities involved in farming, strengthening value chains, innovating and participating in emerging markets. A contemporary digital technology for information processing and communication or ICT as a modern technologies for appropriate solutions. It has shown considerable importance in agricultural applications in developing countries. Application of new and contemporary information and communication technologies (ICTs) for rural agricultural development in the South Asia region has been advancing quite rapidly over the last decade despite of their cost.



ICT in agriculture sector plays a vital role to the transformations relating to the delivery of services as well as agricultural products. Accordingly, various high tech information and communication technologies are in use in the agriculture sector around the world. These technology ranges from the agricultural product development, marketing, distribution to training agriculture sector personnel etc. The demand for agricultural information is now stronger than ever before. Worldwide, ICTs have become invaluable tools for agricultural research and development. ICT needs to be conceptualized in its many facets, perceptions and in its manifold impact in farming societies. Regional initiatives are required to establish ICT based network and developed regional networking of stakeholders through ICT and establishment of specialized agricultural knowledge system.

The demand for appropriate ICT-enabled technologies to support smallholder resource poor farmers were found by expert focal points from South Asia during the regional expert consultations meeting. The need for appropriate ICT-enabled applications for holistic farm productivity and economic simulations, knowledge-based decision support systems, the ability to access and use information for risk assessment and mitigation including that for climate change, the use of geographical information in planning and monitoring their agricultural activities and market-related information, not only for prices but also for appropriate options for increasing productivity



and profit and for ensuring food safety and appropriate information for consumers were identified as priority areas in the efforts to achieve food security.

The uses of ICTs in agriculture are rapidly expanding and provide information needed for the farmers and other stakeholders. However, there haven't been many efforts from the government and non-government side in South Asia. Lack of financial resources, trained manpower, affordability of the end users of ICTs, and lack of commitment from the people involved in transforming information are still challenges to implement and sustainability of ICTs.

This is the compilation of the country status report has been presented by focal points from SAARC Member Countries in a consultation meeting held in RDA, Bogura, Bangladesh on 29-31 October 2018 jointly organized by the SAARC Agriculture Centre and Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP). The expert consultation also generated a good number of recommendations under different thematic areas through intensive discussions. In this book, authors draw the available information and data in SAARC Member Countries on ICTs for development of rural agriculture. Hope this book would be helpful for the researchers, academia, professionals and extension workers for the future endeavors in the SAARC Region for using of ICTs in agriculture.

I would like to acknowledge the contributions made by the focal points experts of SAARC Member Countries in preparing a comprehensive and informative country paper and participating in the expert consultation meeting. The Contribution of Dr. Md. Younus Ali, Senior Technical Officer, SAARC Agriculture Centre to the conceptualization, technical guidance, inputs, reviewing and editing of this publication is duly acknowledged. I hope that this publication would provide detail and comprehensive information on ICTs for development of rural agriculture in SAARC Member Counties.

Dr. S.M. Bokhtiar
Director, SAC

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Chapter One

ICTs for Development of Rural Agriculture in Afghanistan: Policy Concerns

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Abstract

Agriculture is the foundation of rural development in Afghanistan. It accounts for 25 percent of the national Gross Domestic Product, employs about 45 percent of the national workforce and provides a source of income for 44 percent of households. For 28 percent of households it is the most important source of income. The agricultural sector is diverse, ranging from field crop production in irrigated and rain-fed area to horticulture to extensive livestock production. Farming households include small farm households which are more subsistence oriented and middle-and large-size farms that predominantly produce crops for commercial purposes.

An important driver for development is access to information and communication technology. ICTs are a modern tool for enterprises, communities, and individuals to successfully participate in the global economy. E-agriculture is evolving in scope as new Information and Communication Technology (ICT) to be harnessed in the agriculture sector. It is seen as an emerging field focusing on the enhancement of agriculture and rural development through improved information and communication processes.

1. Introduction

Agricultural development is central to the Government's development agenda. To increase agricultural productivity requires multi-sectoral investments in water resources (irrigation), improved planting materials (particularly quality seeds), fertilizers, pesticides and best crop management practices. Increased cereal production, and strengthened livestock sector, will contribute to greater food security. Improved urban-rural linkages and more opportunities to buy, process and store farm products will enhance urban development and transform rural communities. The agricultural improvement through modern information and communication technology (ICT) can help create jobs, increase yields and open markets for farmers, and help Afghanistan transition from an import and agrarian economy to an agro-industrial export nation.



Despite the decades of war and conflict, agricultural practices in Afghanistan have been evolving. While some farmers continue to engage in subsistence farming, many are discovering that intensive farming is profitable, provided the Government investment in creating a range of services and enabling structures. This also includes the formulation of various agricultural sub-sectoral policies and strategies such as policies particularly in cereal crops, food and nutrition, women in agriculture, medicinal plants, etc.

E-Agriculture is evolving in scope as new Information and Communication Technologies (ICTs) applications continue to be harnessed in the agriculture sector. It is seen as an emerging field focusing on the enhancement of agriculture and rural development through improved information and communication processes. In this context, ICT is used as an umbrella term encompassing all information and communication technologies including devices, networks, services and applications; these range from innovative Internet-era technologies and sensors to other technologies that have existed for much longer such as telephones, mobiles, television, radio and satellites.

More specifically, it involves the conceptualization, design, development, evaluation and application of innovative ways to use ICTs in the rural domain, with a primary focus on agriculture and allied fields. Provision of standards, norms, methodologies, tools as well as development of individual and institutional capacities, and policy support are all key components of e-agriculture.

2. Country Status on Application of ICTs in Rural Agriculture

Currently there are 58 ICT solution providers in Afghanistan (ATRA 2018) providing a host of ICT and ICT enabled services, ranging from ICT infrastructure and projects to consumer facing services. The various applications of ICT that are active in rural agriculture are MIS, GIS, Paywand, Plantwise, e-Afghan Ag, AKBIS, etc.

Paywand, the Knowledge Management Facility (KMF) is a collaborative effort of the Ministry of Agriculture, Livestock and Irrigation (MAIL) and Agriculture Credit Enhancement (ACE) Program. The Knowledge Management facility will be responsible for:

- The integration and archiving of agricultural data in a single unit
- The consolidation of existing data into more reliable, understandable and usable products
- The dissemination of agriculture related information making it accessible to a wide range of actors involved in the agriculture sector.
<http://www.adf-af.org/overview-paywand.html>

"Plantwise" is a global programme with the purpose of reducing crop losses and improving food security by collecting and sharing information about



plant health. Plantwise is supported by an alliance of international partners, who typically provide content or funding. Since Plantwise began working in Afghanistan in 2012, a total number of 67 plant clinics have been set up in seven of the 34 provinces.<https://www.plantwise.org/KnowledgeBank/CountryHome/afghanistan/>

Another company by the name “c-Afghar Ag” provides credible relevant information to those helping farmers in Afghanistan.<https://afghanag.ucdavis.edu/>

3. The Role of Mobile Technology in E-Agriculture

Mobile phone usage in third world countries is playing a vital role for the enhancement of farmers business towards agriculture. Recently, communication through mobile phones is considered very important in enhancing farmers' access to better understand agricultural market situation. Therefore, Ministry of Agriculture Irrigation & Livestock established the **"Farmers Call Center (FCC)"**.

Through FCC, the farmers can directly contact the with agriculture experts and solve their problems. Due to security problems in Afghanistan and lack of Agriculture extension workers in remote areas through mobile technology (SMS, IVR, Voice Message) we can disseminate the expert agriculture information to the farmers. Farming communities appreciate mobile phone as easy, fast and convenient way to communicate and get prompt answers of respective problems. FCC has generated an opportunity for the farmers specially to get the information about marketing also keeps them aware for weather forecast for agriculture input application like fertilizer and pesticides which might be affected by unforeseen seen disasters as communicated by technical departments. Mobile phones have provided an opportunity to the farmers to communicate directly with market brokers and customers for sell their product in good price. Farmer Call center started its services from 15th June 2018. Around 4550 farmers are registered in FCC and it entertains 350 calls per day.

4. Rural Access and Exchange Mechanisms: Connectivity and Tele-Centres

Recognizing the right of every citizen of Afghanistan to affordable telecommunication and internet services the Government's Policy is to enable the rapid growth of affordable communications and internet access to all of its people so they may experience the Digital Age, wherever they are and whoever they may be. Establish a national backbone network throughout the country that links large domestic population centers with our international neighbors.



Afghanistan is fast improving its telecom infrastructure and network coverage. Currently there are 6 operators (Afghan Wireless Communication Company launched in 2002, Roshan was launched in 2003. In 2006 MTN Group. Etisalat launched in 2007. Afghan Telecom (AFTEL), the incumbent state-owned fixed-line operator, was awarded a MIS mobile license and launched its mobile service in 2014 under the Salaam brand) in Afghanistan and about 30 million subscribers in 2017 (Teledensity 89%).

Most of the subscribers in Afghanistan are mobile telephony subscriber. 4G LTE services have been launched in the country in 2017 along with existing 2G and 3G networks. In this background, the value addition that ICTs bring to the agriculture sector is potentially transformative. An important driver for development is access to information and communication technology, ICT is a primary input to economic processes, and it is crucial for enterprises, communities, and individuals to successfully participate in the global economy

The Afghan Optical Fibre Network consists of a backbone built primarily along the country's circular Highway 1, also known as the Ring Road, with branches to other provinces and trans-border connections to Pakistan, Iran, Turkmenistan, Uzbekistan, and Tajikistan. Construction was begun in 2007; current plans call for the construction of a network that will span 4,400 kilometers at a total cost of USD\$130 million¹.

5. Impact of ICTs on Agriculture and Livelihood

More than 70 percent of the population of Afghanistan is engaged in Agriculture and the economy of the country is virtually based on Agriculture. Most of the products that the country exports abroad are agricultural products. Thus, the development of the agriculture sector is closely related to national economy and social wellbeing of the people of Afghanistan. The importance of agriculture cannot be over emphasized. Only about 10 percent of the total land area is now cultivated and most of the cultivated land is rain-fed or irrigated by streams. The policy of the Government is to expand farm production through expansion of the area under cultivation and increase in agriculture productivity. Rural income would expand if agriculture production expands and if higher prices are obtained by farmers for their produces. The rural landscape will also change if the crop mix can change leading to higher total income to farmers. And indeed, if the agro products could be processed and value added before reaching the local and international markets. These strategic moves to develop the agriculture sector and therefore, the rural economy can be leveraged through the application of ICT.

¹ An In-Depth Study on the Broadband Infrastructure in Afghanistan and Mongolia, UNESCAP, April 2015



The Government's E-Agriculture Policies are:

- Government, through the Ministry of Agriculture, Irrigation and Livestock will adopt ICT in the planning, management and monitoring of the Agriculture sector and in the delivery of Agriculture related services to farmers and other stake holders connected to the sector.
- Government will develop its institutional capacity and ICT infrastructure and systems to enable provision of timely advice and extension services to farmers on various aspects of field crops, horticulture, animal husbandry, agro processing and other related subjects. Mobile phones and devices, TV and radio will be the preferred channels of delivery of E-Agriculture services.
- Government will develop and deploy optimal ICT based agriculture project and program planning and M&E systems to systematically plan, monitor and evaluate agriculture and rural development projects in the country.
- Government will develop and deploy dynamic Agriculture information databases and ICT systems to disseminate up to date information on Agriculture markets, prices, supply and demand using mobile devices, computers, TV and Radio as delivery channels.
- Government will develop and deploy databases and ICT systems which would enable provision of weather, soil, and other Agriculture information of use and interest to farmers on mobile phones, computers, TV or radio.
- ICT based Early warning systems will be developed and deployed on impending crop disease, climate change, floods and adverse weather conditions.
- Government recognizes that the rural development and agriculture are very intimately intertwined. Therefore, the Government's concerned agencies and departments including MAIL and MRRD will collaborate in the development of E-Agriculture services and coordinate these with other services that are delivered through traditional channels.
- ICT awareness and basic know-how of the rural agriculture community would be raised through mass media campaigns using mobile devices, TV and Radio
- ICT based on demand and interactive E-Agriculture and rural development services will be made available in local languages on mobiles and computers, Radio and TV in user friendly manner.

6. Utilization of ICT to Adaptation of Climate Change Affect in Agriculture

The climate of Afghanistan is well suited for the cultivation of horticultural crops and the country is the geographic origin of many high nutrition value



crops like raisins, pomegranates, pistachios and almonds. There are approximately one million farms in Afghanistan and more than 2,000 wholesalers for horticulture products. Afghanistan can feed many more people if the agricultural industry could address current challenges. It should be the goal of a modern agricultural sector for Afghanistan to become self-sufficient again and subsequently be able to expand into an export industry. As Afghanistan has become very vulnerable to the climate change, early warning weather systems should be developed to assist farmers in planning their planting and harvest operations. Geographical Information System (GIS) application such as weather forecast, Mobile Technology (MT), Web Based Application, Satellite Technology and Remote Sensing are picking up rapidly in our country to collect the data. One project of UNDP by the name of CCAP (Climate Change Adaptation Project) works in the climate change adaptation.

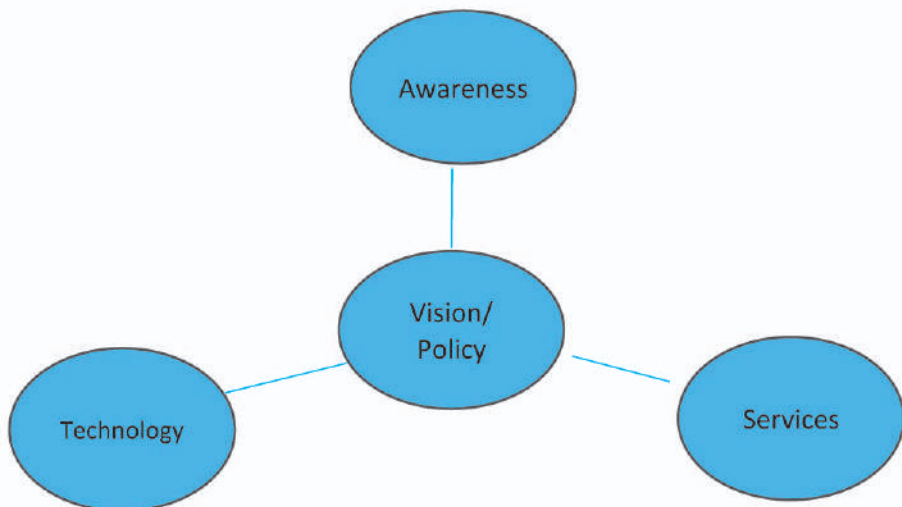
7. Strategic Need for using of ICTs in Agriculture

On long term basis the strategic needs for using the ICTs in agriculture consists of 4 dimensions:

- Vision/Policy
- Awareness
- Technology/Infrastructure
- Services/Application

For rural and urban areas based on this framework ICT can Implement the standard fibre optic/wired/mobile and WLAN.

For remote areas the recommended technology should be Satellite/ WLAN.



Despite many efforts over the years to disseminate and transfer agriculture knowledge to the stakeholders, large amounts of expertise and knowledge are still out of reach to most of them. Agriculture knowledge may be contained in the corporate database, or it may reside undocumented inside the brain of the researchers or even stored in locations unknown to the majority of the people in the organization.

Large sections of the farming community, particularly the rural folk, do not have access to the huge knowledge base acquired by agricultural universities, extension-centers and businesses. In this respect the main challenge is to find this knowledge and apply it to the decision-making process involved in agriculture development. The main issue now is for organizations to recognize, locate and utilize this specialized knowledge; currently embedded in organizational databases, processes and routines as a distinct factor of production to increase productivity and competitiveness. Knowledge management is one of the tools for organizations to achieve the capabilities mentioned above to enable them to remain competitive in this fast-changing world.

8. Access to Market Information through ICT

MAIL developed the Agricultural Price Monitoring and Analysis Information System (APMAIS).

(APMAIS) is a data bank for the agricultural and livestock products prices in market, farm gate and procurement items. APMAIS has three main modules:

- Price in Market,
- Price in Farm gate
- Procurement prices.

APMAIS has reporting section and graphs for pricing monitoring and analysis. Diagnosis of local markets for agricultural and livestock products in 34 provinces of the country to collect prices. APMAIS do comparison of prices on basis of provinces, products, and dates.

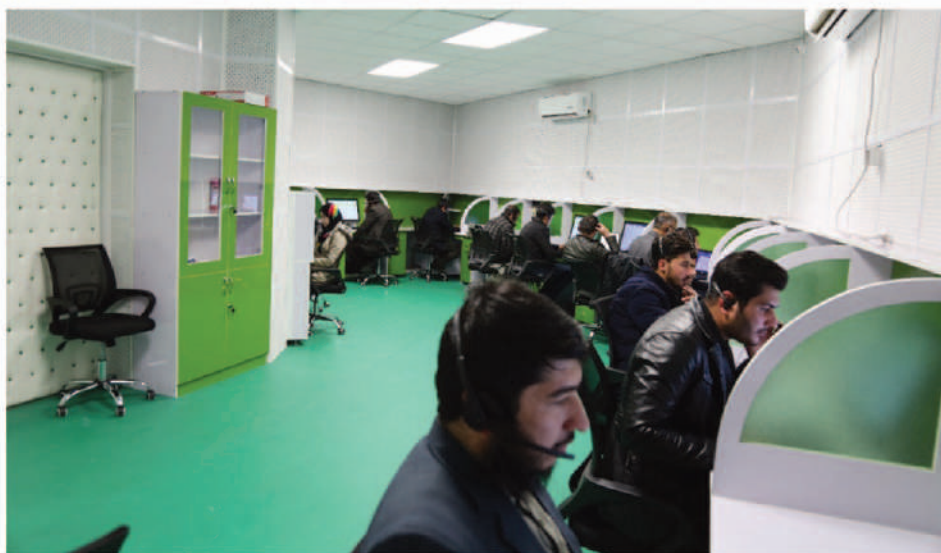
<http://180.94.71.228:1070>

9. Best Practices on use of ICT in Agriculture Extension

MAIL has made some progress in implantation of the concept of e-Agriculture Technologies, in particular in the area of e-Extension, as shown by the examples below:

The **Farmers Call Center (FCC)** consists of a complex of telecommunication infrastructure, computer support and human resources organized to manage effectively and efficiently the queries raised by farmers instantly in the local languages. This is a functional area within an

organization like MAIL where special facilities exist solely to answer inbound calls or make outbound telephone calls, to resolve the queries of pending calls. Usually it refers to a sophisticated voice operations center that provides a full range of inbound or outbound call handling services including customer support, direct assistance, multi-lingual customer support and other services. This is a new dimension in Agriculture Extension Management, which takes account of, and makes full use of on-going information and communication revolution, by optimally utilizing the communication bandwidth to serve the farming community in remotest areas of the country by connecting them to best of the agricultural scientific community. This is an important value multiplier for the existing extension mechanisms, which find it otherwise difficult (in terms of infrastructure and finances) to reach their desired clientele. This will enable establishment of close linkages and seamless communication mechanism among the key stakeholders in the extension system namely – Agricultural Subject Matter Specialists, Input Suppliers, Farmers and Marketing Agencies. Around 4550 farmers are registered in FCC and it entertains 350 calls per day.



Farmer's Call Center

Knowledge Bank

Virtual knowledge Networks are recognized as an important part of corporate knowledge management. Academia has yet to recognize and fully explore the significance of systematic knowledge network development tools for agricultural education purposes. A dynamic Information and Communication Technology (ICT) mediated knowledge management model can now be applied to agricultural research done at any university/research organization



anywhere on the globe and this research can be exchanged in a matter of seconds between scientists, faculty, private industry, students, extension workers and smallholder farmers.

The Knowledge Bank is a focused collection of extension digital materials that can include text Information (Doc. PPT, PDF) Manuals, factsheets books etc., Audio, Video, photos as electronic media formats along with means for organizing, storing, and retrieving the files and media contained in the knowledge Bank collection to online and share all agricultural data with the extension workers around the country, partners, and key stakeholders, farmers, agriculture faculty students and researchers.

Digital Library

The Digital library is a focused collection of digital objects that can include books, visual material, audio material, video material, stored as electronic media formats (as opposed to print, micro form, or other media), along with means for organizing, storing, and retrieving the files and media contained in the library collection. Digital libraries can vary immensely in size and scope, and can be maintained by individuals, organizations, or affiliated with established physical library buildings or institutions, or with academic institutions. The electronic content may be stored locally, or accessed remotely via computer networks. An electronic library is a type of information retrieval system.

Ag-Videos

The Idea of Ag-Video Technology is how to disseminate the expert agriculture information and technology to farmers by using Agricultural videos.

10. Women Involvement in ICTs Focusing on Agriculture

Despite the advancements in technology and digitization the gender gap continues to widen. Statistics show that “women are 14% less likely than men to own a mobile phone and 25 % fewer women and girls use the internet” The impact of this is averse to rural women or female farmers, who often fail to access relevant information (on farming practices, process, and markets, etc.). The golden question echoes, ‘Can access to ICTs by women and girls close the gender gap and improve their livelihoods?’ Access to appropriate technology, skills training, engagement with the private sector and gender sensitive ICT policies are critical areas needed to improve women’s access to ICTs for agriculture.

11. Policy and Institutional Strength for use of ICTs in Agriculture

Access to and information regarding commodity markets, including market prices of locally grown crops, weather data and other information are critical



for farmers to raise their standard of living in today's increasingly global market place. Develop an agriculture information system (AIS), using ICTs to provide Afghan access to farmers in rural areas the information they need.

E-Agriculture: Government, through the MAIL will adopt ICT in the planning, management and monitoring of the Agriculture sector and in the delivery of Agriculture related services to farmers and other stake holders connected to the sector. The role of ICT in Agriculture according to E-Agriculture Strategy is.

Pros:

- Better Ecology and Natural Resource Management using ICT solutions.
- Availability and Accessibility of quality information.
- Empowerment of Farmers, especially smallholders and pastoral herders, with ICT Enabled Application & Services.
- Improved linkages and coordination between researchers, extensions, farmers and other stake holders.
- Regulatory & Policy: ICT's assist with implementing regulatory policies, frameworks and ways to monitor progress.
- Increase the availability, accuracy and accessibility of action platform for agriculture sector stakeholders.
- Universal access of information and service using information and communication technologies devices, platforms and networks.
- Agricultural Extension & Advisory Service: ICT's bridge the gap between agricultural researchers, extension agents and farmers thereby enhancing agricultural production.
- Promote Environmentally Sustainable Farming Practices: ICT's improve access to climate-smart solutions as well as appropriate knowledge to use them.
- Disaster Management & Early Warning System: ICT's provide actionable information to communities and governments on disasters prevention, in real time, while also providing advice on risk-mitigation techniques.
- Enhanced Market Access: ICT's facilitate market access for inputs as well as product marketing and trade in a variety of ways.
- Food Safety & Traceability: ICT's help deliver more efficient and reliable data to comply with international traceability standards.
- Financial Inclusion, Insurance & Risk Management: ICT's increase access to financial services for rural communities, helping to secure savings, find affordable insurance and tools to better manage risk.



- **Capacity Building & Empowerment:** ICT's widen the reach of local communities, including women and youth, and provide newer business opportunities, thereby enhancing livelihoods.

Cons:

Since this E-Agriculture Strategy is signed recently with the Ministry of Communications & Information Technology the cons of this strategy are not yet revealed. With the passage of time the cons of this strategy will be faced and entertained.

E-Government includes, among others objectives, the improvement and creation of websites for government agencies and seven national universities, the establishment of an ICT center of excellence (Kabul IT-Park) to foster high-technology business, and improvement of ICT training and digital literacy.

M-Government promotes the use of mobile applications throughout the government for better public service delivery and program management. It also includes an innovative grant program to assist ministries in implementing mobile-based solutions.

E-Commerce To foster the capacity to trade goods and services by electronic means the appropriate legislation and will establish the necessary mechanisms to create the sector including protecting the rights of consumers and the interests of providers.

12. ICTs for Rural Agriculture Development: Opportunity, Potential Applications, Challenges and Policy Concerns

Rural policy nowadays is at the heart of the policy discussion in many countries all over the world, in the effort to address and effectively support the specific needs and opportunities of rural places and their population in the new era. The focus is on two areas, the one hand it attempts to shed light on the role of ICTs and their applications as enabling tools empowering rural development; while on the other hand it explores the barriers appearing towards the adoption and use of ICTs in rural regions. In such a context, it firstly places emphasis on the evolving new rural development paradigm. Then, the range and potential of ICTs applications is explored, that can serve the implementation of the new policy paradigm in rural regions. It follows a discussion on the steps that are needed in order to develop value-added ICTs applications in rural regions and the barriers appearing in the adoption and use of ICTs in these regions. Finally, are presented some issues of policy concern in respect to the adoption and use of ICTs in a rural development perspective.

During the last decades we are running the era of a new industrial revolution, driven by the developments of Information and Communication



Technologies (ICTs) and the Internet, which have considerably influenced patterns of working, living, socializing, producing, marketing, cooperating, interacting, etc. The core of this revolution is relating to the convergence of Information and Communication Technologies, which enables the collection, processing, storing, transformation, retrieval and finally transmission of information, in whatever form it may take - oral, written or visual – removing thus barriers of distance, time and volume/type of information. The new regime as “informational, global and networked” attributing its distinctive intertwining features. The potential offered by ICTs has created large expectations in many groups of the society as to their ability to deal with challenges and threats in the new era.

More specifically, ICTs have created expectations among others:

- Citizens and consumers in respect to the improvement of the quality of their life and the options available for getting access to better services and entertainment;
- Remote and peripheral regions in respect to the improvement of their access to opportunities in a competitive world and the removal of any kind of barriers relating to geographical distance/isolation.
- Governmental and administrative bodies in respect to their potential to serve the needs of citizens, businesses and other bodies in a more efficient, transparent and responsive way.
- Businesses and small-medium-sized enterprises in respect to the potential offered by
- ICTs for more effective management and organization structures, direct access to employees’ training and other services, direct on-line interaction with customers and suppliers, chances for cooperation.

SWOT Analysis:

Strength:

- Due to GSM technology, majority of farmers owns a mobile phone which indicates the strength of possibility of the two-way communication for agriculture information access.
- Availability of Television and Radio indicates the strength of mass communication of agriculture information.
- Afghanistan consists of four seasons which can be considered as a strength due to which different crops can be harvested in four seasons.

Weaknesses:

- Availability of relevant content for information dissemination.
- Lack of internet usage capabilities of farmers indicates the weaknesses of implementing ICTs for agriculture dissemination.



- Frequent transfer of trained human resources and placement not in accordance with “the right man in the right place has been identified as one of the weaknesses of agriculture extension. Lack of skilled human resources has also been identified as weakness for implementing ICTs for agriculture information.
- Security threat in different provinces of Afghanistan is the main weakness due to which extension worker cannot freely travel to remote areas.

Opportunities:

- Improving market access
- Improving capacity of farmers for ICTs usage
- Enhancing agricultural products
- Increasing involvement of youth in agriculture

Threats:

- Changing socio-economic activities of the farmers
- Policy intervention due to political and institutional leadership
- Farmers perception on ICTs
- Lack of support and funding for future development
- Weakening coordination among related department and ministries and centers

13. Recommendation for Policy, Research and Extension Services

- MAIL in collaboration with FAO has developed a National e-Agriculture Strategy. As a first priority, the strategy has to be endorsed by the minister.
- Funds need to be solicited from the international development partners for implementation of the strategy. Secondly the institutional capacity at provincial in district level has to be build.
- Linkages should be developed between the provincial departments of agriculture and the private sector.
- Collaboration between SARRC Member Countries on agricultural research and exchange should be strengthened
- Training on implementation of the E-Agriculture for Afghan agricultural professionals should be pursued in SAARC Member Countries

14. Conclusions

- Access to information and communication technology is critical to agricultural development, in particular in the delivery of need-based and demand-driven extension services. Afghanistan has just developed the



National E-Agriculture Strategy which will provide guidance for the government and national and international partner. As many rural communities are still inaccessible in Afghanistan because of insecurity, it is imperative that these communities are reached through E-Extension services.

