

An ICT-Based Framework for Agricultural Development in Rural Assam

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1. Introduction:

Assam is one of the agricultural states of India located between 24°8' N–28°2' N latitudes and 89°42' E–96° E longitudes and endowed with abundant agricultural land and water resources. The climate of Assam is humid subtropical in nature with warm humid summer and cold dry winter. Due to unique geographical location and varied physiography, the state has wide array of climatic conditions and it is divided into six agro-climatic zones, namely, (i) upper Brahmaputra valley (ii) central Brahmaputra valley (iii) lower Brahmaputra valley (iv) hill zones (v) Barak valley and (vi) north bank zones. All these zones are richly endowed in natural resources, such as abundant rainfall, alluvial soil, rich and diverse plant and animal genetic base. More than 70% people of this state live in rural areas and agriculture plays the vital role in rural economy. However, most of the agricultural lands face severe problems due to recurring floods in the region causing massive damage in agricultural production, livestock and pisciculture.

Although the Government of India has given high priority in the economic planning to rural reconstruction and development with the objective of achieving rural-urban integration in growth processes [1], its impact on the agricultural sector of Assam is still questionable and a matter of intensive debate due to several reasons [2]. In average, villagers of Assam who are actively involved in agriculture, are poor people and unable to implement the modern technological skills and equipments. The reason is twofold: either the Government has not taken adequate steps to maintain a direct communication with the farmers in implementing government policies and schemes, or the farmers desperately lose all hopes on agricultural activities due to unexpected damages caused by recurring floods, drought and other natural havoc. Therefore, it increases poverty and hunger in rural areas and severely constraining the rural development. Although scientific advances in climate forecasting and information technology provide

tremendous opportunity to develop an effective system for monitoring and managing flood and drought, preparing an early warning system, implementing timely relief programs, crop harvesting, water harvesting etc., rural development of Assam is still a far cry. To enhance the agricultural productivity of a region, the knowledge about the quality of its soil, seeds, fertilizers, and water management is essential. Almost 50 percent of the total land area is utilized for cultivation and around 75 percent of the total population of the state is directly or indirectly dependent on the agricultural activities. In most of the rural areas of Assam, the agriculture is solely dependent on monsoon. Although, meteorological or hydrological data are available nowadays, it does not reach the farmers. The lack of storage facilities for crops also degrades the productivity every year. Further, the price hike in essential foods drastically increases the rural poverty, demanding agricultural growth.

Is there any alternative to overcome these difficulties? What are the factors that create barriers in rural economic growth? What are the ways in which farmers can enhance their skills, productivity, and livelihood? After all, how to overcome and transform the potential challenges to opportunities? These challenging issues demand a strong cooperation among researchers, agro-scientists, government, policy makers, and social workers.

2. Objectives:

The major purpose of this research is to determine the challenges in the application of ICT by the agricultural extension service in Assam and to identify the factors being considered challenging in the application of ICT. In today's scenario, since mobile network covers almost all the agro-climatic zones of Assam, it would be highly beneficial if a mobile-based ICT is developed specifically for the farmers of Assam. This is very much necessary because, in average, 65% farmers of Assam uses their local languages and the available mobile apps, although sufficient for providing necessary information, are no longer useful for them due to language barrier. A suitable mobile app needs to be developed in the regional language of Assam, embedded with necessary up-to-date information. Prices and demands of local agricultural products, availability of seeds, fertilizers, pesticides, farming equipments, livestock, and weather reports are some of the essential ingredients that need to be incorporated reliably in such an ICT-based framework in a cost effective manner for achieving more success in rural economic growth

of Assam. Keeping all these in mind, here we explore how such an ICT-based framework, helps in sustained development of rural economy of Assam through its impact on production, operation, and expansion. We focus on the necessary measures required in an ICT-based framework to enhance economic productivity, improve quality of life, and enrich the culture of rural Assam.

3. Methodology:

Recent developments in mobile technology offer a great opportunity to facilitate the information flow and delivery of technology services to the farmers in a cost-effective manner [11]. In the current scenario of rapidly changing world, mobile communication and service is recognized as an essential mechanism for delivering knowledge (information) and advice for modern farming, best production practices, processing, marketing, input and output prices, financial schemes etc.