- Realizing that as Afghanistan has become among the most vulnerable countries in the world, E-Agriculture tools and technologies will make it possible mitigate against the effects of climate change, to install early warning weather systems and assist farmers in planning for planting and harvest operations.
- E-Agriculture will also make it possible that farmers have easy access to market information at the national in regional level. It is expected that with the introduction of e-Agriculture tools and technology, there would be effective delivery of extension services to the farmers across the country even in insecure areas of the country. The trust and confidence between the farmers and the government will be enhanced. This will result in increased production and productivity, thus contributing to the national goal of food security.
- Last but not least, the Government of Afghanistan will develop and deploy dynamic agriculture information databases and ICT systems to disseminate up to date information on agricultural markets, prices, supply and demand using mobile devices, computers, TV and Radio as delivery channels.

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Chapter Two

ICTs for Development of Rural Agriculture in Bangladesh: Policy Concerns

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Abstract

An agrarian country like Bangladesh, agriculture plays driving force for raising family income, employment generation, food security and country's overall economic development. Remarkable progress in agro production and productivity has been observed in recent years amidst different natural and anthropogenic challenges. Taking these into consideration, sustainable agricultural development in the coming days is a serious concern for the government and the concerned stakeholders. Ensuring right information in right time at farmers' doorstep has significant impact in agriculture. ICTs (information and communication technologies) have the immense power to reach the unreached with the highest efficiency. Different studies revealed that utilization of ICTs in agriculture thus e-agriculture can effectively reduce the information gap and foster agricultural development. In last couple of years significant numbers of effective e-agriculture initiatives have been rolled out in Bangladesh with expansion of infrastructural facilities, adopting sophisticated technologies, enacting different policies and enabling ICTs friendly environment. Still there are many limiting factors associated with ICTs based initiatives in agriculture like- less localized content, affordability, lack of awareness etc. This paper attempts to present the current status of ICTs in agriculture, its impact, strategic needs, opportunities, challenges and few recommendations for improvement.

1. Introduction

Bangladesh is a densely populated developing country in the southern Asia and its area is 147,872 Sq.km where agriculture is the mainstay of its economy. Agriculture contributes 14.10% of the country's Gross Domestic Product (GDP) and serving as the largest employment sector in the country (MoF, 2018). Agricultural activities provide at least a portion of the income of approximately 87% of rural inhabitants. The population of Bangladesh has almost doubled since the 1980s, reaching approximately 161 million people in 2016. High population density coupled with growing urbanization and infrastructure development has put considerable pressure on arable land,



which decreased from 0.11 ha/capita in 1980 to 0.05 ha/capita in 2014 (World Bank, 2016). Ninety-nine percent of farms in Bangladesh are small-scale and fragmented, with an average area of less than one hectare (BBS, 2016). Despite its relatively small size, Bangladesh is a very diverse country in terms of topography, soils and climate. Rice is the country's dominant crop where nearly 80% of cultivated land is being allocated for rice production. Agricultural land in Bangladesh covers roughly 9.1 million hectares, which is 70% of the country's land area (FAO, 2015).

Achieving the target of self-sufficiency in food is one of the goals of the present government. To attain this goal the government has given the highest importance on the overall development of agriculture sector. Bangladesh's agriculture has grown steadily in recent years mainly due to investment in improved technology and mechanization supported by congenial public policies. As a result, despite frequent natural disasters, population growth and numerous other shortcomings associated, food grain production has been tripled between 1972 and 2018, from 9.77 to 41.32 million MT. Cropping intensity has been increased to 216%. Outstanding production has taken Bangladesh to secure 3rd in vegetables production, 4th in rice production, 7th in mango production and 8th in potato production across the globe (MoA, 2018). The present progress of agriculture has led to achieve self sufficiency in cereal crop production as well as rural poverty reduction. World Bank (2016) has expressed its views that 90% of this poverty reduction in the past five years can be attributed to increased farm income. Keeping the sustainable agricultural progress, the country now is looking forward to achieve the nutrition security for its people.

World Bank (2011) defined Information and Communication Technologies (ICTs) as “any device, tool, or application that permits the exchange or collection of data through interaction or transmission.” It “includes anything ranging from radio to satellite imagery to mobile phones or electronic money transfers.” The application of ICTs in agriculture is often referred to as ‘e-agriculture’ is an emerging field where ICTs (Radio, TV, Cell Phone, PDA, PC etc.) are playing a critical and catalytic role to the growth of agriculture.

It is already evident that ICTs in agriculture have helped the farmers of many developing countries to foster productivity by giving them access to vital information, such as weather forecasts, agro advisory and market pricing, empower them by establishing linkages with policy makers and promote growth or agri-businesses and rural enterprises by connecting the country with the international market and through many other avenues.



2. Application of ICTs in Rural Agriculture: Bangladesh Perspective

The idea of e-agriculture in Bangladesh is not very age old. Some small scale initiatives like support to ICT taskforce program was launched by the Ministry of Agriculture in 2003 (Das, 2016). But in true sense ICT based endeavors started taking place while the present government declared the ‘Vision 2021’ before winning the national election in 2008, which has the target to establish a resourceful and modern ‘Digital Bangladesh’ by 2021 through effective use of ICTs. The slogan of “Digital Bangladesh” of the Government of Bangladesh has special significance for national development. Since then several projects for digitalization have been completed and a big number of projects are under progress. The ultimate objective is to make more and more services available at the doorsteps of the people with increased digitalization where possible.

Bangladesh has experienced unprecedented growth in mobile phone penetration with over 154.18 million mobile subscribers and 90.50 million internet subscribers (BTRC, August 2018). The emergence and rapid flourish of mobile technology and the internet has opened avenues for using e-agriculture, enabling effective information flow and connectivity already demonstrated some hope to meet the existing challenges in agriculture. Some of them are as follows:

2.1 Rural Telecenters /ICT Centers

Country wide 4554 Union Digital Centers (UDCs) were established in 2009 by the Access to Information (a2i) program under the Prime Minister’s Office. Agriculture Information Services (AIS), under Ministry of Agriculture have been in the forefront of using ICT for agriculture, established 499 **Agriculture Information and Communication Centers (AICCs)** operated by the farmers group like IPM/ICM clubs in rural areas across the country. 1,621 **FIAC** centers established by DAE, ‘**Batighar**’ established the Bangladesh Institute of ICT for Development (BIID) in collaboration with Grameenphone Community Information Center in 2012. D.Net (an NGO) established ‘**Pallitathya Kendra**’ and similar approach was taken by the Practical Action, an international NGO established 30 ‘**Gyaner Haat**’. Few other alike initiatives such as ‘Gonokendra’ by Dhaka Ahsania Mission, ‘Amader Gram Learning Center’ deliver different citizen services including e-agriculture.

2.2 Web-based Services

The government has launched national web portal, containing more than 25 thousands sites of government bodies in different tiers. The portal **www.bangladesh.gov.bd** with over 2.2 million contents and bears 43,793 offices (up to union level) across the country. Using this unique portal every government agencies under MoA is providing their related agricultural



information. A few of them are- www.moa.gov.bd for Agriculture Ministry related policy documents and notices, www.ais.gov.bd for different crop production technologies and contemporary suggestions, extension portal krishi.gov.bd to manage extension related information on respective areas by the government extension personnel, www.frs-bd.com for online fertilizer recommendations, knowledgebank-birri.org for rice related information, www.dam.gov.bd for agro market information, www.badc.gov.bd for seed, irrigation and related information, www.bari.gov.bd for different crops variety research information. Besides the government agencies some private organizations are also promoting e-agriculture services through websites- www.agrobangla.com, www.ruralinfobd.com, www.biid.org.bd etc.

2.3 Mobile-based Services

Bangladesh enjoys a staggering mobile phone penetration that has provided a new dimension of decision support services to farmers. To provide better services to the people, government launched 500 National Apps on different sectors/services including agriculture (The Daily Star, 2015). Although not all of them got the popularity.

However, among the government agencies under MoA, Agriculture Information Service (AIS) with the collaboration of Practical Action Bangladesh (an I-NGO) launched the **Krishi Call Center-16123**, a call centre for providing instant agro advisory services that has given 99,936 expert solutions from June 2014 to August 2018. AIS also prepared **Krishikotha** and **Agriculture Info Service** mobile apps. Department of Agricultural Extension (DAE) launched some effective mobile apps namely **Krishaker Janala** (Insect/disease identification by photo), **Krishaker Digital Thikana** (Different crop production technologies), **Pesticides Prescriber** (Registered pesticides name and dosages). These have also their web versions. DAE has also started **Krishok Bondhu Call-3331** to connect the farmers with local level extension officials through call routing system. Bangladesh Agricultural Research Institute (BARI) prepared **BARI Application** mobile app (different crop varieties and technologies developed by BARI) where as Bangladesh Rice Research Institute (BRRI) launched **Rice Knowledge Bank** (for BRRI released rice varieties information) mobile app besides their web applications. Barind Multipurpose Development Authority (BMDA) started ICT based water management through **Smart Card** and prepaid meter (prepaid metering system for irrigation water).

Bangladesh Sugar and Food Industries Corporation with the assistance of a2i program launched '**E-Purji**', a mobile based issuance of permit order to the growers for selling sugarcane. So far nearly 100,000 services have been provided by this outstanding initiative and brought huge benefits to the farmers. Besides the governmental initiatives some private organizations



have also launched some effective m-based agro services. These are, **Agro Knowledge Bank** (for providing detailed production technologies of different crops) by mPower (with Agriculture Information Service), **Farmer Query System** is a mobile and/or web based tool for agro advisory services to farmers by mPower, **E-Hub** by Syngenta Bangladesh, **Mrittika**, an application developed by Grameen Intel Social Business. **GP Krishi Sheba 27676** is an agricultural value-added service (Agri VAS) run by Grameenphone Bangladesh that provides agro advisory services as well.

2.4 Precision Agriculture

Some ICT driven precision agriculture initiatives have been taken by GO/NGO collaboration. Such as- **GeoPotato** project by Agriculture Information Service and mPower (Provides early warning of late blight disease of potato through mobile SMS by using satellite data) and **iDSS** Project by DAE, ACI and SNV to use geo-data for providing tailored advisory based on crop growth and weather.

Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) launched **e-village** project in early 2018 with the assistance of Center for Research and Information (CRI) and iSoftStone of Chinese Huawei Technologies where sensor device and app provides early signal to farmers about the pest infections and soil condition for taking immediate action.

2.5 Popular mass media initiatives

Bangladesh Television (State owned Television) telecasts two extremely popular programs *Mati-o-Manush*, *Banglar Krishi* with the assistance of AIS. There are few other agro programs are being telecasted by some private TV channels out of that, *Hridoye Mati-o-Manush* by Channel-I is remarkable one.

Bangladesh Betar (The state owned Radio) with the assistance of AIS has been broadcasting 290 minutes agricultural program per day through 12 radio station (Bangladesh Betar, 2018) having a significant impact especially the extreme rural areas.

Agriculture Information Service (AIS) established a **Krishi Community Radio**, FM- 98.8 at Amtoli, Barguna which has been playing a meaningful role in agro technology dissemination. Nearly 200,000 people are the listeners of this radio.

2.6 Other initiatives

Dhaka Ahsania Mission through the USAID funded AESA project launched '**A**' **Card** (Agriculture Card) which is basically a debit card from a commercial bank. Through the NFC device located at input dealer's shop, farmer's Smartphone will be connected and electronic transactions will be made between them. Such initiative has brought unbanked farmers into the formal financial sector digitally.



3. The Role of Mobile Technology in e-Agriculture

According to FAO (2011), almost 70 per cent of the world's mobile phone subscribers are in the developing world. People find the potential of this technology as it is affordable and accessible way of communication to create economic opportunities and strengthen social networks.

GSMA (2017) opines that, in 2015 mobile technologies and services generated 6.2% of GDP in Bangladesh, a contribution that amounted to around \$13 billion of economic value. This includes the direct impact of the mobile ecosystem as well as the indirect impact and the increase in productivity brought about using mobile technologies.

The mobile telephone is no longer just an audio communication tool but capable of providing additional integrated functions. These benefits are amplified by the fact that the spread of mobile technology has occurred much faster than with other ICTs. In countries like Bangladesh which is densely populated mobile telephony has quickly become much more cost-effective for telecommunication provision in recent years.

The latest report from the Bangladesh Telecommunication Regulatory Commission (BTRC, August 2018) revealed that out of 90.50 million internet subscribers, mobile internet users are 84.68 million that accounts 93.56%. Although the government has taken initiatives to ensure broadband internet connectivity up to union level nevertheless at present due to very limited fixed broadband internet users in Bangladesh (6.33%) different information services are being prepared based on mobile devices. Due to low cost devices smartphones adoption rate has been increasing gradually even in the rural areas of Bangladesh. According to the report of GSM Intelligence, 45 million people were the smartphone users in 2017, which accounted 31% adoption amongst all the mobile users. It has been apprehended the number would be 138 million by 2025 (75% adoption). Meanwhile in February 2018, Bangladesh has already entered into 4G era of mobile connectivity. So, in the upcoming days smartphone would be the key devices for various mobile agro based services.

As far as the sustained agricultural productivity is concerned, mobile phones has the strong opportunity to support agricultural development in Bangladesh. A good number of m-based agro services have been rolled out in recent years (discussed in the section 3.3), still it can facilitate information on market linkage, early warning on weather, nutrition, government subsidy etc. Moreover slow internet speed in the rural areas and tariff charge are still big issues to be addressed.



4. Rural Access and Exchanges Mechanisms: Connectivity and Telecenters

The 'Digital Bangladesh' agenda of the present government consists of four pillars- human resource development, connecting citizens, digital government and private sector. To ensure different citizen services at peoples doorsteps and to deliver public services efficiently Access to Information (a2i) Program of the Prime Minister's Office established 4,554⁺ one stop information and service delivery outlets known as Union Digital Centers (UDCs) in all union parishads, the lowest tier of the Bangladesh government. In 2009 the Union Information Service Center was established and launched across the country in the subsequent years and it was renamed as Union Digital Centers in 2014. These centers are equipped with different ICT devices and render several citizen services including agro information digitally. The UDCs have enabled rural people to access needed information and essential services in fast, cost effective and easy ways. UDC Census 2013 estimated that about 3.91 million people are receiving information and services from UDCs directly of whom 949,120 are women. Nearly 367⁺ million services provided from the UDCs so far (a2i report) and reduced TCV (time, cost and visit) tremendously of the service recipients.

Agriculture Information Service (AIS) under Ministry of Agriculture established 499 Agriculture Information and Communication Centers (AICCs) across the country. 20 centers were established in the FY 2009-10 and increased the numbers through different project/program over the years. These AICC centers are basically farmers operated groups such as IPM/ICM clubs situated at village level. AICC centers received ICT devices and farmers were trained to utilize these resources. AICC centers are acting as the complementary forces with the local government extension agents. From each of these centers, daily 10-12 farmers are getting different agro information services directly.

Department of Agricultural Extension (DAE) under Ministry of Agriculture established 1,621 Farmer's Information and Advice Center (FIAC) In the Union Parishad. These centers are equipped with ICT tools and training aids for providing advices and imparting training to farmers as well as all sorts of extension supports.

From the non-governmental side, Practical Action Bangladesh has established 30 centers known as '*Gyaner Haat*', located at rural areas and provide agro advisory and other services like photocopying. Bangladesh Institute of ICT in Development (BIID) launched telecenters known as '*Batighar*' in 2008 and later on e-Krishok and e-Clinic services were brought under this telecenters. D. net also established telecenters '*Pallitathya Kendra*' to serve rural people.



5. Impact of ICTs on Agriculture and Livelihood

ICT can contribute significantly to growth and socio-economic development if it is well adopted and integrated. The World Bank (2016) finds, nearly 40 percent of the global population has accessed to the internet and among the bottom fifth of the poor, 7 out of 10 households are having a mobile phone. The large adoption and integration of ICTs have reduced information and transaction costs, improved service delivery, created new jobs, generated new revenue streams and saved resources.

Different research results revealed that agricultural productivity increased by relevant, reliable and useful information and knowledge (Demiryurek *et al.*, 2008). Roy *et al.* (2003) also showed that ICTs have positive impact on agricultural development and livelihood of farmers. The computers, internet, geographical information systems, mobile phones, as well as traditional media such as radio or TV stimulate participation and enhance the value of productivity. ICTs have brought significant changes in agriculture development and transfer information and knowledge through various technologies among farmers (Birkhaeuser *et al.*, 1991).

In Bangladesh context, Das *et al.* (2016) found that ICTs played a significant role to augment rice (Boro and Broadcast Aman), potato, wheat, maize and pulse (lentil) production. Rashid *et al.* (2016) found that e-agriculture reasonably increased respondents' access to basic rights and improved quality of life.

In recent years crop production increased many folds in Bangladesh. In 2006 cereal production (rice, wheat and maize) was 27.78 million MT where as in 2018 it increased to 41.32 million MT. Similar trend has been observed in vegetables production. In 2018, 15.94 lakh MT vegetables produced whereas 2.33 lakh MT was produced in 2006. There were many factors triggered these huge production where proper information dissemination definitely played a crucial role. Between these times, mobile phone penetration and other ICT ventures widely took place and thus contributed extensively.

Household Income and Expenditure Survey (HIES) 2016 shows that Bangladesh significantly reduced the poverty where moderate poverty (percent of population below the Upper Poverty Line or UPL) has fallen from 31.5 percent in 2010 to 24.3 percent in 2016, while extreme poverty (percent of population below the Lower Poverty Line or LPL) has declined from 17.6 percent to 12.9 percent over the same periods. According to the World Bank (2016), Agriculture is a leading contributor to poverty reduction in Bangladesh since 2000.



6. Utilization of ICT to Adaptation of Climate Change Affect in Agriculture

Bangladesh is one of the most environmentally vulnerable countries in the world, with floods and storms the most common natural disasters. Between 2010 and 2017, Bangladesh was affected by 36 natural disasters, with more than 1,000 fatalities, over 23 million affected and total damage amounting to more than \$1 billion. GSMA report (2017) revealed that disaster and climate risk is also a factor in agricultural production. Due to topographical position, Bangladesh often is being victimized by flash flood. In 2017 by the catastrophic flash flood approximately 1.58 million metric tons of Boro rice was damaged, which was equivalent to 8.3 percent of national average of Boro production.

There are several international and national studies including those by Center for Environmental and Geographic Information Services (CEGIS), Bangladesh showed that crop yield improves by 10-15% through reduced crop damage by providing localized weather information to farmers.

The CEGIS uses GIS and other high tech ICTs for water management, climate change and disaster management and other issues. Bangladesh Meteorological Department (BMD) provides periodical agromet bulletin through their website (bmd.gov.bd/p/Agromet-Forecast) from where people can get agro meteorological information. Information can be retrieved from their mobile app too. Flood Forecasting and Warning Centre (www.ffc.gov.bd) provides rainfall, water level and flood information as well as providing flash flood forecasting experimentally. Department of Agricultural Extension (DAE) is implementing an agro meteorological project where sensor devices will be established in the Union Parishad offices and will be providing rainfall information in the local extension person's smart phone via mobile app. Besides different early warning messages are being broadcasted through Television and Radio Channels. Moreover different research institutes in Bangladesh (BARI, BRRI etc) developed several climate change adaptive crop varieties and this information are readily available in mobile apps, web portals that were discussed in Section 3.0 of this paper.

Besides the government, Oxfam Bangladesh piloted a project where they equipped 200 female farmers with smartphone and provided SMS, IVR and call center services on agro meteorology and early warning information and found that the use ICT is a viable approach to ensure and improve agricultural production under climate stress and to create economic resilience (Anonymous, 2017).



7. Strategic Need for using ICT in Agriculture

'e.Krishi vision 2025, Service at Farmers Doorsteps' was the pioneer strategic document developed by the Access to Information Program in 2008. Priority action plan (short, medium and long term) was also made in that document. Different agricultural policies and strategic documents developed later on (National Agriculture Policy 2018, Agricultural Extension Manual 2016) where proper attention were given to ICT utilization in agriculture. However a pragmatic e-agriculture strategic plan considering following points would be time worthy:

a) Short term approach (by 2021):

- Local agro knowledge digitalization
- Comprehensive Farmers' database preparation
- Emphasis on precision agriculture
- Solid agro content repository
- Round the clock agro help line (Agriculture call center)
- Complete agro TV channel
- Capacity enhancement of the farmers, input dealers, extension personnel

b) Medium term approach (by 2025):

- Farmers training through video conferencing
- Large scale precision agriculture
- High speed broadband connectivity in every villages
- Agriculture call center in every district
- Location specific agro meteorological database and early warning system
- Virtual agro shopping

c) Long term approach (by 2030):

- Farming land digitization
- Satellite based crop and pest/disease forecasting
- High speed broadband connectivity in every villages
- Farmers digital center (like-AICC) in every villages
- Community radio in every upazilla

8. Access to Market Information through ICTs

Strengthening smallholders' access to quality market information - especially price information - is an area where ICT has the great potentiality. Although different ICT initiatives launched related with crop production (pre, ongoing and post production) but in Bangladesh very limited endeavor made for market information and agro product marketing.



Department of Agricultural Marketing (DAM) under Ministry of Agriculture is responsible for assess the demand/supply of agricultural produces, disseminate market information, and establish efficient marketing system and so on. The DAM website (www.dam.gov.bd) provides agro product price information of different markets (national, district, upazilla) of both retail and whole sale. Besides DAM has mobile app to provide price information.

‘Amar Desh Amar Gram’ is a project powered by FSB (Future Solutions for Business) Ltd and they developed **Amar Desh E-shop** (amardesheshop.com) a total market place, where an e-Commerce platform has been created for rural agricultural producers as they can easily sell their products at anywhere of the world. Digital Green, Bangladesh launched a project **LOOP** (www.digitalgreen.org/loop) where farmers connects markets through village level aggregators and a mobile app maintains transaction and accounting history, SMS receipt and analytics dashboards. **The e-Farmers’ Hub (e-Hub) is a digital agro market platform launched by Syngenta Foundation that connects the farmers with the market through entrepreneur.**

9. Best Practices on use of ICTs in Agriculture Extension

Department of Agricultural Extension (DAE) is the largest extension agencies under Ministry of Agriculture, which has the mandate to deliver demand led, efficient, decentralized, effective and area specific and agricultural extension services amongst all types of farmers. Sub Assistant Agriculture Officers (SAAOs) are the front line extension agents working in the block (the lowest tier of extension systems) are the key role players for disseminating extension services.

Although there are nearly 14,000 SAAOs are working in the field (at block level) but each extension agent (SAAO) has to assist more than 2000 farm families in his/her area. Considering different limitations including resources and working time it’s really difficult to reach even the majority of the farmers. Hence, in many cases farmers run their farming activities with deficit of necessary information. In this situation, utilization of the ICTs by the extension service providers can be a noble solution. Considering the fact, DAE has taken some vibrant ICT initiatives which have the significant impact.

Krishi Batayan (krishi.gov.bd) is a robust extension web portal launched in March 2018, which is being used by extension personnel to manage extension related information on their locality. This portal includes contents, extension dashboard along with sixteen different modules, linked up with researchers, extension workers and academia. The portal includes all the agriculture information of the respective upazila. The portal has also a virtual platform which contains overall information on 768 varieties of 120 crops



and 1000 crop diseases. Another mobile phone based initiatives 'Krishak Bandhu Phone Seba 3331' has also been launched with it. Dialing this number 3331 from any registered mobile, routes the call to the nearest agricultural extension officer, enabling farmer to get real time information. This mobile service has been integrated with that portal.

Agriculture Information Service (AIS) under Ministry of Agriculture is a DevCom based government agency, which disseminates modern agro information and technologies through print, electronic and ICT media. AIS launched 'Krishi Call Center-16123' formally in July 2014. Any person can take instant agro advisory services (crop, fishery and livestock) dialing the number 16123 from his/her mobile. This is the only government owned agricultural call centre where call charge is the lowest (0.25 tk/min). Nearly 100,000+ services have been provided so far, which reduces the time, cost and visit (TCV) of the service receiver noticeably.

10. Women Involvement in ICTs Focusing on Agriculture

Across the developing world, rural women play a crucial role in agriculture and farming and Bangladesh, where women exceed 50 percent of the agricultural labor force, is no exception. The growing participation of women in agriculture has made a big change in rural economy, making them a big contributor to country's overall economy though their economic contributions are often gratifying but not widely recognized.

Women's participation in agriculture has grown exponentially during the past 15 years in Bangladesh. Quarterly labor force Survey 2015-16 by BBS shows that, Agriculture which is the largest employment sector for employment encompasses 63.1% female and 34% male participation across the country. According to the latest statistics of Bangladesh Bureau of Statistics (BBS), women's participation in agriculture has increased by 102 percent in a decade while men's participation has decreased by 2 percent (Zaman, 2017). With the incremental rate of participation women are also being engaged in different phases of crop production. It has been observed that women participate in 17 of the 21 stages and contributes 27% in crop production cycle (Ahmed, 2018).

Considering the fact, ICT initiatives especially for women in agriculture could be very effective in overall productivity. The Declaration of Principles of first World Summit on the Information Society (WSIS) held in 2003 in Geneva focused the enormous opportunity of ICT for women and thus called upon mainstreaming gender equality perspective and use ICTs as a tool.

In Bangladesh, Grameenphone program in 1997 was the pioneer initiative for women economic empowerment through ICT. The village phone program targeted the rural women to become the owner of a mobile phone and made them small entrepreneur. Women started renting the phone and many women



became the phone clients and thus entered into new communication era. The program also showed the how the uneducated women could run a small business even in the rural areas.

In 2008, D.net (a non government organization) launched 'Info Lady' initiative, which was earlier, knows as 'mobile lady', where a young woman with a mobile phone visited household, identified their needs and connected the women with doctor, agriculture experts or lawyer. In 2016, the idea was scaled up and termed as 'Kallyani'. This is a model for empowering communities through women entrepreneurship and made visible impact by bringing socio-economic changes on the lives of the people of the rural community.

Ministry of Women and Children Affairs launched 'Tottho Apa' Project where across the country 490 information centers will be established and through ICT tools (web portal, mobile apps etc) various information and digital services including agriculture, health etc would be provided by the women who will be known as *Tottho Apa*.

However, although numerous e-agriculture initiatives have been taken, gender specific need based agro content is still scarce. Recent participation pattern of women in agricultural work demands need focused agro content before dissemination through ICT channels. Moreover, specific capacity enhancement and awareness program are to be increased.

11. Policy and Institutional Strength for use of ICTs in Agriculture

The national e-agriculture strategy document provides an essential framework for developing or revitalizing a country's e-agriculture strategy in alignment with agricultural goals and priorities. A concrete e-agriculture strategy aligned with other national major policies will render a standardized direction for taking e-initiatives and will reduce redundancy. Bangladesh is well positioned to effectively start using ICT for its agriculture sector. In particular the recent boom of the telecommunications sector and the Digital Bangladesh initiative of the government have ignited the process.

The first attempt of formulate an e-agriculture strategy in Bangladesh was '**e.Krishi Vision 2025**' prepared by Access to Information (a2i) program in 2008. The primary focus was to explore the possibilities of leveraging ICT for the enhancement and development of the Agriculture sector of Bangladesh with a vision for 2025. Later on, the National ICT Policy 2009 categorically identifies agriculture as a thriving sector to pursue ICT enabled services for increasing productivity, facilitate market linkages, develop farmers' databases, establishing agriculture information centers, address climate change issues etc. The National ICT Policy 2015 also emphasizes on e-agriculture.



The National Agriculture Extension Policy 2015 identified ICT as an enabler for the development of agricultural sector and specified scopes of integration of ICT at various levels. To foster e-agriculture at farmers' doorstep, the NAEP focused on strengthening shared access points for farmers, mobile and web based rural advisory services, knowledge management, market information, farmer & input suppliers' database etc.

National Agricultural Policy 2018 expects the agricultural prosperity would be achieved through utilization of ICT in agriculture. To ensure smart farming and digital agriculture different steps such as agro advisory services and community radio, utilization of satellite and GIS, capacity enhancements etc. are to be taken/increased in the coming days. Seventh Five year Planning (2016-2020) also emphasized promotion of e-agriculture with other steps in order to transform the semi-subsistence farming to commercialization of agriculture. Moreover, under the Annual Performance Agreement (APA) of each government agencies, fixed numbers of innovations (mostly based on ICT) are required to be implemented in a year, where agencies under MoA are taking different e-agriculture initiatives have become the regular/main stream works.

12. ICTs for Rural Agriculture Development: Opportunity, Potential Applications, Challenges and Policy Concerns

It has already been established that ICT is a potential tool for agricultural development not only in Bangladesh but also all over the world. In this paper different potential initiatives and statistics clearly reveals how ICTs are contributing for agricultural development in Bangladesh.

For the continuous patronizing and enabling environment by the present government, in the last few years Bangladesh has observed tremendous growth in the ICT sectors. It has a market of 160 million⁺ people, where consumer spending is around \$130 billion plus and growing at more than 7% annually. Bangladesh already stepped into 4G era with 154.18 million mobile subscribers and 90.50 million internet subscribers (BTRC, August 2018) with nearly 31% smartphone users.

According to We Are Social and Hootsuite, monthly active Facebook users are nearly 30 million and 93% of them accessed the site through mobile phones. Again 24% of the declared profiles of the country's Facebook users are female (The Financial Express, 2018). So, with growing internet connectivity, availability of cheaper smartphones, rapid rise in social networking, reduction of bandwidth price in several phases, infrastructural facilities expansion, human capacity development and awareness program plus public private joint effort ultimately created huge ICT savvy consumers that also provides ample opportunities for ICTs in agriculture.



Moreover, the technological progress and enabling environment for that, though slowly but youngsters are showing their interest in agriculture and creating outstanding examples. Many of them are thinking managing the farm of their own by using modern agricultural practices with good forward backward linkage they can earn more than what their friends are earning from other profession. In the upcoming days this rate will be increased as well as opportunity for ICTs utilization on agriculture will be enhanced.

Besides the opportunity, there are some challenges are associated with ICT utilization in agriculture. Basically massive utilization has been started in Bangladesh for last few years. In that case adequate ICT infrastructure, improper and inadequate digital content, lack of awareness, less digital skill and innovative approach, insufficient technical personnel, lack of appropriate and sustainable business model etc are major challenges for wide utilization and expansion of e-agriculture.

Rashid and Islam (2016) found different problems faced by the farmers in using e-agriculture where Lack of knowledge on e-Agriculture ranked top followed by inadequate government digital service centers & facilities, Lower Internet Speed, Quality of Information and Inadequate ICT Experts respectively.

Active internet connection has been increased 29.40 million to 87.80 million from June 2012 to June 2018 even then quality service is still an issue. Moreover, although bandwidth price reduced remarkably, yet the mobile internet subscription charge is not very comfortable to everyone. According to GSMA Intelligence country overview report 2018, Affordability ranked the top barrier to mobile internet use in Bangladesh followed by usability and skills, accessibility, relevance and safety.

13. Recommendation for Policy, Research and Extension Services

Despite several challenges the Bangladesh successfully maintained the economic growth for last couple of years and became eligible to graduate to a developing country from the LDC fulfilling all the three criteria. No doubt that, recent commendable progress in agriculture has played a critical role for achieving that success. To maintain the progress and keeping it sustainable, agricultural production and productivity are to be more amplified. In that context reducing ‘information gap’ is one of the major steps. Utilization of ICTs in agriculture has got the momentum in last decade. Different pragmatic policies, enhanced infrastructure, demographic dividend, public private partnership, agro friendly approach by the government etc has created enormous prospect for e-agriculture expansion in the coming days. However, following recommendation could be considered for future policies:

- **Appropriate digital content** preparation is one of the pivotal points for efficient e-agriculture expansion. The content should be tailored to meet



local needs, keeping in mind that ‘one size does not fit all’. Audio and video content should be made on local languages. The content will have the complete information package like seed to seed production technology, input sources with price, market information, meteorological information as early warning etc in the credible and ‘consumable way’. Since majority of the farmers are not well educated multimedia based content (like-video, photo) is more effective than text based content (like-SMS).

- **Gender specific digital content** preparation should be taken into serious consideration. Demand led information dissemination to the women will seriously benefit the agricultural development.
- **High speed internet connectivity and lowering internet charge** will cater the e-agriculture ventures. Slow internet connectivity especially in the rural areas is one of the largest barriers so far;
- **Device choosing** is another great issue for information dissemination. Smart phone has already taken the place of other gadgets. In the coming days mobile based initiatives are to be more strengthened. Capacity of Government owned ‘Krishi Call Center-16123’ should be enhanced to render 24/7 service;
- **Agro market linkage** is one of the most important issues for the farmers. Very little initiatives have been rolled out so far. Proper market information and market linkage would be great assistance for the farmers. Virtual platform for buying, selling and reliable online payment method will be the great leap for the farmers;
- **Comprehensive farmers’ digital database** preparation is extremely important at this time. Not only it will be helpful for the top policy makers but also will be great tool for regular extension activities at the root level;
- **Proper time** for information delivery is extremely important. Television, radio and other mass media disseminates different agro based programs which are to be broadcasted on farmers suitable time;
- **Precision Agriculture (PA)** has the huge prospect in Bangladesh since the country is highly natural calamity sensitive and PA have immense effect over the ecological and environmental balance by using accurate production inputs. Limited schemes are being implemented already but that need a huge momentum in the coming days;
- **Digital capacity enhancement** both for the farmers, input sellers and field level extension personnel would be more reinforced;
- **Knowledge bridging** between ICT experts and agro domain knowledge experts are extremely valuable. Besides strong linkage among research,



extension and academia will bring real benefit for the farmers. A central digital e-agri knowledge repository could be made;

- **ICT based farmers' groups** are to be increased. Agriculture Information and Communication Center (AICC) in the every village will have great effect in e-agriculture promotion. But a successful business model to be explored for these and alike centers.
- **Trendy social media** like Facebook, YouTube has the millions of users in Bangladesh. Utilizing these huge popular for agro technology dissemination could be very effective. what's more, television, radio, community radio has still the influential role for information dissemination and awareness creation;
- **Popular electronic mass media** like television and radio have still the millions of viewers and listeners in Bangladesh. Besides the effective program making, farmer's suitable time for broadcasting to be ensured. A separate Ag TV Channel would be praiseworthy.
- **Continuous feedback collection** mechanism has the utmost importance for check the efficacy of different ICT initiatives and provides scope for necessary modification and updating;
- **National agro content validation committee** is extremely essential. Rampant endeavors by different media and organizations sometimes create mystification amongst the farmers. Agriculture Information Service under Ministry of Agriculture could coordinate the stakeholders. The committee will also check the redundancy amongst the initiatives;
- **National e-agriculture policy** is highly required now. 'e.Krishi vision 2025' was prepared in 2008 and it was the 'torchbearer' in e-agriculture implementation in Bangladesh. But mean while technology and trend has changed many folds. Although emphasis has been given on e-agriculture in different major policy documents even then a separate e-agriculture policy will be worthwhile.

14. Conclusions

Agriculture is the lifeline of the economy of Bangladesh. Significance of agriculture is not only limited to its contribution of country's GDP rather its magnitude is much more beyond. Agriculture is the part of our culture and millions peoples dream are being embedded with this. Despite different challenges, recent agricultural progress has caught the attention across the globe. Bangladesh has secured tenth position in food production across the globe (MoA, 2018). However production and productivity both are to be increased more to meet the future demand keeping the natural resources sustainable.



It is already marked that ICTs have the huge potentialities for development. The growth of ICT in the context of Bangladesh is also very promising. Pragmatic policies, expansion of connectivity up to rural level, developing huge content, digitization of different citizen services, innovation culture in public and private domain etc in recent couple of years are ultimately turning Bangladesh to a 'Digital Bangladesh'.

However, in the field of agriculture different digital approaches have been taken and some of them have already gained remarkable popularity. Yet many things are to be accomplished. While taking any ICT solutions in agriculture, user friendliness and suitability are to be ensured first. Appropriate promotional campaigning for the usage of these services as well as to behavioral change through awareness creation at farmers level is therefore highly essential. Joint effort by the public and private bodies in designing and disseminating the right kind of e-services will foster the sustainable agriculture development of Bangladesh.

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Chapter Three

ICTs for Development of Rural Agriculture in Bhutan: Policy Concerns

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Abstract

Information and Communication Technology (ICT) has significantly improved the way-forward to communicate the people to learn, do business, backup information and the way farmers do agriculture works. ICT has become inevitable for manifold professions in the world. To avail the opportunities of ICT, the Royal Government of Bhutan has thus prioritized ICT with the vision to have “ICT enabled, knowledge based society as a foundation for Gross National Happiness”. Agriculture sector is very much included in this profound vision to address the towering challenges in relation to sustainable production, processing a marketing of products capitalizing on ICT. Moreover, special and specific emphasis is drawn in building ICT skills in women as agriculture in Rural Bhutan is becoming dominant with female. ICT in general is expected to address challenges and stimulate generation and application of sustainable technologies to address food insecurity of Bhutanese households.

1. Introduction

Information and Communication Technologies (ICTs) encompasses all technical equipment and facilities that convert, process, save and transfer various types of information in digital form. It includes voice telephony, data communications and computer, radio, television and other similar technologies. Copper wires, fiber optics and a variety of wireless technologies are used for communications and exchange of data (Dirk , Gudrun, & Hans-Jürgen , 2013).

While computer technology processes information, the network provides a link to communicate with other computers to maximize the utility of the processed information. The global networks of interlinked computers with its contents accessible to the general public form the internet platform. The use of Internet and access to information has been enhanced with the invention of World Wide Web (WWW) – a system of interlinked hypertext. The ever increasing bandwidth of network technology and application of ICT has cut through all human endeavors like education, medicine, agriculture,



engineering, transportation, etc. Today, ICT has become an essential tool used by individuals, organizations, governments and international agencies to gather data, and to transform data into information for informed decision-making.

The application of ICT is more so relevant in agriculture due to increasing demand for food in the face of depleting resources. It calls for precise and efficient technologies that could be disseminated effectively to produce safe and affordable food for all people at all time. The challenge of adequate food production is more common in under developed and developing countries. It is far worse in landlocked countries like Bhutan with limited arable land and other resources. Under these circumstances, technology in general and ICT in particular could be vital in planning, implementation, monitoring and evaluation of results and impacts of innovative tools and information.

2. Bhutan an Overview

Bhutan is located in the eastern Himalayas bordered with China in the north and India in the south with an area of 38,394 square kilometers and the estimated population of 735,553. Almost 62.3% lives in rural areas practicing agriculture, rearing livestock, and collecting various forest products (NSB, 2017c).



Figure 1. Geographical Map of Bhutan

The ecological zones comprises of alpine highland mountains, temperate regions and sub-tropical climate. It has forest cover of 70.77% followed by shrubs of 9.74%, and an Alpine Scrub of 3.39%, and the least is cultivated agricultural land and meadows that account for 2.75% and 2.51%



respectively. The snow cover constitutes 5.35% and rocky outcrops 4.15% while water bodies, built up areas, non-built up areas, landslides and moraines constitute less than 1% each (FRMD, 2016).

Bhutan has 20 *Dzongkhags* (districts) with 205 *Geogs* (blocks) and 1,044 *Chiwogs* (sub-blocks) that serves as localized administrative units. Development in Bhutan is guided by the philosophy of Gross National Happiness (GNH) which is a multi-dimensional that seeks to achieve a harmonious balance between material well-being and the spiritual, emotional and cultural needs of our society.

3. Status of ICT Application for Rural Agriculture

The potential of ICT as a direct tool for enhancing agricultural productivity and as an indirect tool for empowering farmers to take informed decisions resulting positive impact is massive. It arises out of precision technologies such as Remote Sensing(RS) using satellite technologies, Geographical Information Systems(GIS), scientific data collection using smart phones and soil sciences. The indirect benefits of ICT in empowering farmer are also significant. It provides timely, useful and reliable information to farmers under changing environment.

In general, ICT advancement provides endless possibilities to adopt innovative farming. Lately, Information and Communication Technology Division (ICTD) of Ministry of Agriculture and Forests (MOAF) developed various systems and applications that enhanced decision making; planning and participatory implementation involving communities as detailed out in table 1.

Table 1. Some of the prominent systems in the MoAF

Sl. No.	System/Application	Description/Main Function
1	Marketing and Cooperatives Information System	To promote and support the creation and operation of cooperatives and farmers groups is a priority of the Royal Government of Bhutan and especially of the Ministry of Agriculture and Forestry. About 480 informal farmers groups on Renewable Natural Resources activities were recorded in the beginning of 2010. The department registered a total of 67 groups (55 FGs and 12 co-operatives) in the past year out of which 43 are livestock based and 24 agriculture based. Of the total member of 10948 members in registered groups and Co-operatives as of June 2018, 46.62 % are women(DAMC, 2018).



Sl. No.	System/Application	Description/Main Function
2	Interactive Voice Response (IVR) system for RNR products price	To facilitate and support the farmers with market information, the Department of Agricultural Marketing and Cooperatives (DAMC) under the Ministry of Agriculture and Forests has established Interactive Voice Response (IVR) in 2009. This service provides famers with latest market price information from the five auction yards in the country upon dialing 2009 toll free number.
3	Food and Agriculture Statistical Information System(Country-STAT)	To provide a harmonized RNR statistical data available on the internet for access by all users at all times and in a more efficient manner, this system started in 2007 and completed in 2008. However, it is centralized by FAO Rome in 2013. The data under CountrySTAT-Bhutan are organized under three major groups: national core, district level and sub-district level.
4	ePest Surveillance System	The ePest surveillance system which is maintained by the National Plant Protection Centre (NPPC), Department of Agriculture, under the Ministry of Agriculture and Forests. The main purpose is to collect and share real-time information on pests of Agricultural crops and send data via internet. It is connected to a central server that will allow rapid data entry, collation and analysis, and makes the data reports. However, official data is yet to publish for public use.
5	Forest Information Reporting and Monitoring System(FIRMS)	Database system which generate real time information of forestry activities in the country. The system has registered around 314 users, 253 division units, 651 community forests and 222 forests products until now.

4. Role of Mobile Technology in e-Agriculture

The wide spread use of mobile phone and Internet globally provides ready access to information for rural communities. With the deployment of 4G LTE, data usage via cellular phone saw an unprecedented growth in the country.



Although mobile technology can be applied widely across the value chain; nonetheless, mobile application is relatively less in production and processing units as compared to marketing. In production and processing, application is limited to gaining of access to information on latest breeds or varieties of inputs and recent innovative production technologies. On the other hand, marketing is made more versatile using an online trading platform provided by commodity exchange that facilitates virtual trading and online payment. Moreover, market area is widened by adopting e-commerce that enables business to business or business to customer interaction both within and outside of the country.

Realizing the opportunities the mobile cellular subscription in the country has increased from 544,337 in 2013 to 730,623 in 2017; while, the fixed line telephone subscriber decreased from 26,485 in 2013 to 21,364 in 2017 (MoIC, 2017). This clearly shows the impact of mobile technology especially in rural areas.

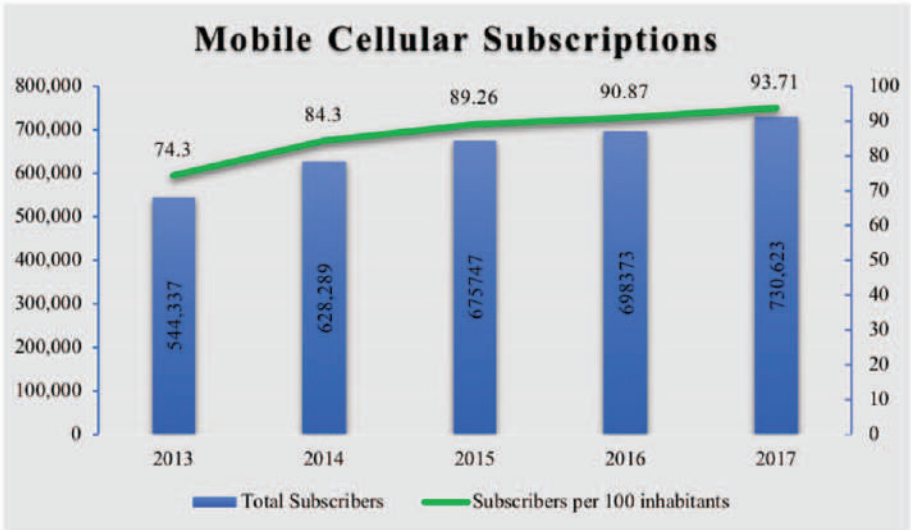


Figure 2. Mobile Cellular Subscribers in Bhutan, 2013-2017

5. Rural Access and Exchange Mechanism

After introducing Internet and television services in country, there was a rapid growth of an Internet Service Provider (ISP) and Cable Television (CATV) operators. According to Bhutan Info comm and Media Authority as of June 2018, there are eight licensed ISP in the country. However, Fixed-line telecommunication services and Cellular Mobile services are catered only by Bhutan Telecom Limited and Tashi Info Comm. With increased ISPs, internet services and cellular mobile services have become cheaper resulting the increase of mobile subscription to 90.9% and mobile broadband



to 79.4% (BICMA, 2017). There is an increase of 1.9% mobile subscription penetrations when compared to 2016 (89%).

With the vision to make Bhutan an ICT enabled knowledge based society, the government has undertaken several ambitious ICT projects like Government-to-Citizens (G2C) Project to deliver citizen services online; “Chiphen Rigphel” to train and educate teachers, students and civil servants on ICT; and Thimphu Tech Park to develop ICT industry in the country. According to the DITT, 18 districts are connected with OPGW fiber cables, 2 districts and 200 community centers are connected with ADSS fiber cables (DITT, 2017). These initiatives have improved access to reliable citizen services.

6. Impact of ICTs on Agriculture and Livelihood

The deployment of ICTs in Renewable Natural Resources (RNR) sector is not new in Bhutan. The increase in usage of mobile phones, Internet, computing devices and social media has changed the way RNR stakeholders’ accessed information. It has also improved the style of agronomy in the country by applying modern techniques learnt through Internet of Thing (IoT). A number of agriculture pilot projects have provided rich learning on sustaining and scaling up ICT in agriculture interventions guided through basic principles of Gross National Happiness(GNH). The Government has also laid significant emphasis on agriculture through Bhutan ICT road maps, eGovernment Master plan, e-Government Framework(e-GIF)and Parenting concepts. Aligning with Parenting concept, ICT Division has been formed in ministry to cater the ICT and media Services. With the formation of ICT Division, there is great impact in the sector as every aspects of ICT could tackled through single gateway.

Table 2. Some of the ICT initiatives for rural agriculture

ICT initiatives	Descriptions on services
Radio and Television for RNR information dissemination	Recognizing the influence of mass media on the rural population, the MoAF has signed a memorandum of understanding with the Bhutan Broadcasting Service to broadcast an RNR themed live panel discussion program on both the radio and television every week. The ICTD under the ministry coordinates the panel discussion “Sanam Rigpa” every Monday on various RNR related topics. A discussion on the same topic with the same panel members is also conducted and broadcast on radio network around the country. To encourage more callers to participate in the discussion, the ministry installed a toll free number (157).



ICT initiatives	Descriptions on services
Community centers as operating service points	With around 200 community centers already established in the country targeting maximum usage by rural farmers, the Ministry encourage rural people to use centers to operate RNR-G2C services. The centers also provide necessary ICT equipment like computers, fax machine, printers, photocopier, scanner, banking and postal services.
Website of Ministry functions as information portal	Access to information has become easy, as website updates evidence based information regularly.

ICTD as a RNR information portal is mandated to execute RNR Information, Education and Communication (IEC) components through use of ICT services and technologies for wider reach. Out of many services, ICTD maintains the Ministry's official website, which is one of the most active websites in the country. The website is regularly updated with latest RNR news, events, breakthroughs and farming technologies. In addition, RNR Newsletter, Sanam Rigphel, Sanam Drupdrey and RNR Extension Manual are published at regular interval. This has serve as a successful medium to disseminate information about innovative RNR technologies and activities to farmers and general public.



Figure 3. Mobile apps in MoAF

The seamless ICT systems maintained through use of recommendable security, software and hardware at ICTD has great impact to farming community in production of agricultural products. For example, the correct pest information from ePest surveillance system would help technical officials in the ministry to decide on myths of controlling pest within time



and this would in turn prevent farmers from losing crops prior to harvesting. With increase in usage of cellular phones, development of mobile apps became crucial. MoAF has few applications such as ePest, Firms and RNR market Info which help decision-makers, stakeholders, farmers in accessing pest and price information in real time basis.

7. Utilization of ICT to Adaptation of Climate Change Affect in Agriculture

A small nation in-between two most populous countries voiced out to remain carbon neutral, although we are not spared from the wrath of climate change. For landlocked country such as Bhutan, erratic weather patterns, fast melting glaciers, and the risk of Glacial Lake Outburst Floods (GLOF) have now become a reality. Though our farmers are not affected intensively at the moment by climate change, if left without monitoring, can become one of the greatest hazards.

Table 3. Proportions of HHs affected by the various Natural Calamities in the year 2017 (MoAF, 2017)

Natural Calamities	Percentage of Household affected
Landslide/soil erosion	2
Hail storm and wind	5
Excessive rain	4
Drought	4

Reflecting on threats, we need to consider measures in mitigating climate changes and adapt by capitalizing ICT solutions. ICT technologies such as Geographical Information System (GIS), Mobile Technology (MT), Web based applications, Satellite Technology and Remote Sensing (RS) are picking up rapidly in the country to collect field data. As such, MoAF is planning to conduct its 3rd RNR census using Census and Survey Processing (CsPro) web based application equipped with Geographic Positioning System(GPS) through MT. The accuracy of data will be enhanced and provide better information for our decision makers to address climate change.

8. Strategic Need for using ICT in Agriculture Extension

Bhutan has integrated Renewable Natural Resources (RNR) Centers comprising of agriculture, livestock and forestry sector in 205 *Geogs*. While the 5 RNR research and development centers, 4 RDC sub-centers, 4 regional livestock development centers produces technologies; the RNR centers at 205 *Geogs* disseminates extension information to the public.



Noting 62.3% of population's dependency on agriculture and significant contribution (16.52%) of agriculture to GDP (NSB, 2017b); there is an urgency to transform agriculture from subsistent to commercial mode to harness the potential to alleviate poverty capitalizing on ICT based Intervention. Such innovations could also address host of challenges such as: decreasing public investment, loss of agriculture land for other development, lack of infrastructure for irrigation and post-harvest storage, labor shortage, rural urban migration (RUM), human wildlife conflicts, inadequate access to market information and credit opportunities.

Table 4. Proportions of HHs affected by the various farming constraints in the year 2017 (MoAF, 2017)

Farming Constraints	% Household
Farm Labor shortage	53
Human wild life conflict	49
Unproductive land	14
Shortage of land	22
Crop damage by insects/diseases	22
Insufficient irrigation supply	27
Limited access to Markets	12

Right ICT solutions can be applied in improving the agricultural productivity, accelerating delivery of modern agricultural services and providing timely, accurate and relevant scientific information to the farming communities.

9. Access to Market Information through ICT

Inadequate market information on price, demand and supply situation constrains farmers from producing large quantities at right time and for right market. Production, thus, is an activity carried out without regard to what, how much and when the market would want. They also tend to sell at a price offered by the middlemen or traders or bring their products to market with virtually no information at all and most of the times, end up with not fetching expected price.

Strengthening RNR market information is important task of the DAMC to enhance productivity and competitiveness of farm sector which would eventually lead to reducing of rural poverty, enhancing food security and reducing dependence on imports. As such, DAMC has instituted farms shops, Bhutan co-operative shops and other market infrastructures alongside of road. Facilitated farmers in various ways.



However, as the agriculture sector transforms from subsistence to market-oriented venture, a well- developed Market Information System has become a necessity. In lieu of this, few ICT solutions are already under implementation:

1. Agri-market system: This system provide information on prices of RNR products; the production data; markets profiles; the export and import reports; weekly market prices; and the information on the latest / recent last auction prices.
2. IVR system for RNR products price: IVR system provides latest market price information from the auction yards. Bhutan has five auction yards located around the country: Phuentsholing, Samtse, Gelephu, Samdrup Jongkhar and Centenary Farmers Market at Thimphu.
3. RNR market Info application: This application is basically the market information generator for producers, suppliers and consumers using G2C application system.

10. Best Practices on use of ICT in Agriculture Extension

Natural terrain and unfavorable landscape is a challenge for the delivery of any RNR services; which could be addressed by applying ICT. From the onset of 9th FYP to 11th FYP ICT was incrementally applied and the response to the few ICT enabled RNR services delivered by the ministry had been promising. The IVR system for dissemination of market information for agricultural products is extensively used by the farmers. As the mobile subscription in the country reached up to 90.9% as of 2017(BICMA, 2017).Therefore, it is evident from above statistics that the information provided through IVR has competent to cover almost 91% of total population. Processing of permits and certificates for various RNR activities is automated online, thus offering more convenience. The number of users using those services had been encouraging too. Owing to the small population of the country complexities of adoption and application of ICT in agriculture extension is relatively lesser providing unique opportunities to establish ICT enabled citizen services.

11. Women Involvement in ICTs Focusing on Agriculture

By population, the proportion of male (52.3%) and female (47.7%) is not significantly different. However, it is seen that proportion of female (59.3%) working in agriculture sector is higher compared to 34.2% of male (NSB, 2017c). Therefore, the rural farming is increasingly getting dominated by women due to gradual migration of men to urban towns and cities in search of income generating opportunities to supplement household income. Almost the entire chain of farming right from production to consumption is handled by women.



Besides farming, women have added responsibilities to attend to the household chores. The task is intensive and it demand incorporation of mechanization to make it less cumbersome. For example, the program such as farmers group/cooperatives training conducted by DAMC in 2017-2018 found 740 women participant compared to only 525 men which is directly proportional to male and female involved in agriculture sector (DAMC, 2018).

With agriculture sector being dominated by women, it is essential to provide IT literacy for women to manage, maintain and share production, processing and marketing information with relevant stakeholders. The benefit would be immense particularly for women dominated rural agriculture country.