The present study was conducted during February-August 2017 in 20 remote villages of 3 districts belonging to three different agro-climatic zone of Assam. We chose 6 villages from Karbi-Anlong district, 7 from Lakhimpur district, and 7 from Goalpara district. A sample of 300 active farmers was selected through stratified random sampling technique as respondent. We investigated their current status of utilization of ICT tools, knowledge level, and methods of farming. In average, they rely on traditional method of agricultural production and processing. Although radio and television are the most commonly used ICT tools in rural households, many agricultural families have at least one mobile phone with internet facilities. Cellphone penetration in rural households has helped close the digital gap with urban areas, which has not been the case with other ICTs. However, the rural farmers do not have adequate knowledge about the application of available agro-based mobile apps like Kishan Suvidha, Pusa Krishi, Crop Insurance Portal, Agri Market etc. We analyzed the reasons behind it and, after such a field study, we offer here an ICT-based framework for the farmers of Assam. We also highlight the necessity of a user-friendly, easy to access, and cost-effective mobile app with all relevant information.

4. The Necessary Steps taken by the Government in Agricultural Development:

Since agriculture plays a vital role in India's economy, significant steps have been taken by Government of India at both the state and

central level to reshape the rural economy. A project on extended range forecast systems (ERFS) is being implemented during the current financial year 2016-17 by the Department of Agriculture, Cooperation and Farmers Welfare, Government of India in collaboration with five partner organizations, namely, IITs, India Meteorological Department (IMD), National Centre for Medium Range Weather Forecasting (NCMRWF), Space Application Centre (SAC) Ahmedabad and Indian Council of Agriculture Research (ICAR). The main objective of this project is to forecast the rainfall and temperature parameters on a seasonal/monthly time scale so that it significantly helps in developing and implementing alternate strategies for the farmers to manage their risk in the event of bad weather forecast. Department of Agriculture and Cooperation (DAC), Government of India in collaboration with experts from the Central Ground Water Board (CGWB), Central Water Commission (CWC), IMD, National Remote Sensing Centre (NRSC), National Rainfed Area Authority (NRAA), and ICAR has planned to facilitate states in finding desirable solutions to the issues pertaining to flood control and drought mitigation and management. In addition to the above mentioned schemes, several steps has been taken to enhance soil fertility on a sustainable basis through the soil health card (SHC) scheme, to provide improved access to irrigation and enhanced water efficiency through Pradhan Mantri Krishi Sinchai Yojana (PMKSY), to support organic farming through Paramparagat Krishi Vikas Yojana (PKVY) and to support for creation of a unified national agriculture market to boost the income of farmers. Across the country, the Government of India in the last three years also developed 623 district agricultural contingency plans through technological interventions for various weather aberrations to cover different sectors of agriculture including horticulture, livestock, poultry, and fisheries. In addition, initiatives have been taken to develop new prototypes of farm machinery, agro-volatic system/solar farming and to establish agro-processing centers and food testing laboratories.

4.1 e-Governance Plan:

Recently, Government of India takes a bold initiative to make all Government services accessible to the common person in his locality, through common service delivery outlets, and ensure efficiency, transparency, and reliability of such services at affordable costs to realize the basic needs of the common person. A national e-Governance programme (NeGP) is being implemented in seven pilot states including

Assam by DAC in the agricultural sector as a Mission Mode Project (A-MMP), covering agriculture, livestock, and fisheries sectors [1]. As articulated in the vision statement of NeGP, it covers a cluster of services regarding relevant information on pesticides, fertilizers and seeds, soil health, crops, farm machinery, training and good agricultural practices (GAPs), forecasted weather and agro-met advisory, prices, arrivals, procurement points, and providing interaction platform, electronic certification for exports and imports, marketing infrastructure, monitoring implementation/evaluation of schemes and programs, fisheries, irrigation infrastructure, drought relief and management, and livestock management. Keeping in view that it may be beneficial in assisting farming community and its other stakeholders in making rational decision for increasing farm productivity and farm income, sustained efforts have been made at multiple levels to improve the delivery of public services and simplify the process of accessing the same. The ultimate objective is to bring public services closer home to citizens.