12. Policy and Institutional Strength for use of ICTs in Agriculture

Telecommunications Act was passed during 77th session of the National Assembly of Bhutan just after introduction of internet and television services in 1999. Similarly, ICT White Paper got approval in October 2003 which provides a clear route for Bhutan's ICT sector in near future through clear expression of vision, strategic components, and future directions. Aligning with the White Paper, Bhutan Information and Communications Technology Policy and Strategies (BIPS) was sanctioned by the cabinet (MoIC, 2004)

The initiatives from the government to develop of ICT in Bhutan under the five broad strategic components of BIPS, government ministries, autonomous bodies and agencies were asked to develop their own sectoral master plan aligning with BIPS. With released of BIPS report in 2004, Information and Communication Technology Division (ICTD) the then Information and Communication Services (ICS), MoAF initiated and developed its own RNR sectoral ICT framework and master plan. It is based on a sectoral analysis that identified the RNR sector's ICT strengths and weaknesses, and an environmental scanning that determined the sector's ICT opportunities and threats (MoAF, 2004).

Bhutan ICT Roadmap in 2011 was developed in the country knowing the importance of ICT that can bring changes to socio economic development with guided principles of Gross National Happiness and it was revised in 2015.

Realizing the trend in increased use of ICT services, the need for a consolidated e-Government Policy that will capitalize on existing technologies to enhance competitiveness, increase productivity, improve service delivery and economic development became necessary. Accordingly, the eGov master plan was developed in 2014 with ICT vision "*An ICT-Enabled, Knowledge-Based Society as a Foundation for Gross National Happiness*" and revised desired outcomes from broad objective of BIPS as follows:



1. ICT for good Governance
2. ICT for a Bhutanese Information Society; and
3. ICT as a Key Enabler for Sustainable Economic Development.

The masterplan covers whole-of-government ICT initiatives that serve the Government, People and Businesses. Aligning with this master plan, the initial five sectors identified for ICT transformation are Education, Finance, Health, Tourism and in fact the Agriculture.

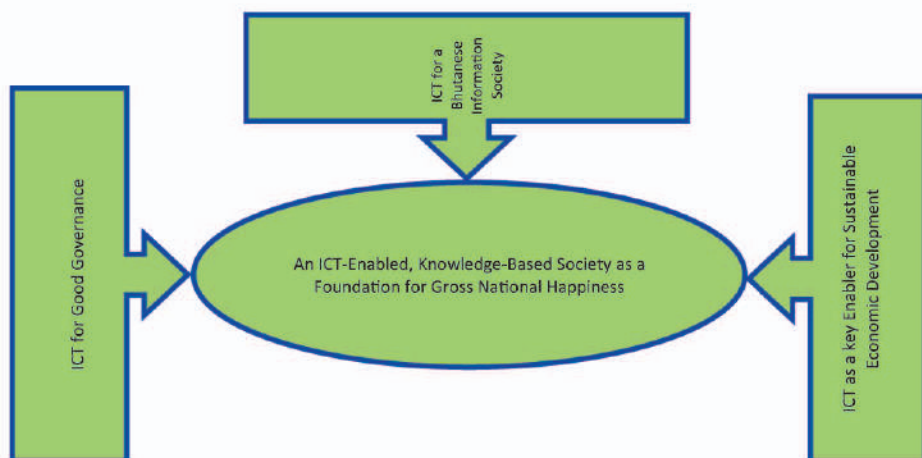


Figure 4. Bhutan e-Government Master plan, 2014

Aiming to harness the ICT potential of Bhutan in achieving its RNR goals and further strengthening the role of ICT in accelerating the growth of the RNR sector in a sustainable and equitable manner, another E-RNR Master plan was developed in 2016 using 11th FYP as the guiding principle. This strategic document outlines development of an E-RNR vision, an action plan for key ICT solutions for the sector and a monitoring and evaluation.

At the moment, ICTD along with ministry is also at its final stage of aligning eRNR master plan with the RNR sectoral 12th Five Year Plan.

13. ICT for Rural Agriculture Development

ICTD was established to cater Technical Services for the ministry and provide technical backstopping wherever necessary to rural people who depend on agriculture and its allied sectors for livelihood. It is also responsible for developing ICT infrastructures and services for efficient delivery of RNR services. However, despite the government's concerted effort, the growth of the ICT sector in country is being confronted with numerous challenges. This is mainly due to lack of IT policies and appropriate IT strategy dealing with cross cutting issues like gender;



environment; climate change; and natural disaster. As a portal for information and technology of ministry, vigorous activities need to be initiated and implemented which disseminate appropriate information to our rural communities.

Base on technicalities and current system of rural agriculture development, the SWOT analysis has been done as follows;

Strengths

- Strong support from government
- Increasing international support

Weaknesses

- Lack of awareness to farmers
- Lack of human capacity
- Lack of budget support
- Lack of appropriate policy support

Opportunities

- Majority of country's population under productive age group (68%)
- Reliable and up to date information for farmers

Threats

- Majority of Farmers are illiterate
- Connectivity issues in rural areas
- High Maintenance cost for systems
- Security of applications and systems

Moreover, Face book pages and we chat group like agriculture movers, functions as information portal for rural people informing about farming mechanisms and best practices.

14. Recommendation for Policy, Research and Extension Services

The following recommendations are made to enrich the use of ICTs in agriculture sector to improve the RNR service delivery within national, regional, districts and extension centers. However, it was felt that there is not much of recommendations needed in policy.

a) Equip with physical ICT infrastructure in research centers

Although 4 RNR Research Development Centers and few sub centers served as guiding framework and research gateway for RNR sector, equipping centers with right research ICT infrastructure became challenging. Therefore, it is utmost importance for ministry to train research personals on use of new research technologies and furnish



centers with modern technologies to be able use research methods of agriculture to improve production and productivity.

b) Capacity enhancement on ICT for Extension Staff

More than 600 extension agent (Agriculture, Livestock and Forestry) officials are placed in field who maintain contact with the farmers. These groups of officials are someone to lookup to by our farmers in use of modern RNR technologies and management practices.

Therefore, ministry should place technically sound officials in the field rather than fresh new recruits as like now. Having placed experienced officials in the field will improve in utilization ICT system with their vast knowledge and this will in turn ensure that the farmers and other users derive maximum benefit from the system.

c) Collaboration System within the Extension System

The research agencies are an important component of the extension system in Bhutan. It is the research centers that develop all the modern RNR technologies and management practices. That knowledge had to be transferred to the farmers by the frontline extension agents. The adoption rate and feedbacks on developed technologies and management practices can be extremely useful for the researchers.

Although ICT services like email is used currently, most of the communication and data gathering are done manually. Therefore, an online collaboration system needs to be developed for the extension system to function effectively. Modern tools like Voice over IP (VoIP) should also be used for the researchers in different regional offices to have instantaneous communication.

d) Develop RNR advisory and extension services

Currently advisory services are offered over various electronic means. Additionally, reports are produced and face to face meetings or workshops are also conducted among agriculturist, RNR workers, farmers and other agro stakeholders. However, to deploy good agriculture practices in the country, the credibility of the advisory services is of utmost importance.

The advisory service system will help the farmers to avail the services over various means such as broadcasting technologies, telecom, internet and mobiles. Therefore, deploying the reports and other advisory contents online and making it accessible is the core requirement to enhance the advisory services offered to the agriculturalist.



15. Conclusions

- i. Information and communication Technology have always added value in agriculture. Ever since people have initiated farming they sought and shared information and techniques from one another. Although farmers in the rural areas generally plant the “same” crop and same variety for years, but the changing weather patterns and deterioration of soil conditions causes new change pests and diseases to emerge. Such circumstances compel farmers and extensions to explore for innovative technologies and information. The reliable information could be obtained with ease if the foundation of ICT and its application are widely promoted amongst farming stakeholders.
- ii. The Information and Communication in agriculture is increasingly recognized as a driver of change and a key factor of development. Now more farmers are seeking into new communication capacities to advance their work just as much as industrial-scale producers. But accomplishing these tasks can be challenging as it requires the implementation of a complex set of policy, investment, innovation, and capacity-building measures. It also requires encouraging the growth of locally appropriate, affordable, and sustainable ICT infrastructure, tools, applications, and services for the rural economy. Besides, lots of communication components are seen not adequately integrated in the design and implementation of agriculture sector development initiatives.
- iii. Generally the central goal for the every agriculture sector is to analyze and disseminate evidence of the impacts of agricultural developments to the rural people to help explore opportunities in agriculture reducing farm drudgery and poverty. In order for this, IT sector has to stay updated of new and different tools to learn about their principles, characteristics and specific functions for effective application.

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Chapter Four

ICTs for Development of Rural Agriculture in India : Policy Concerns

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Abstract

Indian agricultural extension system is known world over for its pluralistic nature, driven by multiple agencies. The estimates in India indicate that to disseminate advanced agricultural technological information to its 120 million farm holdings requires at least 1.3-1.5 million extension personnel against which present availability is only 0.1 million (Planning Commission, GoI, 2007). Of the 40.6% households who received extension assistance, only 11% of the services came from physical government machinery. Most of the farmers are depended on their neighbour progressive farmers, electronic and print media (including radio, TV, newspapers) and private commercial agents (Parikh, 2007). If Digital India delivers on its promise, rural India will likely soon outnumber urban India online for a more real representation of the country. The use of information and communications technologies (ICTs) for popularization of agricultural technologies is thus one way of addressing the information needs of farmers. While not a panacea for all of the problems facing extension, the integration of ICTs as a communication channel and as an enabler of change is considered a critical part of future reforms. Using ICT to achieve agricultural development goals requires supplementary investments, resources and strategies. Consistent investment in technology, capacity building and policy support are the important measures needed at this juncture.

1. Introduction

The Situation Assessment Survey of Agricultural Households in India (NSSO, 70th round), based on a countrywide survey (July 2012-June 2013) of nearly 35,000 households revealed that “farmers continue to remain far removed from new technologies and guidance from state run research institutes” (NSSO, 2014). Over 59% of the farm households received no assistance from either government or private extension services. The National Commission on Farmers has noted that knowledge deficits constrain



agricultural productivity in India. It added that the use of information and communications technologies (ICTs) for popularization of agricultural technologies is one way of addressing the information needs of farmers. The Working Group on Agricultural Extension constituted by the Planning Commission, Government of India for XII Five Year Plan also recommended that there is a need to respond to emerging challenges to the sector by strengthening information dissemination to farmers through use of Information and Communications Technologies (ICTs).

The digital strategies in India were initiated or piloted based on five core necessities. Bringing efficiency in extension delivery, harnessing effective tools for research & education, need to mechanize (level of farm mechanisation is about 35% to 40% in India while most developed countries have over 90%), realizing financial inclusion including markets (farmer value realisation is between 20 % to 30% versus the global benchmark of 50% to 60%) and bridging the broken value chains in Indian agriculture (food processing is still less than 15% in India compared to global averages of 30% to 40%). India has witnessed changes in each of the above mentioned factors and Indian agriculture is now poised to make dent in digital strategies. These interventions could create opportunities for Indian farmers to raise their income levels and may provide strong impetus to India's overall economy as well. The status paper describes few initiatives undertaken in India towards achieving this objective.

2. Current Status of Application of ICTs in Rural Agriculture

India has deployed a plethora of digital pilots in the field of agricultural development in last two decades. The Indian government and public-private-partnerships (PPP) are developing and disseminating a series of innovative, networked solutions, under the Digital India initiative, to increase availability, accessibility and applicability of agriculture services at farm level. These are achieved through 1192.04 million telephone subscribers (1170.02 million wireleses and 22.02 million wireline) 496.12 broadband subscribers as on December 2018.

Key Government initiatives to promote digital agricultural strategies include National e-Governance Plan in Agriculture (NeGP-A), Mobile apps deployment, Knowledge Management Portals, Krishi Vigyan Kendra (KVK) Portal, Touch Screen Kiosks, Kisan Call Centres, Agri-Clinics, Common Service Centers, mKisan, Direct Benefit Transfer (DBT) schemes, Kisan TV and various other applications. Private initiatives include digital start ups in agriculture (such as CropInfo), e-choupal (of ITC), mobile apps (such as FarmRise by Monsanto), weather systems (such as Skymet), Reuters Market Lights, Digital Traceability (such as SourceTrace), Direct market Interventions (such as Naa Panta), etc.



Digital strategies in agricultural research and education are instrumental in changing the landscape of current research and education programs. From the earliest initiatives like Agricultural Research Information Systems (ARIS) to advanced National Bio Informatics Grid, India has always bolstered the agricultural research with state of art digital computing technologies.

3. ICTs in Agricultural Research

The Indian Council of Agricultural Research (ICAR) established its first Super Computing Hub under the project “Establishment of National Agricultural Bioinformatics Grid.” Maintained at the Centre for Agricultural Bioinformatics of the Indian Agricultural Statistics Research Institute (IASRI), the hub hosts microsatellite markers of pigeon pea, tomato, buffalo, goat and other agricultural commodities of global importance to help scientists for development of elite varieties and breeds.

Consortium for e-Resources in Agriculture (CeRA), e-Publishing Online System for Indian Agricultural Journals, Digital Repositories like e-Granth, Krishikosh and KrishiPrabha, Knowledge Management Portals, Enterprise Resource Planning Solution, and Market Intelligence Centres with e-advisory services across the country are the digital initiatives of ICAR. e-Courses for the Graduate level academic programmes in seven disciplines namely; Agriculture, Fisheries Science, Dairy Science, Veterinary and Animal Husbandry, Horticulture, Home Science and Agricultural Engineering with 1107 credits and 15820 lessons have been developed. Knowledge based Resources Information Systems Hub for Innovations (KRISHI) in agriculture, is being developed as a centralized data repository system of ICAR. Mobile apps developed by more than 100 ICAR research institutes, State Agricultural Universities, KVKs help farmers to get information about latest technologies developed in research labs. These apps are facilitating the transfer of technologies from “lab to land.”

4. ICTs in Agricultural Extension System

India Development Gateway (InDG) is supported by Ministry of Communications and Information Technology, Government of India and implemented by Center for Development of Advance Computing (C-DAC), Hyderabad. The multilingual website www.indg.in is a one stop portal to people who seek information in Indian languages related to six livelihood domains (Agriculture, Health, Primary Education, Rural Energy, Social Welfare and E-Governance). "**vikaspedia**" having state wise language portals for better user interface, can be accessed through, www.vikaspedia.in

DACNET- an E-Governance Infrastructure for the Globalization of Indian Agriculture is a project of Department of Agriculture and Cooperation (DAC), Ministry of Agriculture. DACNET is implemented by the National



Informatics Centre-the technology division of the Indian government. DACNET facilitates Indian 'agriculture online.' DACNET's key criteria included ease-of-use, speed of information delivery, low incidence of errors, reduction in corruption, and affordable services. Approved September 2001, the DACNET project has reduced time taken to deliver services while making information available to its citizens over the Internet.

Farmers Portal user farmer will be able to get all relevant information on specific subjects around his/her location. This information is delivered in the form of text, email and audio/video in the local language. These levels can be easily reached through the Map of India placed on the Home page. Farmers will also be able to ask specific queries as well as give valuable feedback through the feedback module specially developed for the purpose.

Agriculture Resources Information System Network (AGRISNET) is a mission mode project funded by the Ministry of Agriculture, Government of India to develop a comprehensive online knowledge portal to disseminate relevant information to farmers. The goal of the project is to follow an all-inclusive approach in terms of ensuring technological connectivity, development of system software and provision of hardware at agriculture department offices up to the block level in all states and union territories. All states have their own AGRISNET portals. For instance, Tamil Nadu's Department of Agriculture has successfully created an internet based information network for 80 lakh farmers in the state.

5. The Role of Mobile Technology in Agriculture

Among many others, Mobile apps will help towards farmers' empowerment and facilitate in extension services. This effort, however, requires lot of complimentary strategies to realize actual benefits.

Kisan Suvidha mobile app provides information on five critical parameters-weather, input dealers, market price, plant protection and expert advisories. An additional tab directly connects the farmer with the Kisan Call Centre (KCC) where agriculture experts answer their queries. Unique features like extreme weather alerts and market prices of commodity in nearest market and the maximum price in state as well as India have been added to empower farmers in the best possible manner.

Agri-market mobile App can be used to get the market price of crops in market within 50 km of the device's location. This app automatically captures the location of person using mobile GPS and fetches the market price. **Crop Insurance** app can be used to calculate the Insurance Premium for notified crops based on area, coverage amount and loan amount in case of loanee farmer. Though these are evolving over a period of time and integration of all the apps into a single interface (such as Bharat Interface for Money – BHIM App) will help farmers realize digital dividends.



Kisan Call Centres: Ministry of Agriculture launched the Personalized Query Redressal System "Kisan Call Centres (KCCs)" on January 21, 2004. Main aim of the project is to answer farmers' queries on a telephone call in their own dialect. A countrywide common Toll Free number 1800-180-1551 is accessible through mobile phones and landlines of all telecom networks including private service providers. Replies to the farmers' queries are given in 22 local languages, from 6.00 am to 10.00 pm throughout the seven days of the week. Call Centre agents known as Farm Tele Advisor (FTAs) are graduates or above (i.e. PG or Doctorate) in Agriculture or allied disciplines. Queries which cannot be answered by Farm Tele Advisor (FTAs) are transferred to higher level experts in State Agriculture Departments, ICAR and State Agricultural Universities, in a call conferencing mode. Since 2004 till Nov 2017, nearly 13 million calls have been received and answered across the country. Uttar Pradesh leads the states with 22.85 lakhs calls followed by Maharashtra (19.61 lakhs), Rajasthan (15.72 lakhs) and Madhya Pradesh (12.28 lakhs).

6. Rural Access and Exchange Mechanisms: Connectivity and Telecentres

Rural Indians have been getting online in increasing numbers, and are expected to catch up with urban India by 2020, when 48% of the online population will be from rural India (up from 36% in 2016). Telecom subscribers' base in India reached 116.8 crores at the end of June 2018 and the overall tele-density reached 89.72 in June (TRAI, 2018).

Common Services Centres (CSC) are the access points for delivery of essential public utility services, social welfare schemes, healthcare, financial, education and agriculture services, apart from host of B2C (Business to Customer) services to citizens in rural and remote areas of the country. In view of the importance of geo-informatics in e-Governance, the National Centre of Geo-Informatics (NCoG) of the Ministry of Electronics and Information Technology has been established to promote "geo-informatics" technology, through its "GIS based e-Governance Process". Geomatics Solutions in Indian agriculture are likely to bring digital disruption by providing farmers what they want in a personalised way.

7. Utilization of ICTs to Adaptation of Climate Change Affect in Agriculture

India is one of the few countries in the world that uses space technology and land based observations for generating regular updates on crop production statistics and providing inputs to achieve sustainable agriculture. In particular, remote sensing is helping in getting information about crop area, crop condition, crop yield, water and nutrient stress, crop parameters, such as



leaf area index, biomass, phenology; soil physico-chemical properties, soil degradation, soil moisture; water spread, water bodies, water quality, etc. These applications show the preparedness of the country to anticipate and act upon the climate variability and its adverse impact on agriculture.

Starting from the coconut root wilt experiment of 1969, where airborne colour infrared cameras were used for detecting the coconut root wilt disease in the State of Kerala, Indian Remote Sensing programme has made tremendous progress. The Indian Space Research Organization (ISRO) has strong remote sensing capabilities that are useful for various applications in the fields of Agriculture, Soils, Fisheries, Livestock, Water, and Weather forecast advisories, matching with international standards & trends. Unmanned Aerial Vehicle (UAV) utility is rapidly maturing, and India stands to benefit tremendously from this technology to support smallholder farmers and their migration to India's own version of precision agriculture.

Satellite data and GIS and image processing technologies are being used in various domains of agriculture, as given below:

- Forecasting Agricultural output using Space, Agro-Meteorology & Land based observations (**FASAL**) – provides the multiple pre-harvest production forecasts of 8 major crops at District/State/National Level.
- National Agricultural Drought Assessment & Monitoring System (**NADAMS**) provides the periodic agricultural drought assessment for 14 Major States.
- Coordinated Horticulture Assessment and Management using geo-iNformatics (**CHAMAN**) helps in area & production estimation of 7 horticultural crops in 12 states.
- Crop Insurance using Space technology and geo-iNformatics (**KISAN**) explores the use of remote sensing in assessment of crop yield.

National Remote Sensing Centre (NRSC) in association with the Government Departments has undertaken geo-tagging of agricultural resources assets for effective monitoring and utilization. This facilitates “Farmer-centric” and “Farm-centric” advisory services.

8. Access to Market Information through ICT

Clearly the shift has happened in the last couple of years from Internet based interventions to mobile app based interventions. For example; An Agritech startup- *NaPanta* facilitates farmers to book agri-equipment rentals and sales from their own farmland. The market place also helps the farmers to sell their farm produce to their customers without any middlemen with their choice of pricing. By using this free mobile app, a farmer can access real-time and dynamic information pertaining to daily Market Prices of 3500+ Markets and 300+ Agri commodities along with 3-year price trend with a simple mobile



internet connection. The digital initiative e-Choupal of ITC Limited, tried to link directly with rural farmers via the Internet for procurement of agricultural and aquaculture products like soybeans, wheat, coffee, and prawns. 'e-Choupal' tried to eliminate intermediation and multiple handling and reduce transaction costs.

The e-Krishi is a novel ICT initiative in the sphere of agricultural trade implemented by the Kerala State Information Technology Mission (KSITM). The project is piggybacked on the existing resources of Akshaya e-kendras for providing the services. Sellers (farmers) and buyers (merchants) register through nearest Akshaya Centre or log on to www.e-krishi.org, post the materials for selling/buying, post and view advertisements and virtual meeting of buyer and sellers through the web and effect transaction. A Toll Free Call Centre help farmers and buyers in solving trade related doubts, provides details on good agricultural practices including local weather.

In April 2016, Government of India launched eNAM (National Agriculture Market), an online platform for farmers that integrates agricultural markets online, allowing farmers and traders alike to view all Agriculture Produce Market Committee-related information and services, commodity arrivals and prices, and buy and sell trade offers, thus helping farmers bid for the best prices across markets. GOI also launched a crop insurance scheme, the *Pradhan Mantri Fasal Bima Yojana* (PMFBY) in 2016, which now covers 37 million farmers.

e-NAM could be a disruptive force in India provided it gets integrated with other systems like Amazon (Amazonization). Other Complementary systems that are required include aggregators, transport, payment gateway, traceability, quality assessments etc., Virtual pooling (that was tried to some extent in ITC's e-choupal in India) will help pool the marketable surplus of farmers with proximity who wish to market in distant markets.

Digitised land registration, mobile phones and 'Uberised' tractor services all are contributing to improved farm management. Digital India Land Records Modernisation Programme (DILRMP) is updating millions of land records, providing title guarantees and increased security of land tenure to farmers while stimulating land rentals by non-viable smallholders and land consolidation. Seamless integration of different nutrient management, diagnostic, pest surveillance platforms developed by ICAR with Aadhar enabled Fertilizer Distribution System (of DAC under NeGPA 2.0) will bring precision agriculture to the door step of farmers.

9. Best Practices in use of ICTs in Agriculture Extension

India is a hub of digital experiments and private sector played an important role in reaching the unreached with advanced digital strategies. Initial pilots such as Warana Wired Village project (Maharashtra), iKisanproject of the



Nagarjuna group of companies (Andhra Pradesh), Krishiworld.net (one of the earliest agricultural portal) etc., have demonstrated the benefits of ICTs in agricultural development.

Krushik Mobile App:

The KRUSHIK Mobile App is developed by Agricultural Development Trust's KVK Baramati during 2016 in Marathi language. It can be downloaded from Google Play Store with Android version. It provides information on Seeds, Fertilizers, Market prices, Weather forecasting etc. The main features of app are Tehsil based weather forecast for next 7 days, Agricultural related news, Agro advisory viz. Crop, Animal Husbandry, Poultry, Goatry, Weather Advisory, Market rates of different commodities, Agricultural related Training programs, Calculator to calculate Drip design, Calculator to calculate Seedling & Seed requirement for a particular area, Calculator to calculate Animal feed, Soil calculator, Articles & Success stories of farmers etc. Queries send by user is replied which went to his account and notification is also sent to his account. A total 47590 users visited and used information till date and number of users/days are 5800.

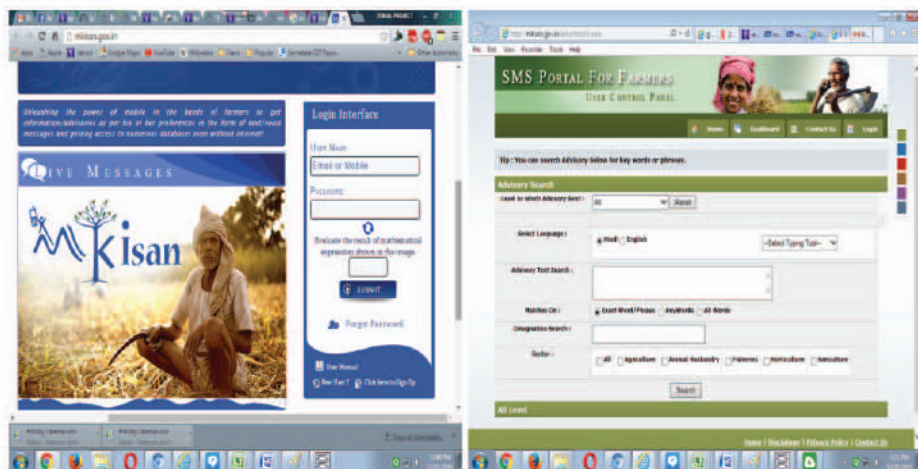


Kisan Mobile Advisory Service (KMAS):

As a major pillar of Research-Extension-Farmer linkage, the KVKs are using majority ICTs in every activity of it is involved i.e. from getting information from research institute, validating at farmers field to disseminating it to the large number of farming community. One of the most striking examples of it is Kissan Mobile Advisory Services. As a part of application of ICTs in KVK system, Kisan Mobile Advisory Service (KMAS) was initiated by the ICAR during 2010-11 to provide timely and need-based information to farming



community. During 2017-18, 90,532 short text & voice messages were sent to 627.23 lakh farmers by 632 KVKs on various aspects of agriculture, horticulture and animal husbandry, weather forecast and pest and disease control.



KVK Portal:

It is an exclusive portal - <http://kvk.icar.gov.in> - for the existing Krishi Vigyan Kendras (KVKs) which are established in rural districts of the country to have direct interface with farmers. There are 705 KVKs in the country. Each KVK has direct interface with at least 1000 farmers. Accessibility multiplied many times with the launch of this portal. It works as a platform to provide information and advisory to farmers on real-time basis. Weather and market-related information can also be accessed by the farmers and others through this portal. Earlier the information related to KVK was not available at one place at the national level, the farmers and other stakeholders had difficulty in accessing the information. Also, there was no online monitoring system to review and monitor the functioning of KVKs against their mandates and objectives. "This portal provides a platform to share information and advisory to farmers and facilitate online monitoring of the KVK activities." Technology assessment and demonstration for its application and capacity development are key mandates of the KVK. In addition, the KVK produces quality technological products (seed, planting material, bio-agents, livestock) and make it available to farmers, organize frontline extension activities, identify and document selected farm innovations and converge with ongoing schemes and programmes within the mandate of KVK. The portal provides provisions for online monitoring of KVKs which include reporting of major events on regular basis and submission of monthly reports online. The portal also



provides information on different services being provided by different KVKs. The forthcoming programmes are also made available on the website which will benefit farmers and youth in joining different training programmes being organized by KVKs. Question and answer facility is available for the farmers. Agriculture related information of the districts is available on the portal. The farmers and the Agricultural Officers may register themselves and seek different information related to KVKs.



AQUA e-Agriservice, implemented at KVK Pune, is a problem-solving system dedicated to find solutions to problems posted. Anyone can pose a question and can be answered by anyone. The answers from public extension experts are marked with Green Colour Logo Salahagar /Advisor/Expert. The services are free to users. Questions related to 15732 topics through 41451 posts have been raised by 25316 members till December 2017.

Village Knowledge Centre (VKC), conceived by MS Swaminathan Research Foundation (MSSRF) in 1988 rendered distant services from a single window point to rural masses. The knowledge centres were connected to a central studio using technologies viz WiMax/VSAT/leased line. The MSSRF also initiated the Rural Knowledge Centres (RKC)s in 2007-08 to tone up the efficiency of Administration in the Islands of Andaman and Nicobar.

The VKC of Union Bank of India – first established in 2005, has 211 such centres across India. Each VKC is manned by an operator helping farmers to access latest information/ knowledge available in the field of agriculture, starting from crop production to marketing.

The Indian Space Research Organization (ISRO) launched the Village Resource Centres (VRCs) programme in association with NGOs/ Trusts and



state/ central agencies to provide the space based services directly to the rural areas. The 461 VRCs set up in 22 States/Union Territories include 81 Expert Centres through which over 6500 programmes have been conducted. Over five Lakhs people have used VRC services.

As a part of application of ICTs in ICAR Krishi Vigan Kendras (KVK) system, Kisan Mobile Advisory Service (KMAS) was initiated during 2010-11. During 2017-18, 90,532 short text & voice messages were sent to 627.23 lakh farmers by 632 KVKs on various aspects of agriculture, horticulture and animal husbandry, weather forecast and pest and disease control (DARE Annual Report 2017-18). Various KVKs are electronically connected through Local and Wide Area Networks. These provide opportunity to share recent research developments in agriculture and allied sectors. It also helps in sharing of information, farm advisory services, etc.

10. Policy and Institutional Strength for use of ICTs in Agriculture

In May 2000, the Parliament of India passed the Information Technology Bill, now known as the Information Technology Law in India. In July 2001, a set of laws known as the Information Technology (Certifying Authority) Regulations, 2001 were issued by the Government of India. These regulations detail the functioning of the certifying authorities in issuing digital signatures. Under Indian Law, computer programs have copyright protection, but no patent protection. A software program is an algorithm in Indian Copyright Act.

The National Policy on IT seeks to achieve the twin goals of bringing the full power of ICT within the reach of the whole of India and harnessing the capability and human resources of the whole of India to enable India to emerge as the Global Hub and Destination for IT and ITES Services by 2020. The Policy aims at attaining these objectives through coordinated action on the part of both the Central and State governments. This goal is made possible through ubiquitous network connectivity based on mobile technology, broadband Internet, fiber penetration to all villages, high-technology and low-cost affordable devices and software solutions which enable electronic access to services including e-payments. The IT policy also aims at promoting innovation and R&D in cutting edge technologies and development of applications and solutions. The Government of India is creating an ecosystem for Internet and mobile driven service industry through leveraging internet and web technologies for developing new products, technologies and businesses, enable seamless, ubiquitous, secure and personalized delivery of government and non-government services through Internet based and mobile based delivery of services throughout the country and promote development of an ecosystem for enabling innovation and entrepreneurship.



Kerala: Government of Kerala announced its first IT Policy in 1998. It was followed by the IT Policies in 2001 and 2007, which provided comprehensive support for the further development of this sector. The vision of the State's IT Policy is to "plan, develop and market the state as the most preferred IT/ITES investment/business destination in India." It aims to utilize ICT for the effective, transparent and efficient delivery of services to the citizens and to make the state of Kerala a 100 percent e-literate and digital. Some of the Policy initiatives include **E-waste** (disposal of obsolete IT equipments in accordance with e-waste management rules of GoI), **New Technologies** (cloud computing, wireless technologies and next generation networks), **Data sharing** (sharing of data across departments to establish a connected government and thereby providing citizens with hassle free services), **Social Media** (Government departments/organizations will have an active presence in the social media and a social media guideline will be put in place), **Inclusiveness** (Government web content shall be made accessible to the differently-abled by complying with the WCAG 2.0 Level AA), **Malayalam computing** (Government websites in Malayalam and shall adopt Unicode characters) and **Data Security** (highest level of security and privacy of citizen data).

Bihar: Under E-Government Interoperability Framework and Open Standards, the state is developing an interoperability framework and IT standards uniformly across the state, so that these standards are not hardware-centric and vendor dependent. Under Bihar Knowledge Society initiative, 5 IT Training centres in each district impart computer literacy and other short-term (6 months) certificate courses for training the unemployed educated youth in various IT skills in PPP Mode. Extensive adoption of M-Governance by State Govt. Departments for making all G2G, G2C and C2G transaction information real time so as to facilitate instant citizen services through SMS in Automatic, Anywhere – Anytime – Anyone mode. Pilot projects on use of IT in rural development in areas like development marketing and popularization of IT for rural applications are in the pipeline.

11. Challenges of Application of ICTs in Rural Agriculture

ICTs alone can't bring about rural development. Education is one of the basic problems for application of ICT. All modern economies have demonstrated in the past that education is the first step to building the capacity which people can then use. Therefore, introducing ICTs alone will not meet the development challenge. For ICTs to succeed in India, education for all must be the first priority. It is, of course, important to note that the proportion of the economy involved in some or other form of adaptation or usage of ICT is still very small. The proportion of people involved in the ICT Industry, especially in the rural areas is negligible. Thus, another priority action, in order for the benefits of ICT to trickle down as well as contribute to the rural



prosperity, would involve setting up several rural and village level micro-enterprises. The basic challenges that usage of ICT for rural development faces are as follows:

- Illiteracy amongst the vast multitude of people.
- Major power-cuts and 'brown-outs' affecting the country-side ranging from 5 to 12 hours each day. Even though uninterrupted power supply systems are used; yet they prove insufficient to cope up with the power breakdowns.
- Serious band-width issues and connectivity problems. Even though technology is available to upgrade the band-width; not enough resources have been budgeted by the Government to change this scenario. However, once a few projects for the upgradation of the band-width on the anvil get commissioned, there should be a significant improvement in the connectivity.
- Financing difficulties encountered by the local grass root level institutions as well as by the state governments. Drastic steps are needed to inject funds for the development of the ICTs in the rural areas; increasingly by the participation of the private sector.
- Acute shortage of project leaders and guides who could ensure implementation of the ICTs at the grass root levels. Unfortunately, most professionals want to work in the urban areas where there are ample opportunities available to them for growth as well as prosperity. In the absence of these 'techno-catalytic' resources; development of ICTs in the rural areas will always be very slow.
- Technical illiteracy: There is need of technical literacy as well as literacy in India; there is a connection between education level and use of electronic means or Internet. This is a major drawback in which the users are not technically literate to use the technology.
- Poverty: Accessing the Internet is a costly issue for necessary communications in the form of installing the required telephone lines needed for internet or email access is similarly too exclusive in developing country.
- Limited citizens' awareness: There is lack of awareness concerning advantages of E-Governance as well as the process mixed up in executing successful G-C, G-G and G-B projects.
- Infrastructure: There is a shortage of required infrastructure like electricity, internet technology and methods of communications will influence the speed.
- Discrimination: There is too much dissimilarity in fast access to public sector services between various divisions of citizens, mainly among



urban and rural communities, among the educated and illiterate, and among the rich and poor.

- **Cost:** Cost is one of the most important exclusive factors that arrive in the path of e-governance success mainly in the developing Country India where majority of the people are living under the poverty line. They do not have the funds for the operating expense of telephone line, internet connections, etc.
- **Hesitate to revolutionize:** People are disinclined to change. As e-governance means transform of the system from manual to computerize based, it is generally disliked by the employees and the general public.
- **Speed:** On the time of internet accessing, speed plays an important role. But due to infrastructure, there are the major dissimilarities between the rural and urban areas; as such the speed of internet connectivity is not same all over India.
- **Lack of Participations of Society, Public and Private Sectors.** Designing of any application requires a very close interaction between the govt. department and the agency developing the solutions.
- **Privacy and Security:** There will be three basic levels of access for e-government stakeholders: no access to a Web service; limited access to a Web-service or full-access to a Web service, however when personal sensitive data exists, the formation of the security access policy is a much more complex process with legal consideration. On the time of execution of e-government projects successful procedures must be taken to guard receptive private information. A lack of comprehensive security standards and protocols can limit the development of projects that contain sensitive information.
- **Language Dominance:** The dominance of English on the internet bounds the access of non-English-speaking population. In the case of India, mostly population does speak Hindi. Due to such irresistible domination of English over these communication channels, computers and the internet are relatively useless in Indian villages' populations.
- **Trust:** The implementation of public administration functions via e-government requires the presence of two levels of trust. The first is that the user must be confident, comfortable and trusting of the tool or technology with which they interact. The second dimension of trust pertains to trust of the government. There has to be a balance between ensuring that a system prevents fraudulent transactions and the burden that extensive checks can take placed on people who are honest.



Potential Applications of ICTs in Rural Agriculture:

Some of the Potential Application of ICTs in Rural Agriculture are Stated hereunder :

- Online services for information, education and training, monitoring and consultation, diagnosis and monitoring, and transaction and processing;
- E-commerce for direct linkages between local producers, traders, retailers and suppliers;
- The facilitation of interaction among researchers, extension (knowledge)workers, and farmers;
- Question-and-answer services where experts respond to queries on specialized subjects modern media services to block- and district-level developmental officials for greater efficiency in delivering services for overall agricultural development;
- Up-to-date information, supplied to farmers as early as possible, about subjects such as packages of practices, market information, weather forecasting, input supplies, credit availability, etc.;
- Creation of databases with details of the resources of local villages and villagers, site-specific information systems, expert systems, etc.;
- Provision of early warning systems about disease/ pest problems, information regarding rural development programmes and crop insurances, postharvest technology, etc.;
- Facilitation of land records and online registration services;
- Improved marketing of milk and milk products;
- Services providing information to farmers regarding farm business and management;
- Increased efficiency and productivity of cooperative societies through the computer communication network and the latest database technology;
- Tele-education for farmers;
- Websites established by KVKs & agricultural research institutes, making the latest information available to extension (knowledge) workers and obtaining their feedback.

Utilization of Radio and Video

Radio is still the only medium for disseminating information rapidly to large and remote audiences, including critical information about markets, weather, crops, livestock production, and natural resource protection. Video has also made substantial impact in convincing farmers to try new technologies; its images and demonstrations make information easier to understand and apply.



Radio overcomes some of the most Challenging Issues related to using ICT in Advisory Services:

- I. **Accessibility:** Radios are relatively cheap to produce and distribute and do not need electricity or special skills to operate. They can also be shared by groups of listeners. It should be mentioned, however, that a key challenge to reaching female farmers through radio is ownership. Often men own the radio and choose the programs to listen to, which may not be relevant for women farmers. Although ensuring women's access to radios in the household may not be so easy, radio programs should target women.
- II. **Literacy and language barriers:** Radio requires no reading and speaks the language of the community it intends to reach.
- III. **Geographic coverage:** Radio can easily and simultaneously reach large numbers of isolated communities over vast geographic areas.
- IV. **Local focus:** Radio can focus on local issues in local languages. The United Nations Development Programme notes that in Latin America, for example, most radio programs are locally or nationally produced, whereas only 30 percent of television programming comes from the region.

Like radio, video has the advantage of attracting people's curiosity, and it appears to be an especially convincing medium when it captures familiar people or situations. Advances in ICT have made video much easier and less costly to produce and disseminate. Like radio, video does not demand literacy, and it suits the narrative culture that prevails in most developing countries. Use of video in small groups, like the one promoted by Digital Green, can foster social cohesion in agricultural communities.

Role of Extension Organizations

Brokering between communication technologies, providers of those technologies and services, and the client groups they serve, is one of the key roles of extension organization. Extension organizations must examine the appropriateness of various ICTs; the accessibility of ICTs in rural and remote areas, how best to reconcile costs and benefits, and how to insure that ICT access includes a diversity of cultures, languages, social strata, and age groups, and is gender sensitive. The extension organizations must understand the specific actors who play (or should play) a role in establishing basic telecommunication services in rural areas. The actors in basic telecommunication services are as follows:

- telecommunications service providers (also known as operators);
- regulators and policy-makers;
- telecommunications policy reform advocates;



- rural clients (current and potential);
- “Last Mile” entrepreneurs – phone shop operators and cyber cafe/ tele-centre operators;
- extension managers and other professionals who deliver rural services.

Robotics & IOT

The Information Technology Research Academy (ITRA), Hyderabad set up by the Ministry of Electronics and Information Technology, had identified various areas for research purpose in respect of robotics, sensors, interpretation and use of sensor data in consultation with the Indian Council of Agricultural Research (ICAR),. The Indian Agriculture Research Institute (IARI), New Delhi is working on a collaborative research project entitled “**SENSAGRI: SENSOR based Smart Agriculture**” involving six partner institutes under the ITRA Project Funding, to develop indigenous prototype for Drone based crop and soil health monitoring system using Hyperspectral Remote Sensing (HRS) sensors, so as to be integrated with satellite-based technologies for large scale applications. Such joint research efforts are recommended, to be undertaken and completed as per timelines.

Seamless integration and exponential thinking is required for bringing digital disruption in Indian agriculture. The basic principles to realize digital disruption in agricultural organizations are mentioned as follows:

- 1) Engaging farmers and providing them with retail like experience.
- 2) Empowering extension professionals to take up the challenges. Encouraging them to enjoy flexibility in terms of tasks and making them aware that they are judged by the outcomes/ impacts.
- 3) Optimising the organizations with available digital start-ups, collaborations and partnerships. Recognizing the role of plurality in digital strategies and their complementarity is essential.
- 4) Transforming Extension Advisory Services with structural and functional adjustments along with focus on collective action. The conventional job chart of extension professionals will undergo rapid changes.

To realise the digital disruption in Indian agriculture we need to create avenues for redesigning the processes (workflows and frameworks), stimulate new thinking (capturing innovations and start-ups within the system) and include crowd sourced research & development innovations (allowing partnerships and local redesigning to certain extent).

For redesigning the extension processes, the national systems may draw lessons from the digital start-ups under four categories i.e. precision agriculture, financial inclusion, data-driven agriculture and digital knowledge sharing /delivery.



In order to exploit the possibilities, countries have to empower poor farmers with digital services that will increase their productivity and incomes and to harness digital strategies effectively to compete in complex, rapidly changing global markets. Accomplishing these tasks requires the implementation of a complex set of policy, investment, innovation, and capacity-building measures.

12. Recommendation for Policy, Research and Extension Services

Artificial Intelligence (AI) has to play an important role for smart agriculture and providing solutions to farmers, therefore, more professionals are needed in the sector with more investment. Collaboration with developed countries for cutting-edge technologies in Artificial Intelligence for developing simulation models, tackling climate change, marketing, pest management, etc., is needed.

Many extension workers and farmers are shy of modern ICTs, hence, capacity development at various levels is required. A lot of information is generated in agriculture and placed at various platforms by public and private organizations. For “One Stop Solution” it needs to be placed at one platform. Participation of society, public and private sectors should be ensured for developing need based apps in local language. The local government bodies (like village Panchayat) could be made a focal point for technology sharing with needed infrastructural facilities. The telecom companies must ensure net connectivity with high speed in rural areas which requires more investment. The successful ICT models at national and regional level may be up-scaled. It has been observed that a lot of information is shared through social media which needs proper regulation mechanism for content monitoring. A comprehensive security standards and protocols is required for the development of projects having sensitive information.

13. Conclusions

ICTs continue to gain popularity and offer unique opportunities to share information among large number of farmers and other stakeholders. While not a panacea for all of the problems facing extension, the integration of ICTs as a communication channel potentially reaching millions of farmers and as an enabler of change is considered a critical part of future reform and investment agendas. Using ICT to achieve agricultural development goals requires supplementary investments, resources, and strategies. The attractiveness of the newest ICTs can lead to a preference for the latest technologies at the expense of older technologies (such as radio), yet the newest, most elaborate, or most innovative technology is not automatically the most appropriate one. An innovative mix of technologies, for instance, radio programs with a call-in or SMS facility for feedback can also be a cost-effective solution.



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Chapter Five

ICTs for Development of Rural Agriculture in Nepal: Policy Concerns

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Abstract

Adoption of improved technology, good agricultural practices and transformation of market information to the farming communities and all actors in food chain are essential for increasing production and reducing the import of food. This amplifies the scope of information and communication technologies (ICTs) in agriculture and there is no doubt that ICT can play a crucial role in increasing production and income of farmers. Nepal has got incredible success in digital adoption compared to its neighbors, with mobile penetration exceeding 100% and internet penetration reaching 60%. There is plethora of ICT applications being used in agriculture sector in Nepal, such as agriculture information portals, mobile apps, Kisan Call Centers (KCC), Village Knowledge Center (VKC), mobile SMS Services, YouTube, and Facebook which are the landmark in ICT in agriculture. Agriculture Information and Communication Center (AITC) has been producing Radio and Television programs which discusses about issues on agriculture and provides expert services to the farmers. AITC, through its Toll free phone in KCC, provides information about agriculture. Agriculture Management and Information System (AMIS) is working to increase the access of farmers to mobile application. However, there is a need for concrete improvement in the area of ICT use in rural agriculture that helps promote adoption of improved technology, increase production and income and contribute to the sustainable livelihoods of rural people. While internet penetration in Nepal has risen sharply in the past few years, a large section of Nepali people still remains digitally disconnected due to less affordability, access to, and digital illiteracy. To overcome this problem, high degree of emphasis on speed connectivity, educate ICT users through trainings and affordable internet access is necessary. Furthermore, Government of Nepal needs to focus on priority areas to create an enabling environment for the success of ICT initiatives. However, implementation and sustainability is a challenging issue. The success depends on a high degree of willingness on implementation of ICTs on daily life.



1. Introduction

Nepal's overall economy is dominated by agriculture sector, which holds great promise for reducing undernourishment and providing the livelihoods of two-thirds of the country's population. With a steady growth in GDP (around 4-5%) during 2010-2015, a massive earthquake in April 2015 significantly impacted the country's economic development and dropped the GDP growth to 0.6% in 2015-2016 (MOF, 2017). However, in 2016-17, GDP growth picked up significantly to 7.5% because of good agricultural harvest and many other factors (MOF, 2017). As Nepal is said to be one of the LDCs and low-income countries, low economic growth rates is a cause of concern. It is expected, for Nepal, to embark on its journey to high economic growth to achieve developing country status by 2022 and middle-income country status by 2030 (Digital Nepal Framework, 2018). Agriculture plays a vital role to achieve this goal, providing a livelihood for almost two-thirds of the population and accounting for almost one-third of GDP.

The variation in the geographical structure of Nepal, ranged from plain Terai to high mountain --Himalayas, gifted grant potentialities of agricultural production system and crop diversification. Despite having these enticing features, Nepal has not been able to tap its growth potential due to prolonged political uncertainty. In this connection, increasing productivity and incomes of the rural farmers is the key to success, and for this, enhancing the ability of farming communities to connect with knowledge banks, networks and institutions via information and communication technologies (ICTs) are the prerequisites. In this journey, individuals, public enterprises and the private sectors all have important roles to play. Because of newly developed technologies, agriculture sector is increasingly becoming knowledge-intensive, and the availability of the right information, at the right time, in the right format, and through the right medium, influences and affects the agricultural productivity, income and livelihoods of many stakeholders involved in agriculture.

Talking about ICTs, we first need to understand what it is and how does it work mainly in agriculture sector. ICT is defined as "diverse set of technological tools and resources used to communicate, and to create, disseminate, store and manage information. ICT can deliver useful information to farmers on crop care, fertilizers, seed resource, market price, thereby reducing associated risks and uncertainties due to climatic variability, fluctuation in the price and availability of input materials required for farming. ICT play an important role in addressing these challenges in agriculture and uplifting the livelihood of rural poor. It has been the base for improving agriculture to enhance productivity and ensure food security. Wireless technologies, global position system(GPS), geographic information system(GIS), computer controlled automated system such as agricultural robots and automatic milking, software technologies, smart phone mobile



application, Radio Frequency Identification (RFID) technology are some of the ICTs used in agriculture. ICT in agriculture is an emerging field in developing countries and should be materialized by incorporating in national development plan and policies. Nepal, being an agricultural country, seems to be far away from these technologies. So, ICT could be a prerequisite for the nation but the farmers of the country are almost deprived from it. The sad part is that, agricultural student who are the future of agriculture are also deprived about the knowledge and use of this technologies.

ICTs help in collecting and sharing timely and accurate information on weather, inputs, markets, and prices; by feeding information into research and development initiatives; by disseminating knowledge to farmers; by connecting producers and consumers, and through many other avenues (FAO, 2017). Identifying opportunities to maximize the market potential, action should be taken along with agro-entrepreneurs, buyers, suppliers, financial service providers, and farmers. This should help pave a path in innovative ways to improve efficiency and maximize productivity in Nepalese agriculture.

2. Current Status on Application of ICTs in Rural Agriculture in Nepal

ICT in agriculture is an emerging field through which agricultural productivity and incomes of the farmers can substantially be increased. Feeding ever increasing population also requires to increase the productivity and food production. In Nepal, where agriculture sector contributes almost 27.6 % to the national GDP, a large part of population is still living in food deficit condition, and the country has to import huge portion of the food (MOALD, 2017). Also, the food crop area has been declined by 2.1 % because of climate change event such as dry land slide and flood during 2017-18 (MOF, 2018). This amplifies the scope of ICT in agriculture and there is no doubt that ICT can play a crucial role in increasing production and income of farmers. ICT helps disseminate innovation and modern technology and lift the farming at a new level. New technological advancement and increased accessibility of ICTs have made easier to adopt such technology and practices. Furthermore, wide coverage and expansion of telecommunication and internet service (as shown in Fig. 1) in the country makes this adoption even faster and better (NTA, 2017).



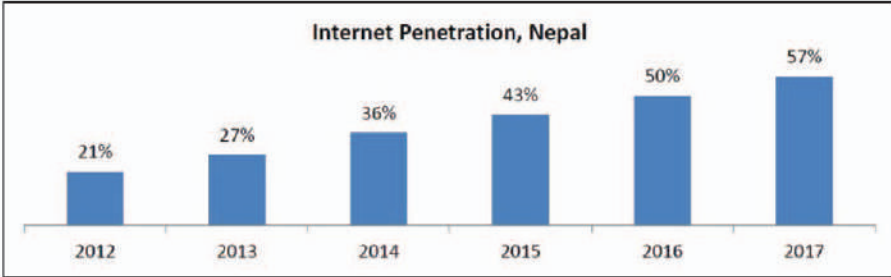


Figure 1: Percentage growth of internet penetration in Nepal over time (Digital Nepal Framework, 2018)

Mobile services industry in Nepal has witnessed significant growth over the last 4-5 years. The mobile penetration has grown exponentially in the last decade to reach 113% in 2017 from 21% in 2009 (Fig. 2). Nepal has enjoyed incredible success in digital adoption compared to its neighbors, with mobile penetration exceeding 100% and Internet penetration reaching 60% (NTA, 2017). The growing popularity of social media is a crucial driver for internet adoption in Nepal, coming second only to Bhutan in South Asia in social media penetration (NTA, 2017).

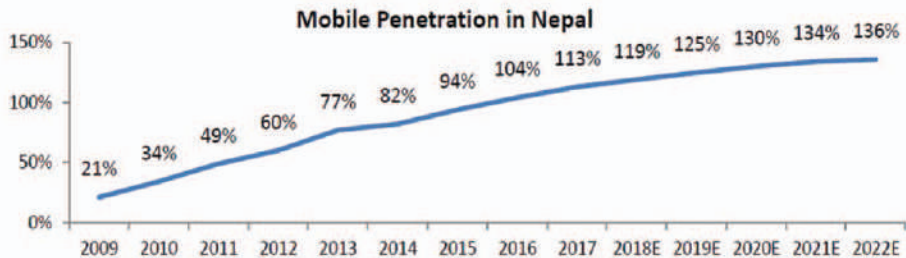


Figure 2: Percentage growth of mobile penetration in Nepal over time (Digital Nepal, 2018)

ICTs interventions, with varied degrees of successes, help rural farmers improve their livelihoods through increased agricultural productivity and incomes, and reduction of risks. There is plethora of ICT applications on agriculture, ranging from using radio to satellite remote sensing. In Nepal, different agriculture information portals (<http://www.namis.gov.np/>), mobile apps – 'HamroKrishi', 'Smart Krishi', IFA krishi, Yuba Krishi. 'Kisan Call Centers', 'Village Knowledge Center', mobile SMS Services, YouTube, Facebook are the landmark in ICTs in agriculture.

AITC has been producing Radio and TV programs which discusses about issues on agriculture and provides expert services to the farmers. AITC, through its Toll free number (16600195000) in 'Kishan Call Center'



(established in March 2015), provides information about agriculture and livestock. The average number of services provided through KCC per day is 15. KCC is to manage the queries raised by farmers effectively, efficiently and instantly. The center is providing production practices, insect pest management, and market information from experts on every Sunday, Tuesday and Thursday, particularly in daytime. Project for Agriculture Commercialization (PACT) and Agriculture Management Information System (AMIS) under MOALD and other governmental organization are working to increase the access of farmers to mobile application (AITC, 2018). As a result, role of ICTs in agriculture becomes crucial particularly in bridging critical information and knowledge gap.

To create favorable environment for the IT sector more reliable and accessible to all people, Government of Nepal has prepared Telecommunication Policy 2004, with its implementation bodies, organizations and communities at various level. High Level Commission for Information Technology (HLCIT) is the one of the largest key institutions formed by Government of Nepal to provide crucial oversight and policy guidance for the development of ICT sector in the country, National Information Technology Center (NITC), Computer Association of Nepal (CAN), IT Professional Forum (ITPF), ISP Association of Nepal, and other Business Associations have driven the country towards the use of ICT in economic development. Although political, economic, social and technological challenges are available in our country. Today, Government is willing to decentralize the responsibilities and processes throughout the system called e-government.

3. The Role of Mobile Technology in e-Agriculture

Mobile technology makes easier the access to information, and creates opportunities to share among farmers and stakeholders. Information on market price, weather condition, direct contact to brokers and middlemen to sell produce, compare the price of nearby markets are the major benefits provided by mobile technology. The high rate of mobile phone penetration in Nepal during the last decade has exceeded 100%, and is still growing (Fig. 2). This helps use other social media such as Facebook, YouTube, video share etc. among young and educated farmers. Farmers use their mobile phones to call the Farmers' Call Centers, and talk to experts directly which is very effective way of information and technology dissemination.

Farmers call center is one of the effective tools/approaches through which real time problems are solved immediately in a two-way interaction between farmers and subject matter specialist over the phone call. Such methods have been effective in disseminating agricultural information to rural farmers in developing countries. However, very less development and practices have been followed in Nepal about the use of ICTs in extension service delivery



system effectively. Currently, telecenter (both government projects and private initiatives) are functioning in many places in Nepal and seem effective to transfer information over the phone calls.

Through a mobile-based service, farmers can now receive localized weather updates and pest/ disease outbreak alerts, which has enabled them to time their planting and apply inputs better. They can also receive updates on market prices and contact buyers directly when they harvest their products so they are no longer entirely at the mercy of intermediaries. For example, Pilot Program for Climate Resilience (PPCR) in Nepal under the ministry of Agriculture and Livestock Development (MOALD) has developed an information portal -- National Agriculture Management Information System (NAMIS), -- and web portal of Kalimati Fruits and Vegetables Market Development Board provide updated agriculture and market information. Similarly, many local FM Radio, National Radio (Radio Nepal), private and government Television channels (Nepal Television - NTV) broadcast price information on daily basis. These information can also be assessed on mobile phones. AITC's Radio and Television program, documentaries are on its mobile apps and online where farmers can listen or watch on their mobile phones easily while connected to internet. To further strengthen the use of mobile phones as an ICT tool, linking with finance institution and do transaction by phone, premium for indexed based insurance can be paid through phone.