To reach the e-Governance services among vast majority of citizens effectively, an Open Technology Centre (OTC) was set up in March 2007 in Chennai, as a Division of National Informatics Centre. Moreover, in the current financial year 2016-17, an amount of 858.79 crore has been approved for implementation of NeGP in agriculture (NeGP-A) in entire country. A number of mobile apps have been developed for the farmers, these are Kishan Suvidha, Pusa Krishi, Crop Insurance Portal, Agri-Market, and so on. As a vision in development of rural India, the Government of India has already taken some remarkable initiatives through ICT. To introduce e-governance on a massive scale, the Common Service Center (CSC) has been established as a strategic cornerstone of the National e-Governance Plan (NeGP). It offers web-enabled e-governance services in rural areas including high quality and cost-effective video, voice and data content and services. In addition to the agricultural services (including horticulture, sericulture, animal husbandry, fisheries, and veterinary), it covers other essential areas including education and training services, health services (telemedicine, health check-ups, medicines), banking and insurance services (micro-credit, loans, insurance), entertainment services (movies, television), utility services (bill payments, online bookings), commercial services (DTP, printing, internet browsing, village level BPO).

4.2 Beyond e-Governance: The Burning Issues:

Although Government has been allocating a huge amount of budget every year and implemented it through various schemes, still the rural economy in Assam is not effectively growing, as expected. Three main crucial issues are: (i) farmers are not receiving information about seasonal climate and weather forecasting report (ii) there is no resource available to know the status of the market to sell their products at appropriate price (iii) due to the lack of a proper irrigation system, lack of safety storage place, impact of unpredictable floods and droughts, a huge amount of crops has been damaged every year, causing unbearable crisis among farmers.

To overcome the problems faced by the farmers, a serious collective and coordinated effort from scientists, economists, policy makers, social scientists, and environmentalists is very much needed. ICT is one of the solutions that might mitigate their needs, enhance their knowledge and confidence, and reshape their agriculture-based economy for a better livelihood [8, 9]. Radio and television has already penetrates as ICT tools in rural areas of Assam. However, since globalization and growing competition demand application of latest technologies to enhance the productivity in the interest of economic well-being of farmers, cell phones can effectively be used as a faster communication device in agricultural sector. Below we shall analyze some essential points that are required to incorporate in ICT for the growth of economy of the rural sector of Assam.

5. The Role of ICT in Agricultural Sector of Assam:

In today's world of digital age, ICT is emerging as an essential tool for the development of human civilization and as a driving force in the world economy. Although the global development of ICT has created a new agricultural paradigm promising improvement of rural livelihood of countries like India, in comparison to the other agricultural states of India, the farmers of Assam are in average economically very weak and unable to implement the modern technological skills and equipments. The ICT based policies implemented by the Government do not reach these common people as the internet services are cost effective and the information on most the mobile apps are not available in the regional language of Assam. In order to provide information on the vital needs of the farmers within an ICT framework, we provide here few essential steps implementation of which can mitigate the challenges faced by

the farmers of Assam with a hope that it can effectively contribute in enhancing the rural economy of Assam. Further, it might open up diverse agricultural activities and generate gainful employment in rural areas, particularly among the landless, small and marginal farmers including women.

6. An ICT Based Model Framework:

The available mobile apps (such as Kishan Suvidha, Pusa Krishi, Crop Insurance, Crop Insurance Portal, Agri-Market) for the farmers, developed by the Government of India within the NeGP-A scheme, would be more effective for the farmers of Assam if they can be made available in the regional language of Assam. Such a mobile app might help in empowering farmers of Assam to a great extent and thus boosting the rural economic growth of the state. All the necessary information should be timely available in regional language. To develop such a mobile app, the following up-to-date information is required.

- (a) A daily-basis market information including price updates and demand of the agricultural products of surrounding districts. This will help farmers to compare prices and sell the products at their own choice. This also provides a direct contact of producers (farmers) with the potential buyers without intervening brokers.
- (b) A detail information about the quality of seeds, fertilizers, and pesticides available in the market would enable them to select varieties suitable for their soil.
- (c) Monthly weather status such as amount of rainfall, temperature, humidity etc. should be available so that the farmers can take precautionary measures for a better safety of seeds and crops.
- (d) Early warning and management of diseases and pests would help them to take right decision at right time and prepare them for better farming.
- (e) Information on best practices of cultivation at particular season would enable them to prepare for better productivity.
- (f) An update information about the latest farming techniques and technologies in both agriculture and animal husbandry would offer them to prepare for more economic growth.
- (g) A detail information about the all varieties of livestock available in the market of surrounding districts would enable to increase their profits.