However, there are some challenges such as infrastructural constraints, credit constraints and less risk bearing capacity. To overcome these problems, there is a need for increased public and private investments and policy changes for attracting private sector investment in this sector. This would enable farmers take information based decision making using a combination of GPS and mobile mapping for more informed crop management decisions. Increased extension services and capacity building efforts can complement information dissemination via mobile phones and associated services to accelerate the adoption of new techniques.

4. Rural Access and Exchanges Mechanisms: Connectivity and Telecentres

Connecting people digitally in the rural areas is the main challenge in developing countries. It is important to connect a large section of people who remains digitally unconnected. In connection with sharply risen internet penetration in Nepal, there is a greater need to provide broader access to connectivity using various approaches or model such as public-private-partnership (PPP) model. One of the major benefits of such connectivity is the availability of high speed internet and access to weather information, geographical data and market information. Broadband internet access and use of mobile phones has seen as a reliable source of rural connectivity. The



quality of broadband access is the main issues however. Some wireless technologies such as WiMAX are being used in some rural areas. In Nepal, CIMMYT, CEPREAD, IRRI has supported to set-up tele-centres in remote areas through which, on an average, five to seven thousand farmers are benefited per year per tele-center by receiving the solution to their problems over the phone calls. This can be replicated and up scaled at national level by various organizations.

5. Impact of ICTs on Agriculture and Livelihood

ICTs play an important role in addressing the challenges faced by farmers in the developing countries. In this paper, we try to explore the potential impacts of ICTs to the livelihoods of small-scale farmers and the efficiency of the agricultural sector in developing countries, including Nepal. Agricultural productivity is fairly low in Nepal as compared to other South Asian countries. Increasing the efficiency, productivity and sustainability of small-scale farms is an area where ICT can make a significant contribution. Associated risk and uncertainties can be minimized by using information from ICTs about pest and disease control, especially early warning systems, new varieties, new ways to optimize production and regulations for quality control.

Assessing Markets and Value Chain

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 (IICD, 2007). Based on the information received from ICT tools, farmers make decisions about future crops and commodities and the best time and place to sell and buy goods. In Nepal, government has started an e-Portal of agriculture information system that offers farmers more relevant information (i.e. local selling/buying and price information system). Kalimati Fruits and Vegetables Market Development Board of the Government of Nepal displays daily wholesale and retail price of different fruits and vegetables on its websites (<http://kalimatimarket.gov.np/home/language/EN>), broadcast from national Radio, mobile phones, local FM Radios and Television channels. However, the sustainability of these systems requires special attention. The involvement of local farmers' organization, cooperatives, producer groups and private sector can play role for its sustainability. SMART KRISHI, IFA KRISHI, KRISHI GHAR are Mobile apps developed and operated by private sectors with public sector partnership/cooperation.

Capacity Building and Empowerment

ICTs help strengthen communities and farmers organizations (FOs) capacities to interact with other stakeholders and negotiating power for input/output price, resources and information rights. It widens the perspective



of local communities and opens up new business opportunities. Transaction become more efficient and transparent, and information are accessible to other members within the organization. GPS/GIS systems help digitize land records, document all the operations/activities of the farm. With the help of mobile banking, transaction and other associated costs are reduced, and simulate the local trade.

Impact on GDP growth is also realized by the extensive use of ICT on agricultural extension and production system in Nepal. Figure 3 shows the increasing trend on the GDP growth by year which indicates the importance of ICT in agriculture sector.



Figure 3: Percentage growth in GDP and digital impact over time (Frost and Sullivan, 2018)

6. Utilization of ICTs to Adaptation of Climate Change Affect in Agriculture

The impact of climate change scenario in Nepal seems to be visible in many areas including agriculture and livestock sector. Fluctuation in temperature (low and high), erratic rain fall (pattern and distribution), drought, floods etc. are the witness of climatic aberration leading to series of problems in agriculture sector. In order to overcome this alarming situation of climate change, mitigation and adaptation alternatives are generally practiced. This requires effective and timely delivery of information and exchange mechanism. Thus, ICT can be used to disseminate the information in multifarious ways which help reduce the time lag and systemically transform the information through networked governance. In Nepal, Department of Hydrology and Meteorology provides updated climatic data base through its websites which, through the use of ICTs, can be for assessing the effect of climate change. This data base could be utilized for monitoring and measuring climate change, measuring the effects of climate change and controlling the level of interactions with the environment, monitoring and measurement of climate change impacts, the impact of weather/ climate on natural resources such as water sea levels, annual rainfall and weather



dependent economic sectors such as agriculture, forestry, fisheries. Also, web portal AMIS provides information on climatic variables such as rainfall, minimum and maximum temperature on daily basis. This data base helps farmers to take decisions on crop plantation and harvesting. Early warning information provided from these portals are helpful to farmers and government to be prepared for the upcoming changes in weather and reduce the impact of such changes or impact.

7. Strategic Need for using ICTs in Agriculture

The use of ICTs in agriculture is mainly guided by a country's e-agriculture strategy which provides an essential framework in alignment with agricultural goals and priorities. ICT efforts can be strengthened, accelerated or aligned through a national strategic planning process. Government bodies and other related stakeholders in agriculture sector should be proactive for implementing the strategy and action plan for the ICTs use. Following points should be considered while making national strategic and action plan:

- An integrated agricultural information system should be created for providing strategic information for farmers, government agencies, agricultural cooperatives and other stakeholders at national, district and community levels;
- Awareness programs/campaigns should be undertaken for farmers;
- Weather and agro-meteorological early warning systems should be developed and deployed to support agricultural production;
- Rural connectivity of farmers should be supported, strengthened, including the investment in ICT infrastructures;
- ICT skills among agricultural extension workers, managers of cooperatives and farmers should be developed;
- Strong and reliable database system and applications should be developed;
- A very strong monitoring and evaluation mechanism should be developed;
- Development of e-village for agriculture is a prerequisite. For this, land digitization, online tax payment (land and agri-products), receiving extension services from SMS or online (website) or mobile apps, two-way communication should be launched.

The above mentioned strategic needs can be conducted by categorizing short, medium and long term action: 1) Short-term: National e-Haat market, Digital skills training for public sector employees, Digitization of land records; 2) Medium-term: Digital payments for all government subsidies, Education and training programs for farmers about use of ICT; 3) Long-term: Compulsory



IT education in schools and colleges, smart irrigation project, specialty food program, state-of-the-art knowledge centers (as suggested by Digital Framework Nepal, 2018).

8. Access to Market Information through ICTs

In Nepal, government has started an e-Portal of Agriculture Management and Information System (AMIS) that offers farmers more relevant information (i.e. new agriculture technology, food crops, vegetables and fruits, livestock, weather updates etc.). Kalimati Fruits and Vegetables Market Development Board of the Government of Nepal displays daily wholesale and retail prices of different fruits and vegetables on its website (<http://kalimatimarket.gov.np/home/language/EN>). This market also provides the price of vegetables and other products through its toll free phone number (i.e. Dial 16180707666666). National level Radio, local FM Radios, and Television channels also provide local selling/buying and price information of various agricultural products. These market information are also displayed on light boards at major markets across the country including regional and local prices. In recent years, short message and text services have taken up and effectively deliver prices and trading information via mobile phone to farmers. This helps link rural producers to collection centers, wholesale market, mills and processors through the use of mobile phones, thereby ensuring a fair income for producers and a steady supply of raw materials for the mills/processors.

9. Best Practices on use of ICTs in Agriculture Extension

ICTs are very useful in agricultural extension and advisory services and in reaching out to family farmers. Most of the farmers' families in developing countries live in rural areas and are in most cases remain isolated from technology and vital agricultural support services needed to carry out farming activities. Application of ICTs in agricultural extension and how ICTs can lead to beneficial behavior change amongst rural farmers is important. But extension alone cannot fulfill the information need of millions of farmers and take them out of poverty unless there is the right combination of policies, technologies, market opportunities, and of course ICTs. This is a joint effort from various stakeholders. The e-Agriculture platform for sharing and updating information among extension, research, education and farmers can be a turning point.

Radio and Television have played, and still continues to play, an important role in agricultural extension. AITC's Agriculture Radio Program, Television Agriculture Program, Kisan Call Center, Web portal are the importance sources of information sources of agricultural extension services in Nepal. Video Documentaries and Public Service Announcement (PSA) continue to be useful in extension services, for example AITC offers online video



documentaries through its web portal and mobile application where farmers and related stakeholders can access information of their interest. As we discussed in the previous section of this paper, use of mobile phones in getting agricultural information and e-Agriculture platform can help constantly the extension staffs, farmers and entrepreneurs. They exchange voice message, text or photos and need based messages for and with farmers which helps empower farmers to use mobile phones. Not only that, this helps promote adoption of new technologies and improved practices.

The main problem is the cost for a smallholder farmer in Nepal. To make this cost effective, they should work in PPP model i.e. the public, the private and the community will have to work together to ensure effective ICT use for farmers. The government should regulate and monitor the availability, access and affordability of the technologies, while the private sector should provide the hardware, the software, the connectivity and the content. In Nepal, the government has invested significantly in digital information systems for agricultural use such as AMIS. But this information systems hardly offers an integrated approach, for example giving agricultural and market information as well as financial services. Data should be open and free for all the users so that everyone can play role in enabling smallholder farmers to effectively use ICTs. Governments should accelerate the open movement through policies, strategies, regulatory mechanisms and structures that support open access and use of data, information and technologies.

10. Women Involvement in ICTs Focusing on Agriculture

Full and equal participation of women and youths in ICTs focusing on agriculture is inevitable. In Nepal, the level of gender disparity in education varies across the country, mainly in rural areas. Women participation in educational programs is fairly low, which impacts the use of ICT among women. For example, women involvement in Kisan Call Center of AITC is very low, percentage of women caller was only 2.4 % during 2017 (AITC, 2018). This is very discouraging while a large number of women farmer involved in production activities in agriculture sector. Therefore, they should be encouraged to use the services provided by call center, and other ICT devices. Gender mainstreaming for the use of ICT in agriculture helps overcoming barriers that prevent women access to information, education opportunities and empower them. Not only that, factors like high cost of technology, lack of skills and information, less access to finance and resource, social behavior, culture, tradition prohibit women's participation in ICT usage in agriculture. Appropriate policy framework should be designed and measures to be taken to address the constraints women face in order to make ICTs as a tool for knowledge and information which help lessen gender disparities and increase potential impact of ICTs in agriculture.



Encouraging women to use ICT remains, however, a challenging task since technology uptake of women tends to be low in South Asia, even in environments where computers are available; since it is generally the boys who are encouraged to use it (Gender Equity and the Use of ICT in Education, 2010). To overcome the gender gap and ensure the use of ICTs by women, gender focused educational programs and positive discrimination (affirmative action) in favor of women for ICT facilities should be explored.

Specifically, the following strategy can be adopted to ensure women participation in ICTs in agriculture:

- i. Ensuring a gender perspective in ICT-based projects, gender-sensitive ICT policy and regulations at national level for overcoming the persistent barriers to women's access to and use of ICTs;
- ii. Encourage the participation and integration of women in the processes of national policy formulation, planning and decision-making through information access mechanisms;
- iii. Develop and provide ICT infrastructure and affordable access to ICT tools and services in rural, especially with a view to expanding access to women participation;
- iv. Training programs for ICT use for women and youths should be designed and implemented;
- v. Promote ICT awareness campaign among youths and women and develop literacy programs;
- vi. Design technologies appropriate to women's needs (suitable to the given social and cultural contexts);
- vii. Gender-focused research and analysis.

11. Institutional Strength for the use of ICTs in Agriculture

Through policies and implementation of action plans, strengthening institutions with the responsibilities of operating ICTs can be done. High-speed internet access to all public facilities, Internet as a fundamental right, National fiber network, Public Wi-Fi hotspots, Digital literacy program are the prerequisites for institutional strength (Digital Framework Nepal, 2018). Furthermore, Nepal has prepared and implemented IT Policy (2000), and Telecommunication Policy (2004). Many other service providers and stakeholders such as Nepal Telecom/ Private telephone providers, National Information Technology Center (NITC), Computer Association of Nepal (CAN), IT Professional Forum (ITPF), IT Colleges and Universities, IT Park-Banepa, ISP Association of Nepal, and other Business Associations are playing role in strengthening the institutional arrangement and use of ICTs. Although political, economic, social and technological challenges are available in our country. However, realizing the importance of ICTs in



development, the government is willing to decentralize the responsibilities and processes throughout the system called e-government.

12. Opportunities and Challenges of ICTs use in Agriculture Sector

The use of ICTs in agriculture sectors are rapidly expanding and provide information needed for the farmers and other stakeholders. However, there haven't been many efforts from the government side in Nepal for various reasons. The most obvious reasons are the lack of financial resources, trained manpower, affordability of the end users of ICTs, and lack of commitment from the people involved in transforming information. Although information or new technology adoption is cheaper and easier through ICTs, more than 50% farmers are not ready or not willing to use ICT in their farming system. Moreover, implementation and sustainability is a challenging issue. The success depends on a high degree of willingness on implementation of ICTs on daily life. There is an opportunity of expanding new tools and approaches of ICT in agriculture sector. The role of ICT is increasingly recognized and was officially endorsed at the World Summit on the Information Society (WSIS) 2003-2005. However, the use of ICT in agricultural development is relatively a new phenomenon, and becoming increasingly important for everyone in daily life (IICD, 2007). The growing demand of high quality and healthy products offers opportunities for improving the service quality and area expansion for ICTs. Realizing these opportunities requires compliance with more stringent quality standards and regulations for the production and handling of agricultural produce. New approaches and technical innovations are required to cope with these challenges and to enhance the livelihoods of the rural population. To maintain these quality and standard will require a high degree of emphasis on real implementation and commitments.

13. Recommendation for Policy, Research and Extension Services

There is a need for concrete recommendations in the area of ICT use in rural agriculture that helps promote adoption of improved technology, increase production and income and contribute to the sustainable livelihoods of rural people. While internet penetration in Nepal has risen sharply in the past few years, a large section of Nepali people still remains digitally disconnected due to less affordability, access to, and digital illiteracy. To overcome this problem, high degree of emphasis on program design and implementation is necessary. Furthermore, Government of Nepal needs to focus on priority areas to create an enabling environment for the success of ICT initiatives. However, implementation and sustainability is a challenging issue. The success depends on a high degree of willingness on implementation of ICTs on daily life. Followings are some the recommendations made in this paper:



- Institutional arrangement and strengthening: A National ICT Policy Implementation Steering Committee should be formed at the Ministry of Information Technology and Communication, including representative from all the sectorial Ministries, telecommunication, private sector;
- Developing monitoring and evaluation framework: Monitoring and evaluation of policy and program interventions should be very strong and a high level of commitment is necessary;
- The government should regulate and monitor the availability, access and affordability of the technologies, while the private sector should provide the hardware, the software, the connectivity and the content;
- Linking farmers to markets: This helps link rural producers to collection centers, wholesale market, mills and processors through the use of mobile phones, thereby ensuring a fair income for producers and a steady supply of raw materials for the mills/processors;
- Ensuring a gender perspective in ICT: Gender-sensitive ICTs policy and regulations at national level for overcoming the persistent barriers to women's access to and use of ICTs;
- Encourage the participation and integration of all excluded women and rural farmers in the processes of national policy formulation, planning and decision-making through information access mechanisms;
- Training programs for ICT use for women and youths should be designed and implemented;
- Develop and provide ICT infrastructure and affordable access to ICT tools and services in rural, especially with a view to expanding access to all related actors in agriculture value chain;
- Design a clear framework for a national e-agriculture vision, strategy and policy is the first step in this digital journey;
- Data should be open and free for all the users so that everyone can play role in enabling smallholder farmers to effectively use ICTs. Governments should accelerate the open movement through policies, strategies, regulatory mechanisms and structures that support open access and use of data, information and technologies. Open data can make new technology more affordable and enable innovation and transparency;
- Cost effective ICT in PPP model: the public, the private and the community will have to work together to ensure effective ICT usages for farmers.

14. Conclusions

- In Nepal, where agriculture sector contributes almost 27.6 % to the national GDP, a large part of population is still living in food deficit



condition, and the country has to import huge portion of the food. This amplifies the scope of ICT in agriculture and there is no doubt that ICT can play a crucial role in increasing production and income of farmers. ICT helps disseminate innovation and modern technology and lift the farming at a new level. New technological advancement and increased accessibility of ICTs has made easier to adopt such technology and practices. Nepal has got incredible success in digital adoption compared to its neighbors, with mobile penetration exceeding 100% and internet penetration reaching 60%.

- There is plethora of ICT applications being used in agriculture sector in Nepal, such as agriculture information portals, mobile apps – 'Hamro Krishi', 'Smart Krishi', IFA krishi, Yuba Krishi. 'Kisan Call Centers', 'Village Knowledge Center', mobile SMS Services, YouTube, Facebook which are the landmark in ICT in agriculture. AITC has been producing Radio and TV programs which discusses about issues on agriculture and provides expert services to the farmers. AITC, through its Toll free phone in Farmers Call Center, provides information about agriculture, many contact centers and/or service centers under district level agricultural offices are delivering service and information and other facilities to the farmers. KCC is to manage the queries raised by farmers effectively, efficiently, instantly and in the desired local language. PACT and AMIS under MOALD and other governmental organization are working to increase the access of farmers to mobile application. As a result, role of ICTs in agriculture becomes crucial particularly in bridging critical information and knowledge gap.
- To create favorable environment for the IT sector more reliable and accessible to all people, Government of Nepal has prepared Telecommunication Policy 2004, with its implementation bodies, organizations and communities at various level. HLCIT is the one of the largest key institutions formed by Government of Nepal to provide crucial oversight and policy guidance for the development of ICTs sector in the country, NITC, CAN, ITPF, ISP Association of Nepal, and other business associations have driven the country towards the use of ICTs in economic development.
- There is a need for concrete recommendations in the area of ICT use in rural agriculture that helps promote adoption of improved technology, increase production and income and contribute to the sustainable livelihoods of rural people. While internet penetration in Nepal has risen sharply in the past few years, a large section of Nepali people still remains digitally disconnected due to less affordability, access to, and digital illiteracy.
- To overcome this problem, high degree of emphasis on program design and implementation is necessary. Furthermore, Government of Nepal



needs to focus on priority areas to create an enabling environment for the success of ICTs initiatives. However, implementation and sustainability is a challenging issue. The success depends on a high degree of willingness on implementation of ICTs on daily life. A National ICTs Policy Implementation Steering Committee should be formed at the Ministry of Information Technology and Communication, including representative from all the sectorial Ministries, telecommunication, private sector.

- Monitoring and evaluation of policy and program interventions should be very strong and a high level of commitment is necessary, and the government should regulate and monitor the availability, access and affordability of the technologies, while the private sector should provide the hardware, the software, the connectivity and the content. Linking farmers to markets helps connect rural producers to collection centers, wholesale market, mills and processors through the use of mobile phones, thereby ensuring a fair income for producers and a steady supply of raw materials for the mills/processors, and cost effective ICTs in PPP model: the public, the private and the community will have to work together to ensure effective ICTs use for farmers.

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Chapter Six

ICTs for Development of Rural Agriculture in Pakistan: Policy Concerns

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Abstract

This paper analyzes the role of Information and Communication Technologies (ICTs) often known as ICTs in agriculture in bringing about a sustainable and inclusive economic growth for the people of Pakistan. Its importance especially for a country like Pakistan where almost 60.78% of the population lives in rural areas cannot be undermined. Not only this, it is pertinent to note that agriculture contributes to about 18.9% to the GDP of Pakistan. Hence in order to strengthen the nexus between agriculture as a major contributor to GDP and an inclusive growth for all, it is imperative to further strengthen the ICT regime in Pakistan. Hence this paper will chalk out the progress Pakistan has made in the domain of agriculture vis-à-vis the proper use of ICTs and various policy concerns that the country tackled and might have to tackle in the future. The ambit of the analysis will mainly pertain to ICTs in agriculture and how it has impacted almost every domain in agriculture or agriculture related arena. The parameters of ICTs in agriculture in terms of a digitalized space for farmers and certain stakeholders from the prism of varying policy concerns will be elaborated. Such an analysis will be based not only on various studies conducted on this topic but also on the empirical evidence from concerned ministries, departments and organizations that are deploying ICTs in agriculture to reap the benefits it has to offer.

1. Introduction

The 21st century has seen new developments mainly in terms of growth of interconnectivity whereby the world in the words of Marshall McLuhan has shrunk to become nothing short of a global village. This has allowed countries to learn from each other and to adopt best practices in most fields. One such example is that of an expansive use of Information Communications and Technologies (ICTs) in almost every field and sundry. This is because ICTs have deemed to give maximum productivity by utilizing least resources. In this world of scarcity, this indeed is a blessing.

However, it is very important to understand what ICTs really entails and the mechanism it adopts to bring about the maximum productivity in general.



Apart from interconnectivity that ICTs enables to bring, one function that it thrives upon is innovation. It is indeed, ICTs allow the users to think of out of the box solutions and to implement it in a manner that benefits maximum populace. The fact that access to information is readily available due to ICT is another advantage that cannot be ignored. This helps to regulate the market mechanism that arises out of imperfect knowledge. Both the consumers and producers feel empowered within their own domain. This is because ICTs ensures accessibility and reliability of information. Hence, the economic advantages of ICT cannot be underscored.

The most important advantage of ICTs, however, for the purposes of this paper is in the form of inclusive growth. Any new innovation or idea should be perpetuated in a manner that it leads to economic growth for all. In this respect, the target should always be “Inclusive innovations – innovations that directly serve the welfare of lower-income and excluded groups – can contribute to development and create work opportunities integrating marginalized groups into circuits of economic activity¹.” And this is also the mission and vision of the new government in Pakistan that won elections on 25th July, 2018. This was manifested in the new government’s 100 days agenda that revolved around Revitalization of Economic Growth by focusing on the marginalized segments of the society. According to the Economic Survey of Pakistan 2017-18 “the government is focusing on supporting small and marginalized farmers and promotes small scale innovative technologies to promote growth in this sector².” Therefore, in this regard, “the present government is focused on developing this sector and in this connection initiated a number of measures such as crop diversification, efficient use of water and promotion of high value crops including biotechnology, reducing mark-up rates, agriculture credit enhancement, subsidized fertilizer prices and cheap electricity for agri. tube wells³.” It is also pertinent to mention here that according to a World Bank study of 42 countries from 1981 to 2003, “GDP growth originating in agriculture benefits the poorest half of the population substantially more,” compared to the more well-off population. Hence, the policy makers in Pakistan and the government is trying to focus on agriculture in a way that it leads to economic growth for all.

In this backdrop, the role of ICTs in agriculture and sundry can be delineated in detail for the purposes of this paper. However, before doing so it is imperative to understand that where it is integral to learn from best practices of various countries, it is also important to undertake a contextual approach to implementation of any idea. Hence, Pakistan in its endeavor to implement ICTs in Agriculture, has tried to take a contextual approach by taking into accounts its limitations, resources and scope. This is because the policy makers in Pakistan are cognizant of the fact that transplantation of ideas and policies without due regard to context in terms of resources and utilization can often have negative results. The ideas and policies should be such that



they can be implemented both at micro and macro level. It should also be noted that Pakistan with respect to ICTs in agriculture has tried to infuse traditional techniques with modern techniques that are the requirement of ICTs. The reason d'être behind this is that often people, and in this case farmers in general, are averse to change that disrupts their way of thinking that has often been perpetuated since centuries and are seen as 'ways of their forefathers'. Hence, the policy makers being aware of this fact have tried to shape ICTs with regards to agriculture in a way that it doesn't alienate the farmers and make them feel further isolated and marginalized. With this background in mind, this paper will try to give a nuanced picture with respect to use of ICTs in agriculture in Pakistan and the policy concerns it poses.

2. Country Status on use of ICTs in Rural Agriculture

Pakistan has taken various initiatives to deploy ICTs in rural agriculture. The reason behind it is simple: agriculture is the backbone of Pakistan's economy. According to Economic Survey of Pakistan 2017-18, agriculture contributes to 18.9% to GDP and employs 42.3% of the labour force⁴. It has also been reported in the survey that during 2017-18, due to the pragmatic policies of Pakistan's government, the agriculture sector exhibited a growth rate of 3.81% by surpassing the targeted growth of 3.5% and surpassing the previous year's growth rate of 2.07%.

All this points towards the fact that agriculture is one of the main priorities of the government in Pakistan and any government in power will try its best to ensure that agriculture remains a thriving sector. It is also interesting to note that Pakistan is the fourth largest cotton producing country in the world and plans to move above the ladder not only in cotton but also in other major crops such as sugarcane, wheat and maize. In this respect, ICTs play an important role and various initiatives for this purpose are delineated below:

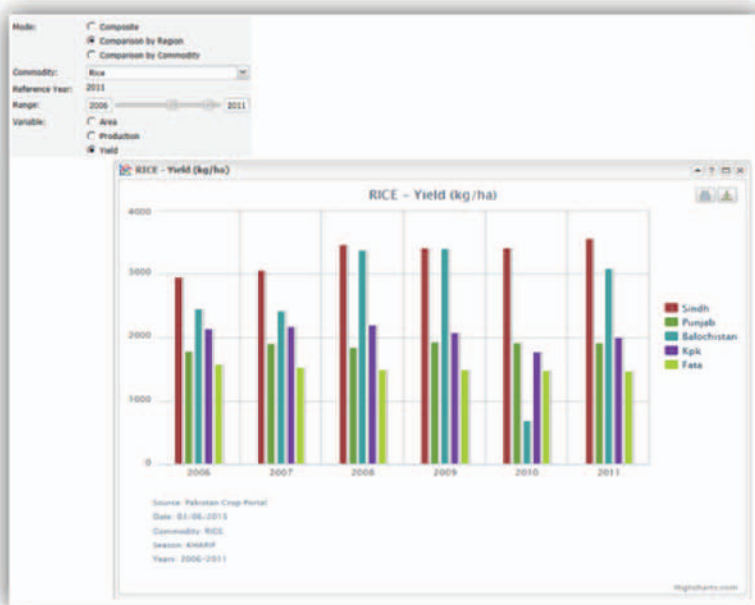
a) Pakistan Agriculture Information System

This is an initiative by Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) and is a component of the "Agriculture Information System" project which is funded by the USDA with technical support being provided by the FAO and the University of Maryland. This initiative is based on 'building provincial capacity for crop estimation, forecasting and reporting using remote sensing.' The nuances pertaining to the said initiative are as follows:

"Improvements in data management related to decision support could only be justified if they made things simpler, more accurate or more accessible. The Crop Information Portal is a web based, open source platform developed to support the analysis and dissemination of Pakistan's crop data and related climatic, agronomic, hydrologic and economic variables⁵." This particular Crop Information Portal, hence, makes it easier to carve out a



historical trajectory related to crop data and sundry and make it easier to share allowing policy makers to take an informed decision. It also allows for the harmonization of data both at national and provincial level. The particular crop data pertains to area, yield and annual production. One of the examples of a historical archive generated by the portal is shown below and this particular instance can be deemed as one of the success stories:



b) Performance Assessment and Evaluation of an Irrigation System Using Remote Sensing and GIS Techniques

A robust irrigation system and proper management irrigation is one of the most important requirements of good agriculture system. The global water scarcity is a known fact and according to FAO 1,800 people by 2025 will be living in countries or regions with “absolute” water scarcity⁶. To counteract this and to ensure that agriculture that is the backbone of Pakistan’s economy doesn’t undergo a setback due to this policymakers in Pakistan are utilizing ICT to a great extent whereby “The use of advanced technology tools such as satellite Remote Sensing, Geographic Information System (GIS) techniques, and hydrologic modeling can greatly help improve irrigation management⁷.” In this regard, the following **success story** is pertinent to highlight:-

“A detail survey of the study area was conducted to mark the longitudinal and latitudinal position of the fields and the corresponding water course through GPS in degree decimal system. The watercourse survey points were marked at three different points i.e. head middle and tail. The coordinates of



the fields and corresponding watercourse were converted into Universal Transverse Mercator (UTM) system⁸.”

c) e-PakAg application

It has been developed by the International Maize and Wheat Improvement Center (CIMMYT)

with the support of University of Davis (UC-Davis) that involves stakeholder consultations, reviews and studies and best practice identification and sharing. The purpose of this particular application is to combine lessons learned both in Pakistan and other countries. The unique feature of this application is that it is not only limited to public sector but engages all the stakeholders such as farmers, private sector, public organizations (extension, research and academia) and civil society.

d) Punjab Growth Strategy 2018

The Punjab Growth Strategy 2018 is particularly focused on acceleration economic growth with a focus on improving social outcomes. As an offshoot of this strategy it has been decided to set up an Agri Hub. This entails a databank of information on weather, market prices, and fertilizer or pesticide management. The purpose of this Agri Hub is to provide targeted information to farmers.

e) Interventions taken by Ministry of National Food Security and Research (MNFSR)

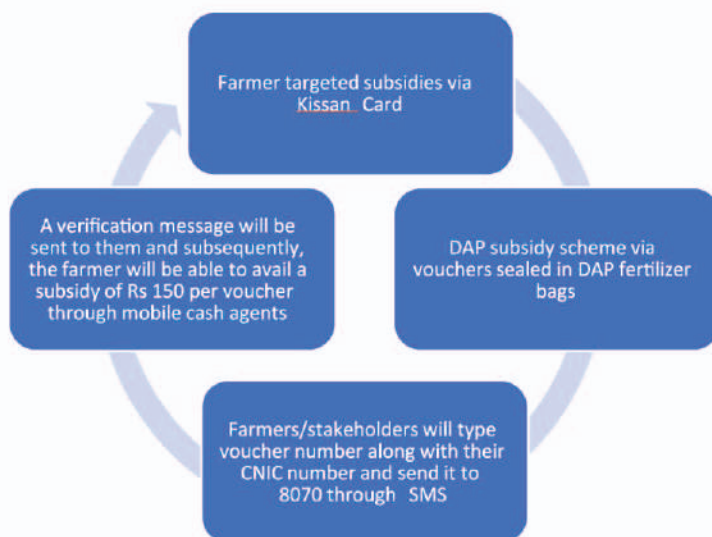
Ministry of National Food Security & Research (MNFSR) is the federal ministry that mainly focuses on policy formulation, economic coordination, and planning for foodgrain and agriculture. It has a wide range of ambit that extends from procurement of food grains and fertilizers to stabilizing import price of agriculture produce, to serve as an international liaison, and to conduct economic studies for framing agricultural policies. National Agricultural Research Centre (NARC), Islamabad established in 1984, is the largest research centre of the Pakistan Agricultural Research Council (PARC) that comes under MNFSR with a purpose to conduct research both on national and provincial level. Various ICT interventions have taken place with a varied degree of success to improve the livelihood of the farmers with a special focus on small-scale farmers. Currently, efforts are being taken place to provide a harmonized digital agriculture space across the country.

3. The Role of Mobile Technology in e-Agriculture

In today's age and time, mobile technology is gaining momentum due to the flexibility and mobility it offers. It is often said that many devices after the advent of a strong and robust mobile technology have become obsolete. According to PTA there are 153 million cellular subscribers. Keeping this in view, Pakistan has adopted mobile technology for its agricultural



advancement and recent years have seen a growth in initiatives taken in this regard. Both the private and public sector have joined hands in this regard to empower and emancipate the farmers through mobile technology.



a) CAPP: Connected Agriculture Platform by Telenor Pakistan, Tameer Bank & Department of Agriculture, Punjab

Under this program, the Government of Punjab has provided Android Phones through which interest free loans, subsidies to farmers, consultancy services on crops and fertilizers and also training can be provided to farmers through a comprehensive digital mobile platform . In lieu of this, 125,000 smartphones have been distributed to farmers to allow access to this platform.

b) Khushaal Zamindar: A Mobile Agriculture Service

This is another initiative by Telenor Pakistan launched in December, 2015. As many as 2.9 million customers have registered on this portal as of 2017². This particular portal not only gives the farmers particular data on various crops and weather forecast but also chalks out mechanism to avert post-harvest losses. There is also an Interactive Voice Response (IVR) Channel in which farmers queries are answered live on air. This Agriculture Service is a confluence of traditional and modern farming techniques whereby it is recognized that Pakistani farmers are mostly social and tend to discuss their various agricultural issues in an evening gathering over a huqqa¹⁰. The success story of this particular forum is as follows:

²GSMA, KhushaalZamindar- A Mobile Agriculture Service, <https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2017/07/Khushaal-Zamindar-A-mobile-agriculture-service-by-Telenor-Pakistan.pdf>



“Power users changed their planting and postharvest and storage practices and reported higher incomes. The likelihood of power users making changes to their planting behaviour is 1.7 times that of non-users, while power users were 2.7 times more likely to make changes to their postharvest and storage practices than non-users. The likelihood that power users will report an increase in income (compared to a decrease or no change in income) is 1.91 times greater than non-users¹¹.”

4. Rural Access and Exchanges Mechanisms: Connectivity and Telecentres

However, it is important to state here that all this is not possible without an improved and strengthened connectivity ecosystem that allows for rural access and an exchange mechanism thereby. Taking this into consideration, Pakistan Telecommunication Authority and Ministry of Information and Technology have taken strides to establish 400 telecentres all across the rural areas of Pakistan. Efforts are also being made to provide the rural population with computers and to impart IT training.

5. Utilization of ICT to Adaptation of Climate Change Affect in Agriculture

The basic conceptual underpinnings of a market economy are that agricultural goods exhibit an inelastic supply (i.e. a small percentage change in prices lead to a small percentage change in quantity supplied) due to vagaries of nature. Hence climate change does have a substantial effect on agriculture. It has been reported that “in the long run, South Asia is expected to witness a wide range of variations in climate wherein temperature and precipitation may undergo an increase of 2.3 to 4.5^{0C} and 10 to 17 percent by 2070-2099 resulting in large losses in agriculture¹².” Keeping this in view, University of Agriculture, Faisalabad in collaboration with UKAID has developed The Agricultural Model Inter-comparison and Improvement Project (AgMIP). The purpose of this is to estimate the trends in climate change by analyzing both current and historical trajectory. It also tries to determine yield forecasting and yield variability through this analysis.

6. Strategic Need for use of ICT in Agriculture

Before undertaking a nuanced analysis on the various policy imperatives and recommendations, it is imperative to understand the strategic need for Use of ICTs in Agriculture both from the prism of comparative advantage with other countries and for an inclusive economic growth.

For an Inclusive Economic Growth:

Of the 7 million farm households in Pakistan, 80% are classified as small farmers. These small farmers are mainly poor with very minimal market



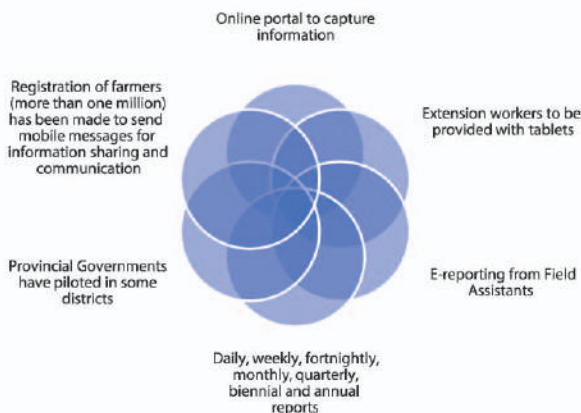
power. These farmers usually suffer in terms of imperfect knowledge mainly pertaining to crop diseases, right type of pesticides to be used, the proper usage of fertilizers, the mechanism to minimize post-harvest losses and climate forecasts. Due to these reasons, these small scale farmers see themselves further marginalized and alienated. In such a situation, ICT has proved to redress the situation. The above initiatives taken by the government of Pakistan shows that small farmer are now in a position to make a more informed decision. Also, the use of mobile technology has enabled these farmers to seek solutions to various problems faced by them. Hence, now information is not only a purview of large scale farmers to whom it can be readily available but also of small farmers.

Comparative Advantage:

Wheat, sugarcane, rice and cotton constitute Pakistan's major crops. These crops are important not only in terms of local production and sustainability but also in terms of exports. As has been discussed above, the world is becoming a global village and there has been an increased use of ICTs in almost all the countries. A strong Agriculture Information System that makes estimates related to weather fluctuations and its impact on crops and gives proper spatial information with respect to these crops is the only way to survive in the international market.

7. Access to Market Information through ICTs

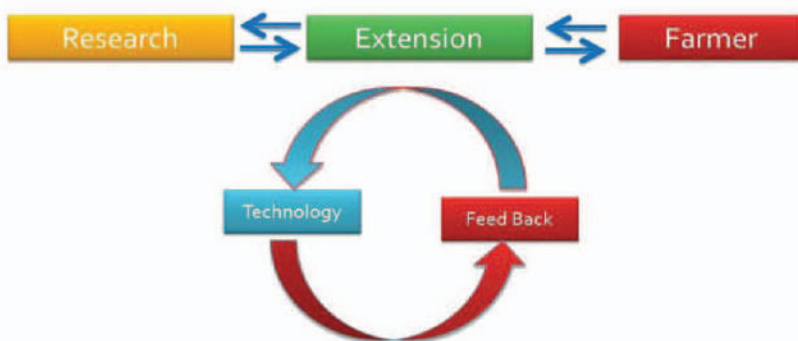
The use of ICTs has made it easier for both the farmers and consumers to have more reliable information in terms of market prices of various agricultural commodities. In this way, both the consumers and farmers feel empowered within their own domain and the negative externality of imperfect knowledge which is a characteristic of today's market economy is thereby curbed. The mechanism deployed by various provincial governments to provide robust market information is delineated below:-



8. Recommendations and Policy Imperatives

For a farmer to increase his crop yield and productivity, it is important for him to adopt Good Agricultural Practices (GAP). Therefore, as outlined above, ICTs play an integral part in it. However, there is a need to further strengthen the ICTs in Pakistan in terms of both institutional and policy framework.

The institutional framework that is required to further boost ICTs in Pakistan and to maximize the utility it has to offer, there is a need to ensure that telecentre are properly established and functional. There have also been reports of extension workers not doing their jobs properly and engaging in other activities for their livelihood. These extension workers are also reportedly blamed of helping large scale farmers only. Hence, a proper check and balance in this regard is necessary for an inclusive economic growth through ICTs in agriculture. Directorate of Extension and Adaptive Research that provides the necessary linkage between research findings and farmers' adaptation to it can be further beneficial in providing the required institutional framework. The workings of the Directorate in this perspective are delineated below:-



Source: Directorate of Extension and Adaptive Research

Another institutional framework that can further make the role of ICTs in agriculture robust is strong regulations in the field of ICTs and internet access/use. Such a regulatory framework should undertake a balancing exercise whereby it should allow the entrance of new IT operators by ensuring that they don't breach any licensing regime. Also, farmers should be given proper training in order to enable them to use ICTs in agriculture in an effective and efficient manner.

With respect to policy framework, it is important to highlight the role women play in agriculture in Pakistan. From sowing to harvesting, woman put in their efforts tirelessly. Hence, there is a need to ensure that ICTs in agriculture is used as a tool of not only women empowerment in Pakistan but



also to increase the crop yield and productivity. A policy can be chalked out where women are given mobile phones and related training free of cost. Another policy framework that is required is the proper implementation and the eventual monitoring of ICTs related projects. It should be ensured that these projects see their logical conclusion and do not remain to paper work only. Once implemented, the steering committee should ensure the proper monitoring and evaluation of such projects. It is also pertinent to mention here that instead of being ambitious, only those projects should be launched/implemented that have the ability to yield maximum benefit. Here, the contextual appraisal should be kept in mind. Another policy imperative required for Pakistan is harmonization of ICTs related endeavors on which the Ministry of National Food Security and Research is currently working.

9. Conclusions

Hence, it can be seen that Pakistan has been successful in implementing ICTs in agriculture to a large extent. This is exhibited by the number of projects it has implemented in this regard. However, Pakistan has tried to ensure that such projects are conducted through a proper cost-benefit analysis in terms of their economic viability and social outcome. ICTs in agriculture in Pakistan have not only been beneficial for policy makers through initiatives like Crop Information System but has also empowered farmers by keeping them connected both to the market and agricultural experts. The new Kissan Card Scheme has proven to be an excellent initiative to ensure the use of DAP fertilizers. However, Pakistan still has certain improvements to make by ensuring that right institutional and policy framework is provided for ICTs particularly in the field of agriculture.

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Chapter Seven

ICTs For Development of Rural Agriculture in Sri Lanka: Policy Concerns

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Abstract

In Sri Lanka, nearly one-third of the total work force (27.1%) is involved in agriculture and livelihood of seventy percent of the rural population is depends on agriculture. Nevertheless, agriculture sector contributions to GDP is around 7.5%. However, contribution to GDP by agriculture sector is continued to decline due to various factors. Sri Lanka is heavily depends on imports for food security. Therefore it is utmost important to increase the productivity of agriculture sector. Research and extension plays an important role to increase the productivity. There are number of factors that contribute to less productivity in agriculture. Less adoption rate of innovations and lack of information about marketplace are the leading factors. To bridge the gap between research and extension and to find marketplace ICT could be utilized very effectively. The Government of Sri Lanka (GOSL) envisions transforming the nation into a prosperous, sustainable, knowledge economy-via- the path of good governance. In the present era of global information revolution, realizing these ambitions are invariably linked to digital inclusion of the society through information and communication technologies (ICTs). Such a transition is not spontaneous and citizens of the country have to make a conscious effort to achieve it. The existing statistics suggests that the situation in ICTs literacy and access in Sri Lanka does not represent a healthy situation. This is problematic since individual usage of ICTs and internet penetration would strongly determine the distribution of benefits of digital development to the common public. Establishment of the National Agriculture Information and Communication Centre of the Department of Agriculture opened up enormous opportunities in streamlining the process or utilizing the adoption of Information & Communication Technologies in agriculture development through coordinating the process of developing E-agriculture solutions.

1. Introduction

In Sri Lanka, nearly one third of the total work force (27.1%) is involved in agriculture and livelihood of seventy percent of the rural population is depends on agriculture. However, agriculture sector contributes to GDP is



around 7.5% (AgStat, DOA, 2017). Contributions to GDP by agriculture sector is continued to decline due to various factors such as climate, increasing cost of inputs, increasing wage of agriculture laborers and less adoption of improved technologies by farmers etc. Sri Lanka is heavily depends on imports for food security. Sri Lanka has divided in to three major climatic zones as dry, wet and intermediate zones. These major climatic zones further divided in to 46 agro ecological regions based on altitude and great soil groups. “Maha” and “Yala” are the two major cultivation seasons, which enables farmers to cultivate a range of food crops. As a stable food, paddy is grown in both “Maha” and “Yala” seasons. Being a major crop in both seasons, paddy contributes 0.6 % to the GDP (AgStat, DOA, 2017).

Agricultural Technology Information on crops in Sri Lanka is generated by national agricultural research system (NARS) mainly under three different ministries; Ministry of Agriculture, Ministry of Plantation Industries, and Ministry of Primary Industries. Ministry of Agriculture covers food crop sector, which includes crops such as rice, fruits and vegetables, and other field crops including spices and grain legume. Plantation Industries covers crops such as tea, rubber, coconut and sugarcane and Ministry of Primary Industries is mandated for export crops such as pepper, nutmeg, cardamom, cinnamon, areca nut, coffee, cocoa, vanilla, citronella, ginger, turmeric, betel etc. Tea Research Institute, Rubber Research Institute, and Coconut Research Institute carry out research and development activities of Tea, Rubber and Coconut respectively. Department of Animal production and Health (AP&H) is responsible for developing livestock sector in the country. In addition to above Institutes, private sector is also involved research and development activities up to certain extend mainly on breeding and seed industry. All sectors have their own research and development systems including central research institutes and sub units, extension programs and advisory services. The common and strong information sharing system of every sector is through print media. However, most of them use video, radio and ICTs such as websites and other information systems.

2. Status on Application of ICTs in Rural Agriculture

The Government of Sri Lanka (GOSL) envisions transforming the nation into a prosperous, sustainable, knowledge economy via the path of good governance. In the present era of global information revolution, realizing these ambitions are invariably linked to digital inclusion of the society through information and communication technologies (ICTs). Such a transition is not spontaneous and citizens of the country have to make a conscious effort to achieve it. The Information and Communication Technology Agency of Sri Lanka (ICTA) has been tasked with facilitating this transition process so that Sri Lanka becomes a ‘digitally inclusive society.’



Recently published global ICTs benchmark indices suggest that Sri Lanka is making a progress towards achieving this goal. Sri Lanka was ranked 79th (out of 192 countries) in the E-Government Development Index (EGDI), 115th (out of 167 countries) in the ICTs Development Index (IDI) and 63rd (out of 139 countries) in Networked Readiness Index (NRI). Sri Lanka was ranked ahead of other South Asian nations and was positioned above many countries in the Asia-Pacific region too. Considering the fact that the country was embroiled in a costly-armed conflict until few years ago, this appears to be a significant achievement.

The existing statistics suggests that the situation in ICTs literacy and access in Sri Lanka does not represent a healthy situation. This is problematic since individual usage of ICT and internet penetration would strongly determine the distribution of benefits of digital development to the common public. The year 2009 is a milestone due to ending of the conflict that lasted for nearly three decades. Since then significant changes have taken place in the ICT sector, nationally and globally.

Smart phones have become a major source of access to internet, e-mail and social media. Rising popularity of social media has attracted hitherto unaffected sections of the society towards ICT. Moreover, number of government agencies has expanded their service base adding new e-government facilities and rapid growth of mobile phone use has facilitated this further. Not only have the government organizations, number of private entities that use e-commerce facilities to expand their market base also increased. Number of service points that offer internet access has increased even in relatively remote areas. They include state owned facilities (e.g. Nenasala, Vidathacentres) as well as private sector facilities (e.g. cyber cafes). ICT facilities at schools are gradually being expanded and ICTs has become a subject in national curriculum offered in many schools. Besides, economy has gathered a momentum of growth since the end of the conflict and ICT sector has shown a rapid expansion, attracting more number of employees into the workforce as indicated by the ICTs Workforce Survey 2013. All these can be considered to have a positive influence on the ICTs literacy of the country that needs to be captured in indicators correctly.

2.1 ICTs Innovation for Development of Agriculture

The traditional agriculture extension system was negatively affected with the introduction of open economic policy and the administrative changes that took place in late 1980s. At present agriculture extension is handled by many organizations. All most all the organizations use some kind of ICT initiative to disseminate agriculture information related to crop production and other needs. The extension system of DOA joined hand with the agriculture research as development has ensured the food security of the nation. However, with the present scenario the Department of Agriculture taken



measures to merge ICT supported agriculture extension systems with the traditional systems to strengthen the agricultural extension system that function more efficiently with the use of modern ICTs. National Agriculture Information and Communication Centre is responsible for implementing ICT initiatives of DOA. This paper describes the ICTs initiatives of DOA, other government organizations and Private sector.

2.1.1 Agriculture Radio Programmes

Farm Broadcasting Service of DOA was established in late 1920s. Radio is the most popular mass media for accessing information by the rural population of Sri Lanka. There are many advantages in using radio to improve livelihood of rural population. Radio is one of the media, which covers huge population. It reaches general mass as quick as possible without many barriers. To reduce knowledge gap of farming community and Farm Broadcasting service of DOA involved in broadcasting agriculture radio programmes mainly through channels of Sri Lanka Broadcasting Cooperation (SLBC) in both Sinhala and Tamil languages for more than Eighty years. More than 32 Agriculture programmes are being broadcasted weekly in Sinhala and Tamil languages (Table 2). Other departments in the agriculture sector such as Department of Animal Production and Health (AP&H), Department of Export Agriculture (DEA), Tea, Rubber, and Coconut related institutes etc. also broadcast their own radio programmes.

A web based radio known as Krushi radio was started in 2013 and hosted under the domain name of www.krushiradio.lk with the objective of establishing a dedicated national radio channel for agriculture. Further, an android based mobile app has been introduced with the expectation of popularizing the Krushi radio among smart phone users.

2.1.2 Television Programmes on Agriculture

Television can be used by government agencies to relay vital information related to disaster, weather forecasts, demonetization etc. This helps in spreading immediate awareness among people. This is due to the fact that cheap TV sets are available in both rural as well as urban areas almost in each and every household. Television programmes are most common means of mass media activity with highly effective in technology transfer especially in the field of agriculture. There are three video programmes produced by the Department of Agriculture for national telecast and which are namely Govi Bimata Arunalu (Agriculture Technology Programme), Mihi Katha Dinuwo (Farmer Success Story) and Ketha Batha Kamatha (Traditional Agriculture).

2.1.3 Interactive Multimedia CD-ROMs

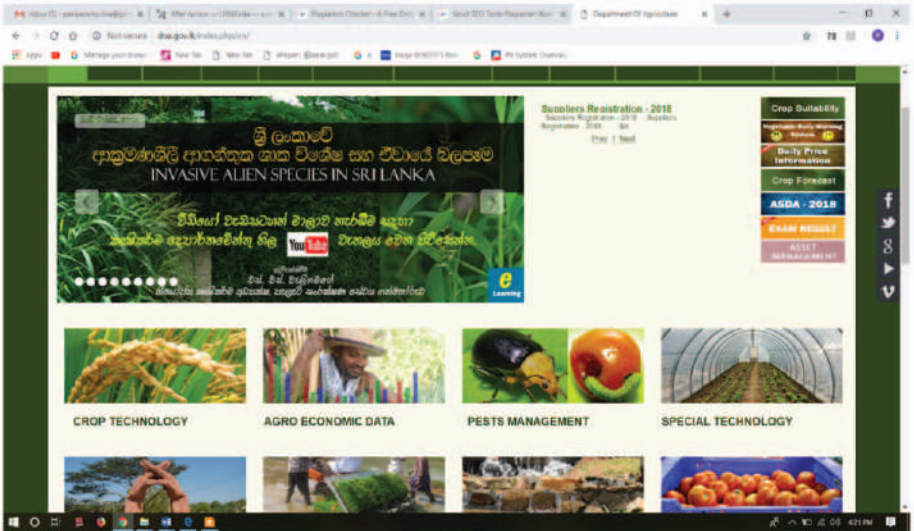
Interactive Multimedia CD-ROMs (IMM CD-ROMs) are the stand-alone applications developed using multimedia authoring tools and each IMM CD-ROM consist of technical know-how of a food crop or an agriculture subject



matter such as Integrated Pest Management, Micro Irrigation or Protected Agriculture. The production of IMM CD-ROMs helped in pooling almost all the technical content of new crop varieties, good agricultural practices, post-harvest technologies, value addition, success stories, etc., through multimedia technology. The contents were organized into chapters, topics and sub-topics. Most of the pages contain a variety of multimedia presentations (video, audio, graphics, animations, and text). All media are interactive and users may review and/or skip section, as they desire. Users can also print contents of each page for different purposes.

2.1.4 Websites

Official website of the Department of Agriculture provides the institutional information to the staff and public. DOA website has been redesigned based Content Management System to ensure the user-friendly interface with capable of decentralized updating facility. All the publications of the DOA uploaded to this web site and any one can download this on free of charge.



Figures 1: Official Website of the Department of Agriculture hosted under the domain name of www.doa.gov.lk

WikiGoviya Website of the Department of Agriculture

Wikigoviya is a web 2.0 based initiatives which established a discussion forum to have progressive dialogues among agriculture stakeholders and developed a Wiki based public agriculture knowledge repository (Agripedia). Further, it is supported with a multimedia-based eLearning system in agriculture. IMM-CD-ROMs produced by DOA on various crops and subjects have been uploaded for e-Learning.



2.1.5 Agriculture Publications

Since the literacy rate of Sri Lanka is more than 93%, print media plays a vital role in dissemination of agriculture information. Realizing the advantages of print media DOA is publishing number of regular publications and technical publications. Five publications are published annually.

There are more than 150 technical publications, which have been published in both in Sinhala and Tamil languages on various topics. These publications contain various technical information from land preparation to harvesting and post-harvest technologies of food crops (paddy, OFC and fruit crops). Crop calendars describe time of cultivation and possible pest and diseases attacks. These crop calendars are very popular among farmers and others who are interested in agriculture. e -News is an electronic newsletter published monthly to create awareness on DOA activities and success stories. This send through e-mail and web page of DOA. Ag-Tec is an electronic publication, which is utilized to inform latest agriculture technologies and timely information to extension and research staff. All publications are uploaded to official website of the DOA and any one could download these publications free of charge. Newspapers also plays an important role in disseminating agriculture information.

3. The Role of Mobile Technology in e-Agriculture

Smart phones have become a major source of access to internet, e-mail and social media. Rising popularity of social media has attracted hitherto unaffected sections of the society towards ICTs. At present cellular mobile telephone subscriptions are around 2.8 million and which is more than the Sri Lankan population (Information and Communication Technology Agency of Sri Lanka, 2018). Moreover, number of government agencies has expanded their service base adding new e- government facilities and rapid growth of mobile phone use has facilitated this further. Not only the government organizations, number of private entities that use e-commerce facilities to expand their market base also increased.

Smart phones are the hot popular sources of information sharing among the local community in Sri Lanka. Smart phones provides a variety of service platforms to share audio, video, text, images, animations etc. in addition to the service of voice calls and SMS available in basic mobile phones. Department of Agriculture, Sri Lanka and private sector institutes have number of initiatives in developing mobile apps to cater the latest need in mobile-based platform.

3.1 Agri Staff

Agri staff is the simple and useful mobile app based telephone directory, which provides the quick access of contact detail of the DOA staff and one touch dialing facility.



3.2 SL GAP

Using this App farmers' could obtain instruction to register for this programme.

3.3 Crop adviser (Krushi Advisor)

This gives technical information about crop production, new technologies, farm machineries, information about services provided by DOA and other organizations and information on agriculture enterprises.

3.4 “GoviVedaduru”

An e – pest surveillance and advisory system was developed for empowering rice farmers to obtain correct identification and recommended solutions for pest and disease problems of rice on time. The system consists of web and mobile applications called “GoviVedaduru”. A user friendly mobile interface was designed in local language to upload maximum of five images and information about the pest and disease problems. Experts will make recommendations for the problem.

3.5 Soil Fertility

Using this App farmer can decide how much of fertilizer should apply to their crops.