- (h) A detail information about the diseases (including epidemics) of the livestock and available vaccines would enable them to save the livestock from undesired circumstances.
- (i) General agricultural news and information on various activities in villages and districts should be available to keep the farmers updated. Information about the various government schemes and policies, funding, loan, subsidies, etc. should also be available for easy access.
- (j) Finally, the app should be affordable and easy-to-access, especially designed for the greater interest of poor farmers.

It is hoped that such a mobile app would play a vital role in reducing the transaction and unnecessary transportation costs of the farmers associated with information, negotiation, monitoring, and coordination. However, for an effective implementation of such a sophisticated ICT tool in agricultural sector of Assam, intervention of Government is very much needed because, our field study indicates that, although the mobile network covers almost all agricultural zones of Assam, the majority of farmers (68 %) are deprived of the essential farming information due to the high cost for smart phones and network connections. If Government takes some initiatives for cost-free access of network service for the farmers until they overcome their financial crisis, it would be a very effective step in the growth of rural economy.

7. Findings:

Our field study shows that the farmers of Assam, in average, follow traditional method of farming that involves high risk and uncertainties. They are facing many threats from poor soils, drought, erosion, flood, pests and diseases. The data that we have collected from the 20 villages of three different districts showed that rice is the main crop cultivated at large scale twice a year. The second largest products are the jute and mustard seeds. Due to intervention of brokers or the negligence of government, the farmers are unable to purchase seeds at affordable costs. Moreover, due to unavailability of proper weather report, very often seeds are destroyed by heavy rainfall and unfavorable weather. Due to the lack of proper irrigation systems, the productivity degrades and creates financial imbalance. Further, the market prices and demands are so fluctuating that the farmers are not getting appropriate prices by selling their products. At each steps of cultivation, the farmers are facing so many difficulties that they tend to lose all hopes. In **Table 1**,

we provide a list of challenges faced by the farmers. Communication, information, and government intervention are the key ingredients to overcome these problems.

In Table 2, we display the data for the number of active farmers who effectively used the various ICT tools for the agricultural activities. Our field study shows that in 89.6% agricultural family have mobile phones with internet facilities. Unfortunately, the effective use of it in agricultural purpose is comparatively very low (13.7%), although various apps are available. The main reasons behind it are the lack of knowledge and the information provided by the apps is neither sufficient nor applicable for them.

The mobile phone revolution offers new opportunities to benefit farmers and rural economy as it can affordably connect rural people to global information networks. To monitor market prices, weather conditions, new pest and disease control, new farming techniques, quality enhancement etc. and to provide such information in a form and format that are consumable to the farmers of Assam, we offer in Sec. 6 the basic structure of an ICT-based mobile app. Such an app might provide all the necessary on-time information related to their agricultural demands. The market availability, retention price, selling price, dealers and warehouse, crop variety, soil health and nutrients requirement, irrigation etc. are essential ingredients of such an app and we hope such a framework will empower farmers to contribute in the development of rural economy.

Table 1: Classification of challenges faced by the farmers (%)

Factors	Variables Factor	Variance by
Organizational	Low quality of service provided by the Service centers, lack of interest by private sector to participate in developing ICT for rural areas	27%
Technical	Lack of appropriate infrastructure, inappropriate available web portals, Lack of expertise, unavailability of Assamese web portal	8%
Financial	Lack of investment by private and public sector, high cost of new equipments, high cost of access to internet, unavailability of mobile phones with internet facility	12%
Social	Negative attitude towards modern technology, Lack of social interaction, Prejudices regarding advantage of ICT,	6.5%
Humant	Low level of knowledge and skills among farmers, beliefs of farmers on traditional education, difficulty of handling mobile phone	31%
Total		85%

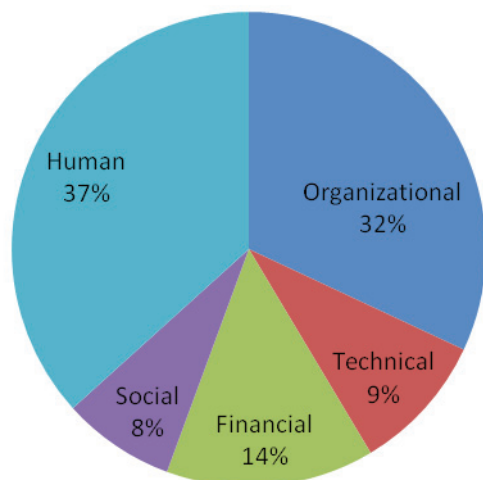


Figure 2: Challenges Faced by the Farmers (%)

Table 2: Number of various ICT tools that are available in the family of 300 farmers of three districts and the numbers that are effectively used solely for agricultural purpose.

ICT Tools	Available	Effectively used	Percentage used
Radio	19	10	52.7%
Television	108	81	75%
Computer & internet	46	12	26.1%
Newspaper	186	90	48.3%
Mobile phone with internet	269	37	13.7%

8. Suggestions:

Although the farmers have a strong willingness to learn new technologies, their education level creates a barrier in acquiring knowledge. The farmers need to obtain certain levels of education that are associated with their farming activities. A distant and open learning system might be helpful and effective to achieve such a goal. In addition, awareness, training and acquaintance programs need to be organized from time to time by highly skilled experts to guide them for modern farming equipments and accessories.

The financial burden on developing ICT for rural areas is mainly rests on the governments. Sufficient training in operation and maintenance, awareness programmes on the benefits of ICT in agriculture are needed to achieve the success. Government needs to take steps in creating and uplifting regional data management centers at each district headquarters to control, manipulate, and distribute all necessary data related to agricultural activities of that region. Proper maintenance of a transparent production and market monitoring system is very much demanding to track the wholesale and retail prices of agricultural products that substantially help to stabilize the domestic prices of food items.

Finally, it is important to note that the rapid growth of population, the effect of climate change, the shortage of water, the long-lasting flood, the newly born crop diseases, and the rapid decrease of fertile agricultural lands due to urbanization, are challenges for state like Assam that can be mitigated by revolutionizing the agricultural policy. This cannot be achieved without implementing modern technologies in agriculture. A strong collective and coordinated effort of the government, agro-scientists, and social workers might substantially help farmers to overcome their difficulties in the implementation of modern farming techniques.

9. Conclusion:

As ICT is dramatically changing all the spheres of human lives, it is highly believed that agriculture is no exception to this [8]. With ever-increasing demands of productivity and the uncontrolled growth of market, the burdens on farmers to handle growing amount of data can be reduced via the application of modern information processing and data management systems. The relevance of ICT for both agricultural development and agricultural extension is extremely high in a state like Assam. To enhance the rural economy, the traditional farming adopted by the average farmers of Assam needs to be revolutionized. To implement a vibrant, dynamic, and innovative approach of farming, ICT will be very much useful provided a novel ICT based framework is designed for the farmers of Assam. In this paper, we have addressed such a framework with a hope that it would mitigate the problems related to information access and connectivity, which, in turn, enhances the productivity and helps in production management.

We would like to conclude by noting that although Assam is an agricultural state of India, the implementation of modern technology in agriculture is still lacking across the state. The technological revolution in the agricultural sector across the globe is unable to touch most of the rural areas of Assam. Fortunately, the mobile communication has touched even the most remote rural areas of Assam. Thus, no one can deny that there are ample of scopes to implement ICT for all-round agricultural development via the mobile apps. It is also important to note that although the up-to-date information about the modern equipments and the status of the markets could be made precise through the implementation of ICT, it is really impossible to provide accurate meteorological information due to the lack of sufficient sensors that are required for numerical weather forecasting. If the modern technology cannot be used to prepare the farmers for any natural disasters (like flood, drought etc.), ICT alone would not be able to bring hope as desired. Much effort is needed from the government to resist natural disasters like flood that destroys crops and agricultural lands of the state every year. Such steps from the government together with the implementation of an ICT – based framework as discussed in this paper might be able to mitigate the needs of the farmers who contribute a lot towards the economic growth of the state.

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