3.6 SMS based Agriculture Information Dissemination

Short Message Service (SMS) is one of the most popular means of information sharing tool in mobile phones. SMS is commonly a two-way communication tool and it is useful in delivering alerts and notifications. Department of Agriculture has introduced the SMS service with the short code of 1920 in order to deliver three different types of services to the local community. Agriculture related any question could be raised through SMS service and which the agriculture call centre unit answers by either SMS or making a call back service. SMS based feedback is received from the listeners of the radio programmes. Weather information alerts is send through SMS for registered farmers. Krushi SMS started from 2018 ‘Maha’ season aiming to provide timely important alerts to registered farmers for 10 selected crops (Paddy, Chilly, Big Onion, Maize, Tomato, Brinjal, Luffa, Papaya, Banana, and Potato). At present there are five thousand registered with Krushi SMS service.

4. Rural Access and Exchanges Mechanisms: Connectivity and Telecentres

91.1 percent of households in Sri Lanka are connected by at least one type of telephone connections (ICTA, 2018). The availability of household telephone connections exceeds 75 percent in Sri Lanka. As far as types of telephone connections are concerned, mobile phones by far exceed the fixed



connections. Conventional mobile phones without internet dominate the connectivity with 67 percent households around the country having them.

Number of service points that offer internet access has increased even in relatively remote areas. They include state owned facilities (e.g. Nenasala, Vidathacentres) as well as private sector facilities (e.g. cyber cafes).

4.1 Agriculture Advisory Service (Call Centre – 1920)

The Agriculture Call Centre known as '*Govi Sahana Sarana Sevaya*' (Agriculture Advisory Service) was established in February, 2006 to cater the quick and timely information dissemination need of the farmer. Farmers have opportunities to seek solutions to their cultivation problems, which they face during day to day farming activities. This service was strengthened by using and adapting to latest IT technologies in October, 2016. The short code 1920 has been connected to all the telecom operators in Sri Lanka. Initially there were four numbers of call centre agent to cater the agriculture advisory and now it is increased up to 20 call centre agents. Agents in the call centres have relevant field experience. This service is operated during the office hours in weekdays. However action has been taken to extend the working hours from 7.00 a.m to 7.00 p.m and during weekends. This 1920 Agriculture advisory service is currently receiving around 250 - 300 calls per day. The 1920 call centre system is supported with the recording facility of each and every calls received with the caller information. Details of the callers and their problems can be entered to the developed MIS database. Farmers have opportunities to contact 1920 through whatsapp, viber and Imo (TP: 070 220 1920) which use data calls (voice, pictures, texts, videos etc.). This call centre has facilities to provide solutions for inquiries using Email facility (1920.doa@gmail.com, 1920service@doa.gov.lk) and by post with relevant supporting attachments such as leaflets, articles etc. Conduct group discussions through Skype (1920 DOA) with farmers, farmer organizations etc. Agriculture Call Centre is the most popular initiative among farmers and which is supported with video calling facility.

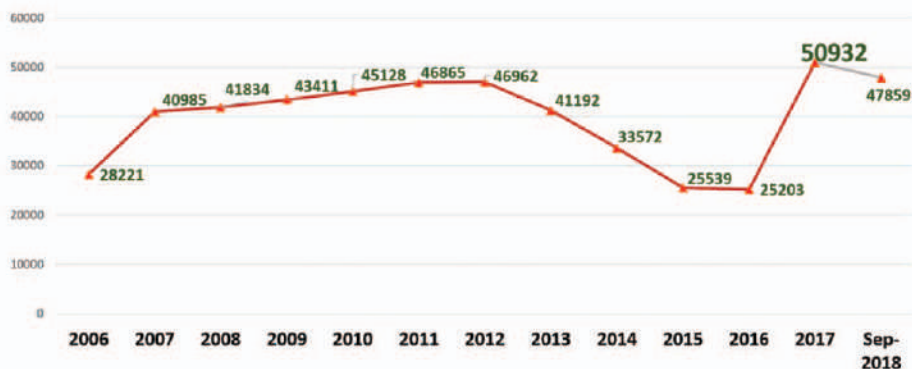


Figure 2: Number of queries answered by 1920 advisory service



4.2 Cyber Extension

The DOA initiated Cyber Extension Units (CEU) in 2004 in order to deliver extension service to rural farmers. Accordingly, 55 units were established in selected Agrarian Service Centres. There were two phases of the project. In the first phase interactive multimedia based digital extension method was initiated by using CDROM as self-learning package under the project and accordingly extension workers became e – extension workers and farmers became as e – farmers when use of IT in agriculture. The second phase of CEU, with real cyber extension connected to internet and telecommunication facilities was introduced in 2007, in order to provide improved research and extension knowledge to farmers. However this initiative was discontinued due to many factors.

5.0 Impact of ICTs on Agriculture and Livelihood

ICTs plays an important role in increasing productivity of agricultural crops there by helps to improve livelihood of Sri Lankan farmers. There are number of ICT initiatives taken by Government and private sectors to improve the agriculture sector of this country. Among the ICT initiatives of DOA 1920 Agriculture Advisory Service, Publications, Radio Programmes and Social Medias are becoming very popular. Private sector participation in ICT proved that it has a positive impact on agriculture. A private mobile provider 'Dialog' is involved in dissemination of agriculture information through mobile phones as voice mail. A detail about this initiative is given below.

“Govi Mithuru / Uzavar Tholan” with Dialog

This is a classic example of Public and Private Partnership in ICT for agriculture development. This service supports dissemination of timely information from land preparation to harvesting. In this service 1 – 1½ minutes voice messages are sending through mobile phones. Through this service agricultural advice at each stage of the cropping cycle, from land preparation to postharvest technologies. Content is provided across twenty crops (paddy, vegetable and fruits) alongside nutrition and home gardening. Contents of the messages are developed and validated by the Department of Agriculture. To obtain this service a farmer has to pay LKR 1.00 per day for a crop. Voice message are given in Sinhala and Tamil languages. 'Govi Mithuru' (in Sinhala) or 'Ulavar Tholan' (in Tamil) service is launched in 2015. This service is specially designed to help farmers by sending the right information at the right time for each farmer's needs, correctly tailored for their crop, location and stage of cultivation. Registered users receive information related to each registered crop as a voice message to their mobile phones. Users have unlimited free access to call 616 to listen to all messages received up to that point. This provide opportunity to send alerts such as pest



and diseases alerts and weather alerts. At present more than 500,000 farmers registered with this service throughout the country.

A Case of study – “Govi Mithuru”



Ms. Kanthi Jayasekara

Ms. Kanthi Jayasekara started farming very recently in Southern region of Sri Lanka. “Crop cultivation is very successful here but not for me as a woman it is very challenging. I have many challenges. I have to work hard because resources are very limited here and it is unlikely to change in the future. It’s not one thing everything, like getting harvest to the market. I am unable to take them there

because I am a woman. A big problem is I am unable to buy pesticides. They don’t sell pesticides to women because they think buying it to commit suicide. Through Govimithuru I am able to remove this issue. If I don’t have enough money I will have to get a loan or pawn things. I can only repay through a better yield. Otherwise if I lose the yield I will lose everything even my personal land. I have lost some land. Only because of Govi Mithuru service was to make around 200,000 rupees profit and I have been able to move forward. Dialog Govi Mithuru has helped throughout from the beginning of the farming process. I don’t have any technical knowledge about this. But since connecting to Govi Mithuru I now get information about diseases and different pests. I receive calls daily and they tell me there may be a chance of disease right now. Once I receive the message I will visit my farm and check if my crops are affected. All the messages are pre – recorded. I can get masses of knowledge for only one rupee a day but it’s worth than one million rupees to me”.

7. Utilization of ICTs to Adaptation of Climate Change Affect in Agriculture

Climate changes have major implications on global food production. There are various types of climate change in Sri Lanka. These include increase in environment temperature, irregular rainfall, frequent floods or drought. These changes directly or indirectly affect Sri Lanka's agricultural sector. This will not only reduce the food supply but also the livelihood of the farmers. Sri Lanka's food security is also facing great difficulties due to climate changes. Studies of climate change impacts on almost all major crops have clearly elucidated the yield reductions in the future climate of Sri Lanka. Moreover, farm animal production, fisheries and forestry also



seem to be negatively affected by climate change. Sea level rise because of global warming, poses another threat to coastal agricultural areas due to inundation and salinity development. Climate change impacts and vulnerability show greater regional variations in Sri Lanka as the country has a greater diversity of agro-ecology. Awareness on climate change and its impacts on agriculture is increasing among the relevant stakeholders including farming communities. However, the implementations of field level adaptations are far below the rate of increasing trends of climate change. Farming systems and traditional agricultural practices can provide wide range of opportunities for climate change adaptation and mitigation in the country. Nevertheless, there are challenges and uncertainties in implementing climate change adaptation especially at farmer levels. To overcome these challenges, relevant national policy frameworks need to be strengthened, in a way that can promote farm level adaptations, which can empower the coping capacity of farmers to the negative impacts of climate change. Collaborative and participatory research programs need to be promoted for the generation and dissemination of new findings. These findings are important to develop and strengthen both long term and near term regional-specific, multiple adaptation planning at different levels to sustain the food security and economic growth of Sri Lanka in the face of climate change. Climate change communication could facilitate the effective dissemination of knowledge and expertise towards adaptation. Although, numerous research findings available on different aspects of climate change in Sri Lanka, there is a lack of collection of findings, which is a major obstacle for the effective communication.

ICTs can also speed up access to information. This is particularly important when an acute climate related shock such as landslide or flood occurs. Mobile based telecommunications networks allow rapid communication of information, thus improving the speed of disaster warning, response and recovery. ICTs can enable access to the set of resources in the event of climate change related shocks or disturbances. ICTs provide access to relevant data and information that is first processed at an individual level, then facilitate communication and interaction between a wide range of stakeholders, and ultimately enable cooperation, which can translate into adaptive actions being implemented with the participation of a wide range of stakeholders.

7. Strategic Need for using of ICTs in Agriculture

The e-agriculture strategy document for Sri Lanka has been prepared based on the framework proposed by the Food and Agriculture Organization (FAO) and the International Telecommunication Union (ITU). The strategy has been prepared through extensive research and stakeholder consultation from multiple sectors and has taken into consideration the fact that ICT would



influence peoples life from many different aspects, not only agriculture, and will act as an efficiency multiplier that enables people and processes to achieve higher level of efficiency, efficacy and enhance the overall quality of life. It leverages on the existing ICT developments that impact agriculture in Sri Lanka and aims to mainstream it. Innovations in ICT is happening at a very fast pace and this document has captured the effects of future disruptive technologies and recommends roadmap for adoption and evolution of current ICT initiatives, to be relevant and useful in future. The cross-sectorial nature of agriculture as well as ICTs requires formal mechanisms for collaboration amongst critical stakeholders. A leadership committee, steering committee and task force structure has been proposed to guide the implementation.

8. Access to Market Information through ICTs

The main problem facing by Sri Lankan farmers is that market information is not available at the right time. Thus they cannot sell their produce at the right price. Farmers do not know which market is suitable for their produces. This leads to intervention middle men. There are many initiatives in Sri Lanka to provide market information to farmers. These initiatives include daily prices of agriculture commodities release by Central Bank of Sri Lanka and SMS about prices of agriculture produces provided by a private mobile service provider 'Mobitel' with Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI). in addition to these services information about the market is being provided to the farmers through mass medias such as radio, TV and newspapers.

Govipola is a mobile application that has introduced by Croptonix Pvt. Ltd as the solution to the lack of a proper marketplace for agricultural goods and services. This Mobile App will make a link between the farmers and the end user to sell and buy agricultural products at a reasonable price in the marketplace. *Govipola* is an organized marketplace where the buyers and sellers meet each other, not physically but technologically. This is a digital marketplace in place of the chaotic physical market. Both buyers and sellers can enter in to the marketplace. Buyers can post their buying needs and farmers can post their selling products in this marketplace. *Govipola* app provides separate categories, that easy to use for the users. *Govipola* mobile app allows the primary producer to connect directly with the end market or the dealers and they can purchase or sell the goods at reasonable prices as they wish. Additionally, well-known agro product companies, exporters, supermarket chains, agribusiness companies and the entrepreneurs in Sri Lanka have joined with *Govipola* and obtain their agro production requirements through the *Govipola* marketplace. This app is a free service for the Sri Lankan farmers and all other stakeholders in Sri Lankan Agriculture sector for the sake of uplift the Agriculture sector in Sri Lanka.



9. Best Practices on use of ICTs in Agriculture Extension

ICT initiatives are very useful in agriculture extension. Providing farmers with timely and relevant information on various aspects of farming is very important to improve the productivity of agriculture. In Sri Lanka use of radio, television, print media, 1920 agriculture advisory service, internet and IMMCD have played and still continue to play an important role in technology transfer. There are many success stories on use of ICT in agriculture. One of the best practice at present situation is use of mobile phones for agriculture extension. As explained above “Govimithuru” and 1920 agriculture advisory service have become very popular among farming communities.

Social Media and Smart phones made the way of delivering contents in a global scenario and which is most similar situation at local level as well. DOA, Sri Lanka has adopted variety of strategy to utilize the utmost popularity of using social media for sharing information in order to deliver agricultural contents. Facebook is the most popular social media in Sri Lanka with the 5.4 million registered users. E-agriculture working group has recommended creating an official page for every institute under the DOA to collaborate with user groups. The official pages initiated various discussions among the agriculture-interested groups and this is the simplest way to disseminate agriculture information in an effective manner with the possibility of feedbacks. Further, DOA utilizes the power of other social media such as YouTube, Twitter and Google plus in agriculture technology dissemination. This helps creating awareness of new technological developments, latest trends, news, etc. among the public. In addition, to DOA number of other organizations and individuals created FB pages and supports dissemination of agriculture technologies and other related information.

10. Women Involvement in ICTs Focusing on Agriculture

The development of ICT interventions within agricultural development has been heralded as a way to improve opportunities for male and female farmers. However, it cannot be assumed that ICTs inherently reduce gender inequalities. The potential for ICTs to be effective in facilitating women’s entry into and performance in agricultural development depends on whether they are designed to accommodate men’s and women’s different capabilities and opportunities. Despite extensive empirical evidence of the propensity for ICT to advance development, women’s access to technology remains consistently low with 25% fewer women having access to internet when compared to men in the developing world. These trends hold true in the Sri Lankan context as well, with women’s participation in the information economy lagging significantly behind that of men. As Sri Lanka continues to make ICT a policy priority in its development agenda, it must consider the consequences of excluding women and girls from the information revolution,



and work to bridge fundamental disparities in access to technology. While the nexus between women's empowerment and development is well established, there has been little focus on understanding the tools for empowerment; particularly, the potential for Information and Communications Technology (ICT) to facilitate women's economic empowerment and stimulate broader growth.

11. National Policy to Support ICTs in Agriculture: Sri Lanka e-Agriculture Strategy

The Government of Sri Lanka has the vision of building the Digital Economy with 8 petal development plan. The objective of the government is to provide digital facilities to every citizen of the country. The government is making an indefatigable effort to develop digital infrastructure to make this vital facility easily accessible to the people across the country. Agriculture is one vital sector of the country and which should be strengthened with latest ICT initiatives and digital services to support the farming community. Therefore, the Department of Agriculture has initiated e-Agriculture solutions to improve the services of its various divisions. Later, the importance of streamlining the ICT initiatives was felt in order to integrate and interoperate the different services provided by the institutes of the Department of Agriculture. It resulted the Development the e-Agriculture Strategy for Sri Lanka with the participation of almost all the stakeholders in Sri Lankan agriculture with the partnership of the Telecommunication Regulatory Commission, Sri Lanka Information & Communication Technology Agency and International Telecommunication Union etc. and which is the first initiative to develop an e-Agriculture Strategy in the world.

The Sri Lanka E-agriculture Strategy lays down a roadmap by which ICT developments can significantly contribute towards achievement of the country's agricultural vision and development objectives. It integrates standalone ICT experiments under a collaborative and inclusive framework while prioritizing solutions that can be scaled up and supported through the required ecosystem. This document provides an analysis and evaluation of current and prospective roles of Information Communication Technology (ICT) in agriculture in Sri Lanka, lays down a vision for e-agriculture in the country and recommends specific actions plans.

12. ICTs for Rural Agriculture Development: Opportunity, Potential Applications, Challenges and Policy Concerns

Access to the right information at the right time through the right medium is crucial for people involved in the agricultural sector. This includes farmers, fishers, foresters, policy makers, industries and other actors in the agricultural value chain. Increasingly, the challenges faced by small holder



farmers as a result of climate change, irregular rainfall patterns, attack of pest and the onset of diseases, drought, desertification are detrimental to the agriculture sector's goals.

However, opportunities exist through innovative ICT solutions to address a number of these challenges. In recent past, the role that ICTs play in promoting innovation in the agricultural sector has been phenomenal and potentially transformative. Smallholder farmers, particularly women and youth involved in the sector, have a huge advantage when the right ICTs are induced into the agricultural value chain. The access to the right information at the right time gives them the capacity to make informed decisions that would improve their livelihoods, make agri-business more attractive and play a major role in ensuring food security.

The rapid growth of mobile voice and internet globally provides new avenues to share and access information. Digitization has provided the capability for convergence of these traditional network technologies and the emerging ones (e.g. Machine to Machine (M2M), Internet of Things (IoTs)) using information technology platforms (e.g. mobile apps, data analytics). These networks when combined with data availability, required applications and the right enabling environment, can unleash the tremendous innovation potential of the Sri Lankan agriculture sector.

The cross-sectoral nature of ICTs propels growth in other sectors that can be further leveraged by the Agriculture sector. For example, use of data gathering and data analytics by weather department can make micro insurance for the agriculture sector more efficient. The deployment of mobile banking and mobile money by the Telecom and Banking sector can significantly address financial and transactional challenges for the rural communities. The two combined can create a base for providing social safety net for people involved in agriculture sector activities. E-government services too can provide a bouquet of services as well as guidelines critical for e-agriculture growth in the country.

While in many farming communities people still rely on feature phones, which offer mainly voice and text services, smartphone access are becoming affordable and their use is on the rise. Social media platforms such as WeChat, WhatsApp etc., are becoming services of common use. The rapid growth of broadband, especially mobile broadband provides a great opportunity for the agricultural sector. Also, access to Internet at the telecentres with guided assistance can significantly improve livelihoods and reduce drudgery. With added banking services, the potential is manifold.

In terms of service capabilities offered by ICTs, new technologies pave the way to advance the services from 'push' (e.g. radio, television, SMS) and 'interactive' services (e.g. Government to Customer(G2C) services, interactive website) further on to transactional (e.g. mobile payments,



banking services, payment platforms) and finally connected services. (e.g. a network of sensors and databases integrated over secure platforms monitoring and offering services on various devices and providing timely, accurate and real-time information). Transactional capabilities are the key to linking revenue to services being offered over ICT platforms.

More specifically, e-agriculture has the potential to meet the agricultural goals of Sri Lanka by contributing in the following areas:

- a) Improving agricultural research and national agricultural information systems.
- b) Facilitating International trade and domestic market access and trade.
- c) Improving agricultural extension and advisory services.
- d) Promoting sustainable farming practices.
- e) Improving postharvest handling and logistics.
- f) Enhancing disaster management and early warning systems.
- g) Facilitating financial inclusion, credit, insurance and risk management schemes.
- h) Advising policies and monitoring effective implementation.
- i) Improving data availability and analytics for food safety and traceability.
- j) Enhancing linkage between government, researchers and producers which in turn facilitates effective policies.
- k) Improving farmers' incomes and productivity on a sustainable basis.
- l) Enhancing knowledge management and access to information.

13. Recommendation for Policy, Research and Extension Services

The strategy is guided by the Agriculture Policy Framework and National Agriculture Policy framework and National Food Production Programme (2016-18) documents published by the Ministry of Agriculture (MOA), Sri Lanka, which identifies the following priority objectives for the agriculture sector:

- Achieve self-sufficiency in food crops, which may grow locally and save foreign exchange on imports of those food items;
- Increase availability of safe food by promoting eco-friendly practices and minimizing agro chemicals and pesticides in food crop production;
- Ensure food security through appropriate management of buffer stocks;
- Introducing and implementing agro-ecological region based food crop cultivation programs;



- Increase the productivity of crop production through appropriate technologies;
- Establish proper coordination among all agricultural stakeholders in the local food production process and connect all schools, civil organizations and general public to the program;
- Provide quality inputs for production and establish proper marketing mechanism for their products;
- Ensure building a healthy nation.

The strategy aims to address these challenges and in doing so envision achieving “Excellence in adopting e-solutions to transform agriculture for national prosperity”. It specifies a set of e-agriculture outcomes and makes the following strategic recommendations.

- Increase the availability and accuracy of agricultural information by creating, updating, analyzing and linking critical databases.
- Develop accessible, affordable and secure ICT platforms, networks and devices with enhanced sensing, hosting, analytical, identification, tracking and communicating features.
- Improve the awareness, education and skills of farmers, extension staff, livestock herders and other sector end-users by creating and disseminating credible agricultural knowledge remotely.
- Reduce the demand-supply gap, and enhance outreach and profitability of Sri Lankan products and services through vibrant e-agriculture market places and efficient logistics.
- Improve the research capability, quality, credibility and reach of extension advisory using ICTs.
- Promote innovation in e-agriculture services. Sri Lanka E-agriculture Strategy 2016
- Reduce the individual risks of agriculture sector stakeholders
- Improve the financing, investing and banking outreach to agriculture sector leveraging on electronic and mobile technologies.
- Improve the existing framework of policies, legislations, regulations and guidelines critical for e-agriculture and ensure its effectiveness implementation.

14. Conclusions

Less adoption rate of innovations and lack of information about marketplace are the leading factors for less productivity in agricultural sector. To bridge the gap between research and extension and to find marketplace ICTs could be utilized very effectively. There are number of indicators that proves



potential use of ICTs for agriculture development. The Government of Sri Lanka (GOSL) envisions transforming the nation into a prosperous, sustainable, knowledge economy via the path of good governance. In the present era of global information revolution, realizing these ambitions are invariably linked to digital inclusion of the society through information and communication technologies (ICTs). Such a transition is not spontaneous and citizens of the country have to make a conscious effort to achieve it. The existing statistics suggests that the situation in ICT literacy and access in Sri Lanka does not represent a healthy situation. This is problematic since individual usage of ICTs and internet penetration would strongly determine the distribution of benefits of digital development to the common public.

Establishment of the National Agriculture Information & Communication Centre of the Department of Agriculture opened up enormous opportunities in streamlining the process or utilizing the adoption of Information and Communication Technologies in agriculture development through coordinating the process of developing E-agriculture solutions. Further, DOA, Sri Lanka has formed a highest-level body known as E-agriculture Working Group to coordinate the ICT initiatives and development of E-agriculture Solutions. Based on the Sri Lanka E-agriculture strategy the working group has prioritized the activities to be addressed immediately and initiated the development process.

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Chapter Eight

Report of the Regional Expert Consultation Meeting on “ICTs for Development of Rural Agriculture in South Asia: Policy Concerns”

The SAARC Regional Expert Consultation Meeting on “ICTs for Development of Rural Agriculture in South Asia – Policy Concerns” was organized at Rural Development Academy (RDA), Bogura, Bangladesh on 29-31 October 2018 subsequent to the approval of 11th SAC GB and 54th PC, SAARC Agriculture Centre. The expert consultation meeting was jointly organized by the SAARC Agriculture Centre (SAC), Dhaka, Bangladesh, Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP), and Rural Development Academy (RDA) with the following objectives:

1. To learn current status of application of ICTs in rural agriculture;
2. To promote networking, linkages and exchanges between experts in ICTs in agriculture;
3. To review prevailing policies for use of ICTs in rural agriculture;
4. To propose policies and strategies for sustainable use of ICTs in rural agriculture development.

An inaugural function of the consultation meeting held on 29 October 2018 at RDA, Mr. Md. **Mr. Md. Shamsul Haque**, Director General (SAARC & BIMSTEC) Ministry of Foreign Affairs, Bangladesh graced the occasion as the Chief Guest. Dr. Nargis Jahan, Acting Director General, RDA presided over the inaugural session. Mr. Tomasi V Raiyawa, Acting Director General CIRDAP was also present in the inaugural session as Guest of honour. Dr. S. M. Bokhtiar, Director, SAC welcomed all dignitaries, guests and participants in the Meeting. Dr. Md. Younus Ali, Senior Technical Officer, SAARC Agriculture Centre (SAC) coordinated the program and led the SAARC delegation to Bangladesh.

The Faculties of RDA and professionals from SAARC Member Countries Afghanistan, Bangladesh, Bhutan, Nepal, Pakistan and Sri Lanka participated in the consultation meeting. Also one professional from CIRDAP Countries-Lao PDR was also participated in the meeting. During the 3 days program, Six Member Countries were presented the country status report on the issue. Apart from the consultation meeting, the delegates got opportunity to visit different ICTs in agriculture village model. After elaborate discussions, a good set of recommendations were made on different thematic areas for further intervention.





Group photo with Member Countries participants



Chief Guest delivering Speech

Major recommendations to implement ICTs for Development of Rural Agriculture

Policy

- Availability of sustainable and reliable Agricultural Information
- Capacity enhancement of women in Agriculture in ICTs
- Mandated Committee for Agricultural content validation and program monitoring
- Policies for implementing ICTs for Rural Agricultural Development

Program and Initiatives

- ❖ Availability – to develop infrastructural setup of ICTs.
- ❖ Sustainability – to ensure institutionalization of the policy e.g. primary data collection, research, apps development, capacity building.
- ❖ Reliability – to formulate technical advisory committee.
- ❖ Gender specific & sensitive agro information creation and dissemination
- ❖ Strengthen Public Private Partnership for collaboration
- ❖ Agricultural Product cluster(high value fruits, perishables, grains etc.) and target group (farmers, women, youth, agro entrepreneurs) specific programs and initiatives should be designed for-
 - ICT capacity building
 - Communication
 - Awareness building
 - Creating business advisory service provision
 - Value addition
 - Postharvest management
 - Branding
 - Certification etc.



Strategies

- Sort out precise information and ensure dissemination of that information to the Target Audiences
- Categories appropriate ICT solutions for all constraints faced by Farmers
- Monitoring and Evaluation of programs/initiatives need to be carried out in regular interval
- Subsidized Smartphones, sims and mobile packages for female farmers
- Bundle packages with agro information services especially in post harvest times when more are required and available
- Prepare a very comprehensive digital database of agro-based information which need to be updated daily, weekly, monthly based on the content category

Immediate Term:

- Engage all stakeholders and identify the gaps that can be met by applying ICT

Medium Term:

- Set up committees, come up with innovative ideas in equipping stakeholders
- Piloting the ideas and concentrating on results
- Installing a monitoring and feedback mechanism

Long Term:

- Sustainable Business Model development for interventions involving ICT in agriculture

Actions:

- ❑ Develop connectivity of internet, mobile and other sorts of communication technology
- ❑ Build research institutions, data bank, user friendly applications (in terms of print, media, software, etc.)
- ❑ Frame guideline from advisory committee
- ❑ Identify content that women in agriculture would like to receive through ICT tools
- ❑ A committee should be created that will be reflective of relevant stakeholders cross cutting sectors
- ❑ Country specific dialogue involving multi stakeholder groups
- ❑ Focal person/group from each country exchange ideas remotely and periodically
- ❑ Regional discussion and exchange for implementation and adaptation



Participant list of the Regional Consultation Meeting

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20. **Ms. Rebaka**
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Photo Gallery



Visit Plant Nursery by the MSs Participants at RDA



Visit Calke Farming by the MSs Participants at RDA





Group Photo of MSs Participants at RDA



Visit Activities of RDA





Short Presentation by CIRDAP Re-Representative



Visit Activities of RDA by the MSs Participants





Visit ເຮືອ-gas Plant at RDA





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